INTEGRAL

MONITORED RETRIEVABLE STORAGE (MRS) FACILITY

CONCEPTUAL DESIGN REPORT

VOLUME I BOOK II – DESIGN DESCRIPTION

Prepared for

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THE RALPH M. PARSONS COMPANY OF DELAWARE
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Concurrence by _______________ 9/30/85
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FOREWORD

This report presents a summary design description of the Conceptual Design for an Integral Monitored Retrievable Storage (MRS) Facility, as prepared by The Ralph M. Parsons Company under an A-E services contract with the Richland Operations Office of the Department of Energy. More detailed requirements and data are in the Basis for Design and other portions of the Design Report, bound under separate cover, and available for reference information.

The data provided in this Design Description include contributions by the Waste Technology Services Division of Westinghouse Electric Corporation (WEC), which was responsible for the development of the waste receiving, packaging, and storage systems, and Golder Associates Incorporated (GAI), which supported the design development with program studies. Both WEC and GAI were under subcontract to The Ralph M. Parsons Company.

The MRS Facility design requirements, which formed the basis for the design effort, were prepared by Pacific Northwest Laboratory for the U.S. Department of Energy, Richland Operations Office, in the form of a Functional Design Criteria (FDC) document, Revision 3, dated March 1985.

After the finalizing of the design documents, Revision 4 of the FDC was approved. Because of schedule constraints, only the Regulatory Assessment Document and the Executive Summary were revised to reflect changes in the criteria. The primary technical areas that were revised and will require future design modification are as follows:

(1) Ratio of rail/truck cask receipt
Impact: The increase in rail casks changes the handling and related decontamination requirements, requiring revision of the amount of potentially contaminated wastes produced and subsequently processed in low-activity radwaste.

(2) Site data specific to Clinch River
Impact: The increase in wind speeds revises the wind loads for the Non-Category I structures, potentially increasing structural member sizes. The decrease in degree-days affects the fuel oil supply requirements and the related storage capacity of fuel oil.

(3) Quantity of West Valley high-level waste
Impact: The storage cask quantity may require revision. No design changes are anticipated for the Receiving and Handling Building.

(4) Canistered fuel lag storage
Impact: Because the term "consolidated" was deleted for the 1,000-MTU capacity, up to 10% of the canisters may contain intact assemblies. The current storage vault design will not accommodate 1,000 MTU if 100 MTU are canistered as intact.

The Design Description of the Design Report is contained in four books, the contents of which follows:

Book I - Executive Summary

Book II - Sections 1 through 33

Book III - Section 34, Equipment and Instrumentation List, and Section 35, Outline Specifications, Divisions 1 through 16

Book IV - Appendixes

ABBREVIATIONS AND ACRONYMS

A	ampere
AASHTO	American Association of State Highway Transportation Officials
ac	alternating current
ACV	air-control vestibule
A-E	Architect-Engineer
ALARA	As Low As Reasonably Achievable
AMS	Alarm Monitoring Station
ANSI	American National Standards Institute
ANSI NQA-1	American National Standards Institute Nuclear Quality Assurance Requirements for Nuclear Power Plants
API	American Petroleum Institute
ASME	American Society Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
assy	assembly
ASTM	American Society for Testing Material
AWG	American Wire Gauge
AWS	American Welding Society
AWWA	American Water Works Association
Btu	British thermal unit
BWR	boiling water reactor
CBM	Certified Ballast Manufacturer
CCSA	common control switching arrangement
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CHTRU	contact-handled transuranic waste
CPU	central processing unit
CRT	cathode-ray tube
DB	drybulb
db	decibel
DBE	design basis earthquake
dc	direct current
DCS	Distributed Control System
decon	decontamination
deg	degree (angular)
dia	diameter
DOE	Department of Energy
DOP	dioctyl phthalate
DOT	Department of Transportation
DPDT	double pole/double throw
EA	Environmental Assessment
ECC	Error Correction Code
EIA	Electronic Industries Association
EMT	electrical metallic tubing
EPABX	Electronic Private Automatic Branch Exchange

F	Fahrenheit
FDC	Functional Design Criteria
FID	flame ionization detector
FIS	Federal Interim Storage
FLA	full-load amperes
fpm	feet per minute
fps	feet per second
FS	Federal Specification
F.S.	full scale
ft	foot, feet
ft-c	footcandle
FTS	Federal Telecommunications System
HAW	high-activity waste
HAW/RHTRU	high-specific-activity material that may exceed Class C specifications for low-level waste and may or may not contain some quantity of transuranic material
HC	hydrocarbon
HEPA	high-efficiency particulate air
HID	high-intensity discharge
HLW	high-level waste
HP	health physics
hp	horsepower
HVAC	heating/ventilation/air-conditioning
IES	Illuminating Engineering Society
in.	inch, inches
I/O	Input/Output
ISFSI	Independent Spent Fuel Storage Installation
k	kips (1,000 lb)
kg	kilograms
KSR	keyed/send/receive
kV	kilovolt
kVA	kilovolt-ampere
kV-AR	kilovolt-ampere (reactive)
kW	kilowatt
kWh	kilowatt-hour
lb	pound, pounds
LLLTV	low light level television
LLW	low-level waste
lm	lumen
m	meter, meters
max	maximum
MB	megabytes
MCA	multichannel analyzer
MOS	metal oxide semiconductor

mph	miles per hour
mR/hr	milliroentgen per hour
mrem	milliroentgen equivalent man
mrem/hr	milliroentgen equivalent man per hour
MRS	Monitored Retrievable Storage
MSP	Manufacturers' Standard Practices
MT	metric tons
MTU	metric tons of uranium (based on pre-irradiation)
MWD/MTU	megawatt days per metric ton of uranium
N/A	not applicable
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NIM	Nuclear Instrumentation Module
NPT	National Pipe Thread
NPTF	National Pipe Thread Female
NPTM	National Pipe Thread Male
NRC	Nuclear Regulatory Commission
n/sec	neutrons per second
NWPA	Nuclear Waste Policy Act of 1982
OA/FA	on air/forced air
OBE	operating basis earthquake
OC	on centers
OSHA	Occupational Safety and Health Administration
P&ID	piping and instrumentation diagram
pcf	pounds per cubic foot
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch absolute
PWR	pressurized water reactor
QA	quality assurance
QC	quality control
R/hr	roentgen per hour
R&D	research and development
R&H	receiving and handling
rem/hr	roentgen equivalent man per hour
RHAF	remote handling air filtration
RHTRU	remotely handled transuranic waste
RO	repository overpack
SDBC	solidly drawn bare copper
sec	second
SF	spent fuel
SNM	special nuclear material
SPDT	single pole/double throw
SS	stainless steel
SSE	safe shutdown earthquake
STC	sound transmission coefficient

TBD	to be determined
TEFC	totally enclosed fan cooled
T/G	transfer/generator
TRU	transuranic waste
U	uranium
UBC	Uniform Building Code
UHF	ultra high frequency
UL	Underwriters' Laboratories, Inc.
UPC	Uniform Plumbing Code
UPS	uninterruptible power supply
VHF	very high frequency
wt	weight
WV	West Valley

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DESIGN DESCRIPTION

INTRODUCTION

The Basis for Design established the functional requirements and design criteria for an Integral Monitored Retrievable Storage (MRS) facility. The MRS Facility design, described in this report, is based on those requirements and includes all infrastructure, facilities, and equipment required to routinely receive, unload, prepare for storage, and store spent fuel (SF), high-level waste (HLW), and transuranic waste (TRU), and to decontaminate and return shipping casks received by both rail and truck. The facility is complete with all supporting facilities to make the MRS Facility a self-sufficient installation.

The MRS Facility has the capability to receive and store a minimum of 3,600 metric tons of uranium (MTU) per year, primarily as spent fuel and a small amount (less than 20 MTU/yr equivalent) as HLW. It has in building lag storage capacity for 1,000 metric tons of consolidated fuel in canisters, plus an outdoor storage capacity of 15,000 MTU of SF and a small amount (less than 100 MTU/yr equivalent) of HLW. The design assumes a spent fuel mix of 60% by weight from pressurized water reactors (PWRs) and 40% by weight from boiling water reactors (BWRs), based on 0.462 MTU per PWR assembly and 0.186 MTU per BWR assembly. It is capable of retrieval and shipment of at least 3,600 MTU/yr or equivalent per year of canistered spent fuel and waste to a geologic repository for disposal.

The receipt rate, in terms of fuel assemblies, is 12,400 fuel assemblies (60 wt% PWR/40 wt% BWR).

The spent fuel received at the MRS Facility may be full intact assemblies, either packaged or bare, or disassembled and consolidated in canisters. Full intact assemblies fuel can be received either sealed in canisters as one unit or disassembled and consolidated in canisters. At the MRS Facility, fuel rods can be consolidated in canisters capable of containing all of the fuel rods from whole numbers of either PWR or BWR assemblies. Nonfuel-bearing components of disassembled spent fuel assemblies will be reduced in volume and packaged in preparation for onsite storage.

The MRS Facility is capable of receiving shipments by rail and truck, and can receive, unload, load, and ship all standard rail and truck SF, HLW, and RHTRU shipping casks. For design purposes, it was assumed that the spent fuel will be received 50 wt% by rail and 50 wt% by truck. Nonstandard or off-normal cask shipments are routed to a special onsite lag storage area while determination is made as to the procedure to follow for routing through the MRS Facility handling and storage process.

The detailed description of the MRS Facility is provided in subsequent sections.

SECTION 1

IMPROVEMENTS TO LAND

1.1 INTRODUCTION

The cancelled Clinch River Breeder Reactor Project, in Tennessee, has been selected as the primary site for the MRS Facility. The DOE Oak Ridge Reservation and the cancelled Hartsville Nuclear Power Plant (both in Tennessee) have been designated as alternate sites. Civil site development plans have been developed for a conceptual design of the MRS Facility at the Clinch River site. In addition, general facility layout drawings were developed for the MRS Facility at both the Hartsville and Oak Ridge sites. The conceptual design at the Clinch River site is described in this section and the differences at the alternate sites are described in Appendix F.

1.2 FACILITY LAYOUT

The primary storage concept is that of using sealed storage casks to store SF, HLW and HAW/RHTRU.

The overall site plan for the MRS Facility comprises three distinct areas: the limited access area, the protected area, and the storage area. Two site plans have been developed for the Clinch River site; one plan is of the primary storage concept and the other is of the alternate storage concept. The layout of the limited access, protected, and storage areas of the two concepts is discussed in this section.

1.2.1 PRIMARY STORAGE CONCEPT - SEALED STORAGE CASKS

The overall site plan of the sealed storage cask concept at the Clinch River site is as shown on Drawing H-3-56725. This drawing shows the limited access and protected areas at the south end of the site, and the storage area to the north. The layout of the MRS Facility on this site was developed using, as much as practicable, the area previously disturbed for the Clinch River Breeder Reactor Plant (CRBRP). The protected and limited access areas occupy, for the most part, the area previously disturbed. The MRS Facility layout for the primary storage concept at Clinch River, as shown on Drawing H-3-56726, encompasses approximately 303 acres of land (from the top of cut to the toe of slope).

The R&H Building, located within the protected area, is located at the northern end of the existing CRBRP temporary parking area. This area has already been leveled, and provides a foundation of continuous, unweathered rock for most of the R&H Building. The protected area also contains the Standby Generator Building, Steam Generator Building, Cooling Tower and Chemical Building, CHTRU Facility, and the Protected Area Gatehouse.

Access control for personnel and nonradioactive shipments entering the protected area is provided at the Protected Area Gatehouse. The Protected Area Gatehouse is located at the entrance to the protected area from the limited access area. Control of shipments containing radioactive material is provided at the Inspection Gatehouse, which is located at the northwest corner of the protected area.

Lag storage for railcars is provided on both the north and south sides of the R&H Building; truck lag storage is provided north of the R&H Building. The fenced-off normal shipment storage area is located northeast of the R&H Building.

Security requirements for the protected area are met by the provision of two 8-ft-high fences with the 100-ft alarm zone between them, the patrol road around the inside perimeter, and the Protected Area Gatehouse at the entrance. The outer security fence is located a minimum of 328 ft (100 m) from all spent-fuel handling and storage facilities to meet the requirements of 10 CFR 72. A 100-ft-wide isolation zone is provided on the outside and a minimum 50-ft-wide isolation zone is provided on the inside of the double security fence. Alarm zone monitoring and closed-circuit television (CCTV) surveillance are discussed in Section 25.

The limited access area is located south of the protected area. The industrial area, containing the cask manufacturing and concrete batch plant, is located at the eastern end of the limited access area. The relative locations of the industrial, limited access, and protected areas were determined with regard to security, accessibility, and the functional relationships between the areas. The cask manufacturing plant, for example, is located as close as practical to the back side of the R&H Building to keep the travel distance of the cask transporter to a minimum.

The site plan for the limited access and industrial areas is shown on Drawing H-3-56727, Sheet 1. This drawing shows the Administration Building, Security Building, and Fire Station, all located near the main entrance to this facility. The Main Gate/Badgehouse, located at the main entrance, provides access control for all personnel and nonradioactive shipments entering the facility. Shipments containing radioactive material will enter the facility directly into the protected area through the Inspection Gatehouse. The Site Services Building, Vehicle Maintenance Building, and the Warehouse are grouped together because they are all functionally related. An area is allocated for the site maintenance vehicles not far from the Site Services Building, where the maintenance vehicles will be controlled. Fuel storage tanks are located east of the warehouse adjacent to the industrial area. The water treatment building is located on the west end of the limited access area to be in close proximity to the existing water supply line. The Sewage Treatment Plant is adjacent to the Water Treatment Building and centrally located relative to the sources of sewage. This location also accounts for the direction of the prevailing winds.

The heliport for emergency medical evacuation is located outside the limited access area near the industrial area.

Security requirements for the limited access area are met by the 8-ft-high chain-link fence surrounding the area and by the Main Gate/Badgehouse for access control.

The sealed storage cask facility is located at the northern end of the MRS Facility. The storage facility, shown on Drawing H-3-56727 (Sheet 3), is designed to safely store 15,000 MTU of spent fuel and 100 MTU equivalent of HLW. The sealed storage casks are stored on 18-in.-thick concrete pads, 37 ft wide. Each pad contains two rows of casks. The cask layout on the support pad is shown on Drawing H-3-56729 (Sheet 1). The concrete support pads are spaced 50 ft apart to allow access for the transport vehicle and emplacement crane. The layout of support pads is shown on Drawing H-3-56727 (Sheet 3). A total of 22 concrete support pads, varying in length from 132.50 to 829.50 ft, are shown to store the 1,760 sealed storage casks used to meet the storage requirements. The 1,760 casks include 129 casks required to store onsite-generated HAW/RHTRU.

Space is provided in the southern part of the storage facility for 132 transportable metal (dual-purpose) casks. These casks are laid out in two double rows, each 37 ft wide. A 50-ft-wide space has been provided between the double rows for transport vehicle and emplacement crane access. A layout of these casks is shown on Drawing H-3-56729 (Sheet 1).

Security requirements for the storage area are met by the provision of two 8-ft-high fences, with a 100-ft alarm zone between them, surrounding the three exposed sides of the storage area. A 100-ft-wide isolation zone is provided on the outside and a 50-ft-minimum-wide isolation zone is provided on the inside of the double security fence. For the most part, a single 4.5-ft- high, barbed-wire fence is located 1,476 ft (450 m) from the centerline of the outermost row of sealed storage casks, where air-scattered radiation dose rates are 25 mrem/yr per 10 CFR 72. On the east side of the storage yard, the 4.5-ft-high fence follows along the inside of the road that is adjacent to the Clinch River; thus, it is less than 1,476 ft (450 m) from the sealed storage casks. Where this occurs, the embankment that is provided at the outer edge of the exterior isolation zone protects the public from direct radiation. The south side of the storage area abuts the protected area containing the R&H Building. A single 8-ft-high fence separates the storage area from the remainder of the protected area containing the R&H Building. The exterior fence of the double fence is located a minimum of 328 ft (100 m) from the stored material. Alarm zone monitoring and closed-circuit television surveillance are described in Section 3.8. Access to the storage facility is through the protected area and is controlled at the Protected Area Gatehouse. The storage area gate station is located at the entrance to the storage area. A patrol road is also provided along the inside of the interior fence.

1.2.2 ALTERNATE STORAGE CONCEPT - FIELD DRYWELLS

The alternate storage concept is that of using field drywells to store SF, HLW, and HAW/RHTRU.

The overall site plan of the field drywell concept at Clinch River is shown on Drawing H-3-56732. The facility layout of the limited access and protected areas for the field drywell concept is the same as the layout for the sealed storage cask concept, with the following two exceptions. The drywell concept does not require a cask manufacturing and concrete batch plant; therefore, the industrial area, with its access road and railroad, does not exist for this concept. The second difference is that the heliport is located adjacent to the employee parking lot nearer to the Main Gate/ Badgehouse. The MRS Facility layout for the alternate storage concept at Clinch River as shown on Drawing H-3-56733 encompasses approximately 465 acres (from the top of cut to the toe of slope).

The field drywell storage facility is located at the northern end of the MRS facility. The storage area shown on Drawing H-3-56734 (Sheet 3) is designed to safely store 15,000 MTU of spent fuel and 100 MTU equivalent of HLW. The storage area is divided into cells separated by access roads. The storage facility stores 13,555 spent-fuel drywells, 1,619 nonfuel-bearing and HLW drywells, and 1,154 drywells for onsite-generated waste. It also contains the storage area allocated for the 132 transportable metal casks. An enlarged plan of the southern part of the storage area is shown on Drawing H-3-56736 (Sheet 1). This drawing shows the spacing of spent-fuel drywells at 16 ft center to center. The spacing for the secondary waste and onsite-generated waste drywells is 10 by 5.5 ft. The layout of the transportable metal casks is similar to the layout used in the primary storage concept, providing transport vehicle and emplacement crane access. The other cells in this storage facility contain the remaining spent-fuel drywells.

Security requirements are met by the provision of two 8-ft-high fences with a 100-ft alarm zone between them surrounding the exposed sides of the storage area. A 100-ft-wide isolation zone is provided on the outside and a 50-ft-minimum-wide isolation zone is provided on the inside of the double security fence. A single 4.5-ft-high, barbed-wire fence is located 1,476 ft (450 m) from the edge of the outermost transportable metal cask, where the air-scattered radiation dose rate is 25 mrem/yr per 10 CFR 72. The south side of the storage facility that abuts the protected area containing the R&H Building is separated from it by a single 8-ft-high fence. The exterior fence of the double fence is located a minimum of 100 m from the stored material. Alarm zone monitoring and closed-circuit television surveillance are described in Section 3.8. Access to the storage facility is through the protected area and is controlled at the Protected Area Gatehouse. The storage area gate station is located at the entrance to the storage facility. A patrol road is provided around the inside perimeter of the entire storage facility.

1.3 ACCESS AND CIRCULATION

1.3.1 PRIMARY STORAGE CONCEPT

Rail and road access to the MRS Facility for the primary storage concept is shown on Drawing H-3-56725. The rail and road layouts for the entire MRS

Facility are shown on Drawing H-3-56726. Drawing H-3-56727, sheets 1 and 2, shows the layouts in more detail.

Rail access is provided to the site by connecting to the existing Norfolk Southern rail spur just north of the Oak Ridge Gaseous Diffusion Plant (ORGDP). This new spur continues east and then south around the ORGDP to Highway 58.

A rail underpass is provided to cross Highway 58. After crossing under the highway, the railroad turns southwest and follows Highway 58 until it reaches the river road leading to the site. The rail spur crosses the river road at grade and follows the road on the river side up to the site. Rail shipments carrying radioactive material to the site will be brought by Norfolk Southern locomotives around the ORGDP up to the Inspection Gatehouse, where they will be switched to an MRS yard engine. Nonradioactive shipments, such as fuel oil, or supplies for the warehouse, will be switched from the Norfolk Southern engines to the MRS yard engines outside of the Main Gate/Badgehouse. Rail shipments for the cask manufacturing and concrete batch plant can be taken right up to the plant by the Norfolk Southern engines, or they can be switched with yard engines at the turnout near the Inspection Gatehouse.

Rail shipments containing radioactive material will be inspected at the Inspection Gatehouse, then routed onto one of the two tracks that are provided for each of the north and south receiving bays of the R&H Building. A rail storage yard is provided on both the north and south side of the R&H Building. Each storage yard consists of five body tracks. One track is provided for incoming spent fuel cars, one for outgoing spent fuel cars, one for empty incoming repository cars, one for full outgoing repository cars, and the fifth one for both incoming cars carrying repository overpack canisters and the associated outgoing empty railcars. These storage yards are connected to both ends of the respective receiving bays of the R&H Building to provide flexibility for unloading and loading the railcars.

Rail shipments of supplies going to the warehouse or fuel oil shipments to the fuel storage tanks are routed through the main entrance and are controlled at the Main Gate/Badgehouse. A rail spur and storage tracks are provided for the warehouse. This same spur continues beyond the warehouse to serve the fuel tanks. A spur is also provided into the vehicle maintenance facility. Another spur is also provided to the cask manufacturing and concrete batch plant for sand, gravel, and cement shipments.

Trucks and autos coming to the site will arrive via Highway 58. They will exit onto the river road which leads to the main access road to the MRS Facility. Trucks carrying radioactive shipments will enter the protected area directly through the Inspection Gatehouse. A 24-ft-wide road leads from the Inspection Gatehouse to both the north and south receiving bays of the R&H Building. Access is provided from the road to the truck lag storage area. A road is provided from the back side of the receiving bays of the R&H Building and off-normal shipment storage back to the truck lag storage area. The truck lag storage area can also be bypassed. A 50-ft-wide transport vehicle road is provided from the back side of the R&H Building to the Cask Manufacturing Plant and to the SF, HLW, and HAW/RHTRU storage area. Gates, normally closed, are provided where the transport vehicle passes through the security fence. A patrol road is provided inside the interior security fence. This patrol road is also used for access to the Standby Generator Building.

Controlled access to the limited area is provided at the Main Gate/Badgehouse. Employees are required to park outside the limited access area. Special-permit vehicles and supply vehicles are allowed onsite after inspection at the Main Gate/Badgehouse. Access to all of the facilities in the limited access area is provided by a network of 24-ft-wide roads. Vehicular access is provided on all sides of the buildings for fire protection vehicles. Where required, vehicular access to the buildings is provided. Sidewalks are provided from the Main Gate/Badgehouse to all of the facilities in the limited access area. Access ramps for the handicapped are provided at the road intersections and building entrances, where required. Vehicle and pedestrian access from the limited access area to the protected area is provided via the protected area gatehouse.

The main access road to the facility continues past the turnoff for the limited access area to the cask manufacturing and concrete batch plant, as well as the heliport.

Access to the storage facility is by the transport vehicle road, which comes from the R&H Building from the south. A motor-operated (card-actuated) gate is provided at the entrance of the storage facility to separate the storage facility from the remainder of the protected area. A minimum of 50-ft access is provided between all of the concrete support pads as well as the transportable metal cask storage area. A minimum 80-ft-wide corridor is provided at the ends of the concrete pads to allow for transport vehicle turning. A patrol road is provided along the interior fence for security vehicles.

1.3.2 ALTERNATE STORAGE CONCEPT

Rail and road access to the MRS Facility for the alternate storage concept is shown on Drawing H-3-56732; an overall layout of the rail and road layouts within the MRS Facility is shown on Drawing H-3-56733. Drawing H-3-56734, Sheets 1 and 2, shows the layout in more detail for the protected and limited access areas. As can be seen from these drawings, access and circulation is basically the same for both the primary and alternate storage concepts. An obvious difference is that the cask manufacturing plant is not required and no road or rail access is provided beyond the limited access area.

Access to the storage facility is by the transport vehicle road from the R&H Building from the south. A motor-operated (card-actuated) gate is provided at the entrance of the storage area to separate the storage facility from the remainder of the protected area. A main access road, 36 ft wide, runs from the entrance to the northern end of the facility. A 24-ft-wide access road serves the central-eastern cell because of its lower elevation. This is

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

150mm

6"

to reduce earthwork costs. A perimeter patrol road is provided, which connects to the main access road at the northern and southern ends of the facility.

The shielded transport vehicle carrying casks to the drywells will travel along the access roads until it reaches the storage cell for unloading. It enters the cell from either one of the central access roads. Access from the patrol roads directly into a storage cell is not possible because the main drainage ditches run alongside of them. Once inside a storage cell, the shielded transport vehicle can travel freely, usually straddling the drywells to reach its destination.

The double rows of the transportable metal casks are spaced 50 ft apart to provide access for the transport vehicle and the emplacement crane.

1.4 ROADS, PARKING, AND WALKWAYS

1.4.1 PRIMARY STORAGE CONCEPT

Three types of roads are used at the MRS Facility: the primary road, the tertiary road, and the transport vehicle road. The limits of these three types of roads are shown on Drawing H-3-56727, Sheets 1, 2, and 3.

Typical road cross sections are shown on Drawing H-3-56730, Sheet 1. The primary road is an asphalt road, 24 ft wide. Two variations of this road are used, one with 6-ft-wide shoulders, the other with curb and gutters. The main access road to the MRS Facility and from the Inspection Gatehouse to the R&H Building, the off-normal storage, and the lag storage areas are designed for the heavy trucks carrying radioactive shipments. The primary roads throughout the limited access area, as well as the parking lots, are designed for H-20 loadings.

The tertiary road is a 20-ft-wide grave road. This road is mainly designed for light traffic, such as the patrol vehicles. However, the section of this road used for access to the Standby Generator Building is designed to accommodate the anticipated heavier traffic.

The transport vehicle road is a 50-ft-wide gravel road. This road is designed to accommodate the transporter traffic for the transportable metal cask, as well as the tracked concrete cask transport vehicle.

The only defined road in the storage facility is the patrol road. This road is a 20-ft-wide tertiary road designed for light traffic, such as security vehicles. A typical section of a tertiary road is shown on Drawing H-3-56730, Sheet 1.

The access areas between and around the storage pads is paved with a 12-in. aggregate base on top of 12 in. of well-compacted subgrade designed to support the tracked transport vehicle used for the sealed concrete storage casks, the rubber-tired transport vehicle used for the transportable metal casks, and the tracked emplacement crane. The transportable metal cask transport vehicle is the controlling factor in this cross section of the storage facility.

No designated parking areas or walkways are provided in the storage facility.

1.4.2 ALTERNATE STORAGE CONCEPT

The same three types of roads that are in the primary concept are used in the alternate concept. The only difference is the design of the transport vehicle road. The road is similar to that in the primary concept, except that it is a 36-ft-wide gravel road. This transport vehicle road is designed to accommodate the transporter traffic for the transportable metal cask, as well as the rubber-tired, shielded transport vehicle used to transport canisters to the field drywells.

Primary roads and patrol roads are designed the same as in the primary concept. The limits of the three types of roads in the alternate concept are shown on Drawing H-3-56734, Sheets 1, 2, and 3.

The three types of roads in the storage facility are the 36-ft-wide access road, the 24-ft-wide access road, and the 20-ft-wide patrol roads. Both access roads, as well as the entire surface of the storage cells, are paved with a 12-in. aggregate base course on top of a 22-in. subbase on a subgrade of which the top 12 in. has been recompacted. These roads and all surfaces are designed to support the rubber-tired shielded transport vehicle, as well as the emplacement crane and transport vehicle for the transportable metal casks. The high wheel loads of the rubber-tired shielded transport vehicle dictate the cross section of the storage facility. The patrol road is designed for light traffic, such as security vehicles. Typical sections of the transport vehicle road and the tertiary (patrol) road are shown on Drawing H-3-56730 (Sheet 1).

No designated parking areas or walkways are provided in the storage facility.

1.5 RAILROADS

1.5.1 PRIMARY STORAGE CONCEPT

The main access rail spur to the MRS Facility, as well as all the rail spurs and storage yards inside the facility, conform to the requirements of the Norfolk Southern Railroad Company standards. All rail turnouts are provided with manual switches. In addition, the turnout in front of the Inspection Gatehouse is provided with an electronic switch that is controlled at the Alarm Monitoring System (AMS). Typical sections for single and multiple tracks are shown on Drawing H-3-56730 (Sheets 1 and 2).

1.5.2 ALTERNATE STORAGE CONCEPT

Except for the rail to the Cask Manufacturing Facility, the railroad design for the alternate storage concept is the same as that for the primary storage concept.

1.6 GRADING AND DRAINAGE

The drainage scheme for the MRS Facility at the Clinch River site is based on the Clinch River Breeder Reactor Project "Redress of Site" finish grade contours as MRS Facility existing contours. For areas outside of the CRBRP limits, USGS quadrangle (dated 1968) maps were used for existing contours.

1.6.1 PRIMARY STORAGE CONCEPT

In the limited access and industrial areas, drainage is accomplished by sheet flow, ditches, and culverts. Catch basin and storm drains are used where open ditches are not practical. The drainage pattern for the limited access and industrial areas is shown on Drawing H-3-56728, Sheet 1. Grading is such that rainwater flows away from the buildings overland to swales, ditches, or catch basins. Ditches ultimately carry the rainfall runoff to runoff ponds before being discharged to the Clinch River. Most of the limited access and industrial area is drained to existing runoff ponds A and B.

The grading and drainage plan for the protected area is shown on Drawing H-3-56728, Sheet 2. In this area, sheet flow, swales, ditches, and culverts are used to drain the site. As in the limited access area, grading is such that rainwater flows away from buildings to swales or ditches that carry the water offsite. Generally, the west half of the protected area drains to existing runoff pond D. The east half drains to a new runoff pond before discharging to the Clinch River.

The general drainage pattern of the storage facility utilizes sheet flow and swales flowing to ditches around the perimeter of the facility. The finish grade is warped to follow the existing grade as much as possible to minimize cut and fill operations. Finish grades in the storage area are between 0.5 and 2%, with a maximum of 3%. The top of the concrete support pads is 6 in. above the surrounding finish grade and is also warped to follow the finish grade contours. The grading and drainage plan for the storage facility at the Clinch River site is shown on Drawing H-3-56728, Sheet 3.

A high point ridge runs north and south down the center of the storage facility. Runoff is directed east and west of this ridge line in swales that run between the concrete storage pads. Once beyond the concrete pads, the water sheet flows to the ditches provided at both the eastern and western sides of the facility. Swales are provided along the northern and southern ends of the facility to collect runoff from the patrol road as well as from the access areas between the concrete casks and the ditches. The swales along the northern and southern ends of the facility have high points that coincide with the high point ridge down the center of the facility. These swales flow from the high point to the ditches at the eastern and western sides of the facility. The ditches at the eastern and western sides of the facility drain to culverts that carry the flow through the security fences to the runoff ponds. Concrete lining, ditch checks or riprap is used in ditches where velocities would otherwise cause erosion. Manproof barriers are provided on all culverts that pass through the security fences.

An interceptor ditch is provided along the northern side of the storage facility to divert any overland flow that might be flowing toward the site.

1.6.2 ALTERNATE STORAGE CONCEPT

The drainage of the limited access and protected areas in the alternate storage concept is basically the same as that in the primary concept. Minor differences occur because the cask manufacturing plant is not part of the alternate concept. The grading and drainage plan for the limited access and protected areas of the alternate storage concept is shown on Drawing H-3-56735, Sheets 1 and 2.

The general drainage concept for the storage facility is sheet flow across the storage cell to ditches and culverts that carry the water to the runoff ponds. Finish grades are set to follow the existing contours as much as practicable to minimize cut-and-fill operations. The grading and drainage scheme for the storage facility at the Clinch River site is shown on Drawing H-3-56735, Sheet 3.

An interceptor ditch is provided along a portion of the western side of the storage facility to divert overland flow that might be flowing toward the site.

The storage area is designed with a high point ridge running north and south down the center. Water sheet-flows to the east and west patrol roads, where collector ditches are provided. These ditches run to the culverts which flow through the security fence to the runoff ponds. Manproof barriers are provided where the culverts pass through the fence. There is no ditch or swale between the central access roads and the storage cells, allowing for easy transport vehicle access.

Corrugated-metal pipe culverts are provided to route the ditches under the east and west patrol roads and through the security fences. Finish grades in the storage facility are a maximum of 3%. In the spent fuel drywell storage cells, water generally sheet-flows to the ditches, but is diverted around the drywells by small swales, as shown on Drawing H-3-56736, Sheet 1. In the storage cell containing the transportable metal casks, the secondary waste, and onsite-generated HAW/RHTRU drywells, water sheet-flows between the foundations of the transportable metal casks. The drainage pattern for this storage cell is shown on Drawing H-3-56736, Sheet 1. Also shown on this drawing is the drainage pattern for the secondary waste and onsite-generated HAW/RHTRU storage drywells. Runoff is diverted to swales that run through the rows of drywells to the collector ditches.

1.7 FLOOD PROTECTION

The MRS Facility at the Clinch River site is located well above the 100-yr flood plain. It is also located above the Probable Maximum Flood (PMF) level and the flood surge level. The 100-yr flood level is at approximately el.

750 MSL, the PMF is el. 782.6 MSL, and the flood surge level is el. 809.2 MSL.

The finish floor elevation of the R&H Building is at el. 820, and the support buildings are all above el. 813 MSL.

In the primary storage concept the storage area is at elevation 870 MSL and above. The interceptor ditch, located at the northern end of the facility, will divert any runoff from the higher ground to the north.

In the alternate storage concept the storage area is at elevation 827 MSL and above. The interceptor ditch, located on the western side of the facility, will divert any runoff from the higher ground to the west. The drainage system in all areas is designed to preclude flooding from onsite precipitation runoff.

1.8 LANDSCAPING

Landscaping at the MRS Facility is limited to the following areas: the main entrance to the site, the employee parking lot outside the limited access area, the front of the Administration Building, the area between the Administration Building and the Main Gate/Badgehouse, the area around the Sewage and Water Treatment Buildings extending to the Main Gate/Badgehouse, and the walkways leading to the Site Services Building, Security Building, and Fire Station. Landscaping is also provided at the entrance to these same buildings. In the protected area, landscaping is provided along the walkway to the R&H Building, around the parking area for the R&H Building, and at the entrances to the R&H Building.

Landscaping consists of trees, shrubs, and ground cover commensurate with the site location and type of facilities constructed. Plant species used are tolerant of the specific site conditions. Irrigation is not provided, as it is not required for landscaping at the Clinch River site.

All disturbed earth areas not covered by structures, paving, or landscaping are covered with a 2-in. layer of crushed stone or are seeded with grass for erosion control.

To prevent erosion the following is provided. All areas between the perimeter patrol road and security fence plus the 100-ft-wide alarm zone are covered with 2 in. of gravel or crushed stone. The 100-ft-wide isolation zone outside of the security fence is seeded with grass.

SECTION 2

RECEIVING AND HANDLING (R&H) BUILDING

2.1 INTRODUCTION

2.2 CIVIL AND SITE DEVELOPMENT

2.2.1 PARKING

Parking for employees working in the R&H Building is provided outside the Main Gate/Badgehouse. Parking is also provided adjacent to the entrance of the R&H Building for site vehicles serving the building. A designated parking area is provided near the facility for the cask transporter vehicles.

2.2.2 LANDSCAPING

The area around the entrance to the R&H Building is landscaped (see Section 1.8).

2.3 STRUCTURAL

2.3.1 DESIGN BASIS

The design of the R&H Building is based on specific site characteristics available for each of the selected sites. The soil bearing capacity of 15,000 psf for bedrock or weathered rock, and 4,000 psf for compacted fill, is used in lieu of the 6,000 psf specified in the Basis for Design. Certain portions of the R&H Building are designed to withstand environmental loads, including Design Basis Earthquake (DBE), Operating Basis Earthquake (OBE), Design Basis Tornado (DBT), and Design Basis Ashfall.

The tangential speed of the Design Basis Tornado used for design analysis is 290 mph in lieu of the 300 mph specified in the Basis for Design.

2.3.2 CATEGORY CLASSIFICATION

The R&H Building is composed of Category I and Non-Category I structures. Areas of containment structures (hot cells) and those areas that must remain functional during and after natural phenomena are designated Category I; they are designed to withstand extreme environmental loads, including DBE, OBE, DBT, and Design Basis Ashfall. Areas not containing a radiation source nor important to radiation safety are classified as Non-Category I.

2.3.3 STRUCTURAL SYSTEM

The structural system used in the Category I and Non-Category I structures of the various areas of the R&H Building are described in this section.

2.3.3.A. Category I Structures

1. Concrete Structures. Most Category I structures are of cast-in-place, reinforced concrete. The primary containment areas (hot cells and process enclosures) are enclosed by 5-1/2-ft-thick concrete for personnel shielding. The secondary confinement areas (operating areas and radwaste areas) are enclosed by concrete that varies from 1 to 4 ft thick, based on shielding requirements. Steel or lead is used to make up for the shielding thickness requirements where space is limited.

The main Category I structure encompassing the shielded process cells, shielded canyon cells, cask unloading rooms, loadout and decontamination rooms, exhaust filter rooms, exhaust fan rooms, UPS rooms, battery rooms, and other storage and maintenance rooms) is approximately 400 x 400 ft, and is separated from the transfer/discharge corridors and other Non-Category I structures by expansion joints, except in the receiving, inspection, and shipping areas. The expansion joints are provided to permit the structure to expand and contract with temperature change without adversely affecting its structural integrity. The receiving, inspection, and shipping areas, although connected to the main Category I structure, do not possess rigid lateral supporting structures to restrain thermal movement in the north-south direction.

The roofs and exterior walls are 1-1/2 and 2 ft thick minimum, respectively, to serve as tornado barriers designed to withstand tornado-generated missile impact and prevent concrete scabbing. Concrete barriers are located to shield openings and doors (except tornado-proof doors) from any direct passage of tornado-generated missiles.

Roofs and floors are supported by cast-in-place, reinforced concrete beams, walls, and columns. Floor live loads vary from 100 to 700 psf. These loads are treated as uniform loads covering the entire floor areas. Localized heavy loads are investigated separately. The service gallery floors are designed for 200-psf live load; however, a 500-psf localized load is anticipated during service conditions when shielding windows must be removed. This loading condition is assumed not to occur simultaneously with the OBE. Roofs and floors serve as rigid diaphragms to transfer seismic loads to shear walls and the foundation. All concrete walls serve as bearing walls and shear walls. The foundations are spread footings and continuous wall footings. The Category I structures are located on bedrock or weathered rock with a minimum bearing capacity of 15,000 psf. The slab-on-grade is placed on compact fill, designed to support floor loads and vehicle loads, including the 315-ton cask transporter vehicles.

2. Steel Structures. The exhaust stack is of steel construction, 50 ft above the roof level and cantilevered from the roof level. The stack is

designed for extreme environmental loads (DBT, OBE, or DBE) to protect the Category I concrete roof structure from the impact caused by the collapse of the stack during and after natural pheonomena. The stack is not designed to withstand the local damage that may be caused by tornado-generated missiles. Local tornado damage will not affect the stability or cause the collapse of the stack.

Supports for Category I equipment, piping, and ductworks are not included in the conceptual design. The floor design response spectra will be developed in the final design to derive the seismic loads imposed on the systems and supports.

2.3.3.B. Non-Category I Structures

Non-Category I structures are of steel, concrete, or masonry construction, designed for normal loads. The areas of Non-Category I structures are as follows:

1. Receiving, Inspection, and Shipping Areas. Steel-framed buildings, located north and south of the Category I structure, have 7-ft steel trusses, spanning 79 ft, supporting a steel-framed roof with a 1-1/2-in. metal roof deck. The 36-in. steel columns step to 24 in. at crane level, supporting roof trusses and the 36-in. crane runway girders for the 150-ton bridge crane. One side of the roof is connected to the concrete wall enclosing the main Category I structure. The crane rails are supported by concrete or corbel cast in the wall.

Spread footings at columns are designed for the roof loads and crane load with impact load. Exterior footings are located below the frost depth. For the vehicle loads (including the 170-ton trailer), a 12-in. concrete slab-on-grade is provided. The floor is thickened at the train rails to support the 220-ton railcars. Lateral loads (wind or seismic) are resisted by steel bracings in the east-west direction, and by the main Category I structure in the north-south direction. The metal roof deck serves as a diaphragm to transfer lateral loads to the resisting elements.

2. Incoming Air-Control Vestibule (ACV) - Receipt and Washdown Areas. Steel-framed buildings, located west of the receiving, inspection, and shipping areas, are composed of high-bay and low-bay areas. The high-bay areas are two-story structures with the roof structures being a continuation of the receiving, inspection, and shipping areas. The floor structures are of concrete fill over steel floor decking, supported by steel beams and girders framed into the 36-in. exterior columns and the concrete walls of the main Category I structure. The low-bay areas are separated from the high-bay areas by expansion joints to permit thermal movement in the east-west direction. The north ACV area has tapered steel roof girders supported by 12-in. steel columns. The roof is connected to the low-level radwaste area concrete structure for lateral stability. The south ACV area has rigid frames of 30-in. girders and 33-in. columns to resist both vertical and lateral loads. Lateral loads (wind or seismic) are resisted by steel bracings in the east-west direction. Footings and slab-on-grade are

the same as those described for the receiving, inspection, and shipping areas (Section 2.3.3.B.1).

3. Outgoing Air-Control Vestibule (ACV) - Vehicle Exit Areas. Steel-framed buildings, located east of the receiving, inspection, and shipping areas, are separated from the electrical equipment rooms and receiving, inspection, and shipping areas by expansion joints. Rigid frames of 30-in. girders and 33-in. columns are designed to support the steel-framed roof structures and withstand the lateral loads (wind or seismic).

4. Administration Area. The administration area is a reinforced concrete block structure with steel-framed roof and slab-on-grade floor. The roof is supported by bearing walls and steel columns with continuous wall footings and spread footings, respectively. Lateral loads are resisted by block shear walls and steel bracings. The structure is separated from the main Category I structure and low-level radwaste area by expansion joints.

5. Electrical Equipment Rooms. Steel-framed buildings, connected to the north and south ends of the transfer/discharge corridor concrete structure (Category I), are separated from the main Category I structure by expansion joints. Steel columns on spread footings are designed to support roof structures.

6. Low-Level Radwaste Area and Solid Radwaste Area. A reinforced concrete building, encompassing the low-level radwaste area, solid radwaste area, and their adjoining areas, is separated from the main Category I structure and the administration area by expansion joints. Ten-inch and twelve-inch concrete roof slabs are supported by concrete walls and columns on continuous wall footings and spread footings, respectively. Lateral loads are resisted by concrete walls as shear walls.

2.4 ARCHITECTURAL

2.4.1 GENERAL

The R&H Building is designed to comply with the applicable sections of the following parts of Title 10, Code of Federal Regulations:

(1) 10 CFR 20-1984, Standards for Protection Against Radiation

(2) 10 CFR 72-1984, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

The R&H Building is also designed to protect operating personnel and the public from the radiation emitted from stored materials in accordance with the "As Low As Reasonably Achievable" (ALARA) principle.

Architectural programming of the R&H Building (the process of defining the problems that the design must solve) is based on the specific requirements stated in the Functional Design Criteria (FDC). Space allocation sizes and configurations were determined by interaction of all of the various design requirements.

The R&H Building arrangement evolved as a result of evaluation and analysis of all of the program requirements, including:

(1) Material handling and process flow
(2) Functional dependencies and relationships
(3) Site arrangement impact and restraints
(4) Vehicular access and routing
(5) Solid and liquid radwaste process requirements
(6) Category I/Non-Category I designations
(7) Contamination confinement
(8) ALARA sequential zoning concept
(9) Personnel access and control
(10) Equipment installation and maintenance access
(11) Operating requirements
(12) Building Code and Life Safety Code analysis
(13) Decontamination and decommissioning

Space requirements were developed for each functional area as the schematic arrangements evolved. Planning tools used in the design included development of site arrangement plans, equipment arrangement plans, functional flow diagrams, and space data matrices of operational areas.

The final physical form of the building is an optimization of the spaces required and their relationships to one another in the final configuration. The material handling and process flow requirements were the determining factors in the overall building configuration. The vertical unloading of spent fuel and HLW into the shielded process cells and shielded canyon cells; process equipment and lag storage requirements inside the cells; and vertical loadout of canistered spent fuel and HLW were all major factors in determining the size and configuration of the multistoried building. Other hot cell operations and maintenance-related functions were then located in adjacent available spaces.

The R&H Building arrangement provides an administration area, twin receiving and handling areas, twin remote handling areas, twin transfer/discharge areas, radwaste areas, and building service areas. It is a multilevel, reinforced concrete structure of Category I and Non-Category I construction. The Category I structure is designed for containment and for maintaining radiation exposures of operating personnel within the design objectives of 10 CFR 20, DOE Order 5480.1A, and other applicable regulations, including application of ALARA principles to facility operating philosophies. The Category I portion of the building is basically a rectangle, 374 x 458 ft, flanked by various Non-Category I rectangular appendages of different sizes. An area summary of each level is given in Table 2-1.

Table 2-1 - R&H Building Approximate Area Summary[a]
(square feet)

Level	Category I	Non-Category I	Total
Basement and Tunnels	4,270	980	5,250
Ground Level	168,280	120,910	289,190
1st Mezzanine	48,330	-	48,330
2nd Level	156,215	9,265	165,480
2nd Mezzanine	91,465	-	91,465
3rd Level	108,430	-	108,430
Roof Penthouse	880	-	880
Total	577,870	131,155	709,025

[a]Excluding car puller enclosures.

The Steam Generator Building is a completely separate building with a floor area of 6,600 sq ft, located in close proximity to the R&H Building.

The Cooling Tower Chemical Building is a completely separate building with a floor area of 1,200 sq ft, located near the cooling tower.

2.4.1.A. Administration Area (Non-Category I)

The administration area is located on the ground floor level and occupies a rectangular space, 112 x 135 ft. It is the main personnel entrance to the R&H Building, and consists of offices for monitoring personnel, building operations, and management functions. Health physics facilities, change-rooms, showers, and toilets for male and female personnel are located in the administration area. A lunchroom and conference room are also provided.

(1) Office area - The office area accommodates the following functions:

Assignment	Number of Personnel by Shift: Day	2nd	3rd	4th	Total
Management	3	2	2	2	9
Staff	2	2	2	2	8
Operations	3	2	2	2	9
Secretarial	3	-	-	-	3
Total	11	6	6	6	29

Six private offices and one semiprivate office accommodate the management, staff, and operations functions. An open office accommodates the secretarial function and includes a small reception area. With the exception of the Building Manager's private office, all other offices are used by personnel working around-the-clock shifts. A small office adjacent to the conference room is provided for use by visitors.

(2) Conference room - A conference room furnished with tables, chairs, and audio-visual equipment is provided to accommodate up to 32 persons or may be divided into two separate rooms, each accommodating up to 16 persons.

(3) Clothing issue rooms - Protective clothing, boots, air-breathing devices, etc., required for personnel safety and protection, are stored in clothing issue rooms at the entrances to male and female changerooms.

(4) Janitor rooms, changerooms, pass-through shower stalls, toilets, and separate clean/dirty toilet facilities for 80 male and 30 female personnel per shift are provided. Double-tier lockers are provided for a total of 320 male and 120 female personnel.

(5) Lunchroom - A lunchroom with tables and chairs for 110 occupants is provided, and is equipped with vending machines, microwave oven, refrigerator, and a sink.

(6) Health Physics area - A Health Physics (HP) area is located near the personnel exit from the Category I portion of the R&H Building. All personnel are monitored and, if necessary, receive decontamination treatment in the Health Physics area. Space is provided for HP technicians, a supervisor's office, decontamination facilities, and storage.

	Number of Personnel by Shift				
Assignment	Day	2nd	3rd	4th	Total
Supervisor	1	-	-	-	1
Lead Technician	-	1	1	1	3
Technicians	13	13	13	13	52
Total	14	14	14	14	56

(7) Security - The personnel entry door of the R&H Building is controlled by a magnetic card-key access system. Emergency exit doors are alarmed. Doors used for process operations are not alarmed.

2.4.1.B. Receiving, Inspection, and Shipping Areas (Non-Category I except as noted)

The twin receiving, inspection, and shipping areas flanking each side of the R&H Building are designed to receive shipments of spent fuel (SF), HLW, and HAW/RHTRU from commercial generators of nuclear waste by both rail and truck. They are also designed to handle casks for transfer to the remote handling area. The cask, with impact limiters and covers in place, is surveyed and inspected at the Inspection Gatehouse before entering the R&H Building. Paperwork is also reviewed upon entering the incoming receipt and washdown area (ACV), and again upon entering the receiving, inspection, and shipping area, where impact limiters and covers are removed and stored; radiation surveys, visual inspections, and smear tests are conducted; and decontamination performed, if necessary, before the cask is moved into the cask unloading area.

The receiving, inspection, and shipping areas are also used for registering, handling, and staging of outgoing casks that will be shipped by rail to an offsite respository.

Weatherproof doors are provided at each rail/truck lane entrance to and exit from the incoming and outgoing ACVs and the receiving, inspection, and shipping areas. The doors are large, insulated, interlocking, metal-slat, rolling (roll-up) service doors, with weatherstripping at the sides and bottom to minimize air infiltration. Similar, but uninsulated, doors are provided at openings separating interior spaces.

Doors into Category I areas (such as at the cask handling, preparation, and decon rooms, and shipping cask transfer corridor) are designed to withstand tornado-generated missiles and pressures, and satisfy design basis earthquake or operating basis earthquake requirements.

Each receiving, inspection, and shipping area includes an incoming air-control vestibule (140 x 59 ft); a receiving, inspection, and shipping area (320 x 80 ft) with a 150-ton-capacity overhead traveling bridge crane; and an outgoing air-control vestibule (140 x 59 ft). Two rail/truck lanes pass straight through all three areas. Adjacent to the receiving, inspection, and shipping area are two cask handling and decon rooms, each having an elevated cask cover access platform and monorail with 5-ton-capacity hoist. Also adjacent is the shipping cask transfer room, which leads to the shipping cask lidding room, which also has an elevated lidding platform and monorail with a 5-ton-capacity hoist. The functions and number of personnel are as follows:

	Number of Personnel by Shift				
Assignment	Day	2nd	3rd	4th	Total
Foremen	2	2	2	2	8
Crane operators	3	2	2	2	9
Riggers	8	6	6	6	26
Millwrights	5	3	3	3	14
R&H technicians	16	15	15	15	61
Total	34	28	28	28	118

2.4.1.C. Remote Handling Area

The remote handling area is designed for remote unloading of casks into the shielded process cells. Other related functions (such as equipment maintenance, crane maintenance, and decontamination) are also provided. For personnel access to the shielded process cells and shielded canyon cells, air locks and Health Physics storage rooms are provided. The operating galleries around the shielded process cells and shielded canyon cells provide operators with visual control of process activities, and allow for use of master/slave manipulators; wall-mounted, traveling electromechanical manipulators; and the swipe transfer system.

(1) Cask Unloading (Ground Level)

Two shielded cask unloading rooms are provided for each cask handling and decontamination room (total 8) for the remote unloading of casks into the shielded process cells located directly above at the second floor level.

(2) Shielded Process Cells and Shielded Canyon Cells (Second Level, Category I)

Four shielded process cells and two shielded canyon cells with reinforced concrete floors and walls lined with welded, leak-tight stainless steel are provided as follows:

Four shielded process cells, 42 x 78 x 36 ft high, are provided for receipt and processing (disassembly and consolidation) of spent fuel; two shielded canyon cells, 56 x 294 x 36 ft high, are provided for encapsulation of spent fuel, an in-building lag storage vault, and for receipt and processing of high-level waste (HLW) and HAW/RHTRU. The shielded canyon cells are also provided with loadout ports. Each shielded process and canyon cell is served by independent access ports from the cask unloading rooms and loadout rooms below. In-process lag storage is provided in each shielded process cell and in each shielded canyon cell area.

(a) Shielded Process Cells - The spent-fuel process cells include a primary process area for bare or canistered intact-fuel or consolidated fuel assemblies. The central handling area includes facilities for the fuel and canister transferring system, inspecting, identifying, and consolidating fuel assemblies. The consolidation station includes facilities for disassembly of intact fuel assemblies (including facilities to remove fuel from received canisters), consolidation and encapsulation of fuel rods, and shredding and compaction of nonfuel-bearing fuel assembly components. When desired, the consolidation step may be bypassed.

(b) Shielded Canyon Cells - The shielded canyon cells include facilities for encapsulation, welding, inspecting, testing, swiping, decontaminating, labeling of packaged wastes ready for storage, and spent-fuel canister transfer. Similar facilities are provided for repository-type canisters.

These cells also process canisters containing HLW, HAW/RHTRU, consolidated fuel rods, and encapsulated fuel assembly hardware, and function as an in-building lag storage vault and for loadout of SF, HLW, and HAW/RHTRU to the storage facilities and to offsite repositories.

(c) Welding Station Areas - The welding equipment is located in shielded alcoves, 14 x 19 x 17 ft high, adjacent to each shielded canyon cell. The equipment, being located in alcoves rather than in the cell, is more accessible for contact maintenance of the welding equipment.

The process crew in the operating galleries consists of the following:

Assignment	Number of Personnel by Shift				
	Day	2nd	3rd	4th	Total
Foremen	5	4	4	4	17
Unloading technicians	4	4	4	4	16
Consolidation technicians	8	8	8	8	32
Welding, loadout, and decon technicians	6	6	6	6	24
Total	23	22	22	22	89

(d) Nonfuel-Bearing Components Waste Drum Transfer and Decon Cell (Second Level) - Located between pairs of shielded process cells are drum transfer/decon cell complexes that support the nonfuel-bearing fuel assembly components waste shredding operation within each cell.

(3) Cranes and Crane Maintenance (Second-Level Mezzanine)

An overhead traveling crane and a shielded crane maintenance and decontamination room are provided for each shielded process cell, decon cell, remote handling air filtration cell, and remote handled equipment maintenance room. Each shielded canyon cell is provided with two cranes and two shielded crane maintenance and decon rooms, one located at each end.

(4) Equipment Maintenance Rooms

Shielded remote handled and contact handled equipment maintenance and transfer hot glove-box repair rooms (all located directly below the cells) are designed to permit maintenance, decontamination, dismantling, removal, and transfer of in-cell equipment through cell floor hatches.

Maintenance personnel include the following;

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
Crane maintenance technicians	3	-	-	-	3
Remote, contact, and cold rad-waste maintenance technicians	2	-	-	-	2
Total	5				5

2.4.1.D. Transfer/Discharge Area (Ground Level, Category I)

The transfer/discharge areas each occupy a space 44 x 86 x 38 ft high, and are designed to accommodate the discharge of consolidated spent fuel, HLW, and HAW/RHTRU canisters and drums into either a cask (Primary Storage Concept - Sealed Storage Casks), which is mounted on a crawler-type transporter, or a self-contained shielded transporter (Alternate Storage Concept - Field Drywells), for delivery to the storage site.

Personnel requirements for the Primary Storage Concept are as follows:

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
Foremen	2	1	1	1	5
Welding, drum, and canister supply technicians	4	4	4	4	16
Transporter operator	1	-	-	-	1
SF, HLW, and HAW/RHTRU storage area:					
Foreman	1	-	-	-	1
Technicians	2	-	-	-	2
Crane operator	1	-	-	-	1
Inspector	1	-	-	-	1
Total	12	5	5	5	27

Personnel requirements for the Alternate Storage Concept are:

Assignment	Day	2nd	3rd	4th	Total
	Number of Personnel by Shift				
Foremen	2	1	1	1	5
Welding, drum, and canister supply technicians	4	4	4	4	16
Transporter crew	2	2	2	2	8
SF, HLW, and HAW/RHTRU storage area:					
Foremen	1	1	1	1	4
Technicians	2	2	2	2	8
Inspector	1	1	1	1	4
Total	12	11	11	11	45

2.4.1.E. Radwaste Area (Ground Level, Category I for HAW Radwaste; Non-Category I for Low-Level Radwaste)

There are two separate radwaste areas: the high-activity radwaste HAW/RHTRU area, 76 x 89 x 31 ft high, for processing high-activity wastes (generated in the shielded cells) and the low-level radwaste area, 83 x 176 x 27 ft high, including both a low-level liquid radwaste area and a low-level solid radwaste area. The radwaste areas prepare site-generated radioactive waste for storage or disposal. The MRS Facility will ensure that disposal criteria (such as physical and chemical quality) are in accordance with environmental regulations and standards. For economic reasons, some waste will require volume reduction before disposal. The end product of proper waste treatment will be radioactive materials, including discarded contaminated parts and tools, encapsulated with matrix material inside sealed containers, which will then be stored in proper storage facilities. Materials will be reduced in volume by shredding and/or compaction before encapsulation. For further definition of the process, see Section 2.6.2.

The radwaste treatment process systems require the following crew:

Assignment	Day	2nd	3rd	4th	Total
	Number of Personnel by Shift				
Supervisor, all maintenance	1	-	-	-	1
Foremen	2	1	1	1	5
Process cells, solid, liquid, and high-activity radwaste technicians	6	3	3	3	15
Total	9	4	4	4	21

1. High-Activity Radwaste HAW/RHTRU. The high-activity radwaste system area is subdivided into various spaces according to functional requirements. These include a HAW cell, HAW equipment room, maintenance decon, contact maintenance, and operating areas.

2. Low-Level Solid Radwaste. The solid radwaste system area is subdivided into various functional spaces. In addition, there is a 12-ft-deep basement, 26 x 30 ft, which contains conveyors and other equipment for loading drums with treated radwaste. There is also a waste collection storage room, 20 x 45 ft, in which untreated waste in drums is stored until it is processed.

3. Low-Level Liquid Radwaste. The liquid radwaste system area is subdivided into various functional spaces containing vessels, pumps, evaporators, and ion exchangers.

2.4.1.F. Analytical Laboratory Facility (Ground Level, Category I)

An analytical laboratory facility, 45 x 65 x 15 ft high, contains equipment, apparatus, and chemicals required for the counting and analysis or sampling of contaminated solids, liquids, and gases. The laboratory includes the following functional rooms: high-level analytical laboratory (complete with a shielded sample storage cubicle and two hot cell cubicles), a low-level analytical laboratory, a sample storage room, a counting room, an analyzer room, a chemical and gas analysis room, a reagent room, an analytical laboratory office, supply storage, and air-control vestibules.

In addition to laboratory cabinets, sinks, and furniture, shielded and isotope fume hoods and glove boxes are provided.

The analytical laboratory crew includes the following:

	Number of Personnel by Shift				
Assignment	Day	2nd	3rd	4th	Total
Lab Supervisor	1	-	-	-	1
Lab data management	1	-	-	-	1
Lab specialist	1	1	1	1	4
Lab technicians	2	2	2	2	8
Total	5	3	3	3	14

2.4.1.G. Control Room (Second Level, Category I)

Different aspects of the operations, including certain designated maintenance activities within the building, are observed and controlled from the control room. Data acquisition equipment handles the monitoring of personnel, inventory control, records, and proc[illegible] for the control of contaminated materials and building process activities. Operations in cask unloading rooms, process cells, and loadout rooms are observed by closed-circuit television (CCTV), and a system of communication is available for efficient operation of the facility. The control room is 48 x 46 ft, including adjoining supervisor's room and two storage rooms. Control room personnel include the following:

Assignment	Day	2nd	3rd	4th	Total
	Number of Personnel by Shift				
Operators	4	4	4	4	16
Supervisor	1	1	1	1	4
Total	5	5	5	5	20

2.4.1.H. Other Building Functions

Space will be provided for each of the following building services:

- Aqueous and chemical decon makeup
- Supply fan rooms
- Exhaust fan rooms
- Heat recovery equipment room
- Exhaust filter rooms
- Chiller room
- Standby/battery/UPS and electrical equipment rooms
- Compressor room
- Plumbing equipment (toilets, showers, laundry, washdown, decon, etc.)
- Mechanical equipment rooms
- Telephone equipment room
- Laundry room
- Manipulator/crane storage and maintenance room
- Contact handled equipment maintenance room
- Cold maintenance room
- Materials receiving and storage room
- Storage rooms
- Remote handling air filtration rooms
- Drum/canister storage
- Drum/canister transfer rooms
- Car puller enclosures

Separate buildings are provided for the following building services:

- Steam generation
- Cooling tower chemicals

The personnel are as follows:

Assignment	Day	2nd	3rd	4th	Total
	Number of Personnel by Shift				
Laundry room	2	-	-	-	2
Materials receiving and storage	2	-	-	-	2
HVAC operations and maintenance technicians	9	5	5	5	24
Manipulator/crane storage and maintenance room technicians	2	2	2	2	8
Total	15	7	7	7	36

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
R&H Building total personnel	133	94	94	94	415

2.4.2 MATERIALS OF CONSTRUCTION

The R&H Building is designed to have a 40-year lifetime, with nominal usual maintenance, and is designed to be maintainable or replaceable to extend life in 20-year increments, and to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The Category I core of the building is a multilevel structure with reinforced concrete floors, walls, and roofs, insulated metal siding, and insulated single-ply roofing. The building has sealed joints, tornado-resistant doors, air-control vestibules, and a ventilation system designed to maintain an internal negative pressure.

The prefinished metal siding and flashing at the Category I portions of the structure will require infrequent repainting, on an as-needed basis, so as to ensure a rust/corrosion-free surface for extended life of the structure. The gravel-ballasted, single-ply roofing/flashing system will require infrequent replacement during the extended life of the building.

(2) All interior walls, floors, and roofs subject to expusure from high-level radioactive materials are constructed of reinforced concrete and lined with stainless steel on surfaces subject to major decontamination operations. The remaining surfaces receive special coatings.

(3) All other interior walls are constructed of reinforced concrete or concrete block of various thicknesses, as required for structural or shielding needs. Nonbearing interior partitions, with no requirements for radiation shielding, are constructed of cement plaster on light-gauge metal framing.

Both the Steam Generator Building and the Cooling Tower Chemical Building are pre-engineered metal buildings with prefinished, insulated metal siding and roofing.

(4) All exterior walls and roofs, except Non-Category I parts of the building, are constructed of reinforced concrete of various thicknesses, as required by structural or shielding needs.

(5) The Non-Category I parts of the building are the incoming and outgoing ACVs; the receiving, inspection, and shipping area; the administration area; and the electrical equipment rooms. Materials

of construction include steel framing for walls and roofs (concrete block walls at administration area), insulated metal panel siding, and a single-ply roofing membrane.

The car puller enclosure lean-to appendages are constructed of uninsulated, prefinished metal siding and roofing.

The prefinished metal siding and flashing at the Non-Category I portions of the structure will also require infrequent repainting, on an as-needed basis, so as to ensure a rust/corrosion-free surface for extended life of the structure. The gravel-ballasted, single-ply roofing/flashing system will require infrequent replacement during the extended life of the building.

(6) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

2.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Classifications:

Administration area	B-2
Receiving and inspection facility	B-2
Remote handling area	H-1
Transfer/discharge area	B-2
Radwaste areas	H-1
Control room	B-2
Building services areas	B-2
Steam Generator Building	B-2
Cooling Tower Chemical Building	B-2

(2) Ceiling heights (suspended ceiling):

Vestibule, offices, control rooms, corridors, Health Physics area, lunchroom	9'4"
Changerooms, toilets, janitor closet, locker rooms, shower stalls	8'-0"

(3) Kind of traffic:

Foot traffic
Forklift
Railcar transporter
Tractor-trailer transporter
Concrete storage cask transporter
Drywell canister transporter (Alternate Storage Concept)

(4) Size of access openings (width x height):

Personnel	3'-0" x 7'-0"
Personnel	6'-0" x 7'-0"
Equipment (vertical and horizontal)	Varies: 12'-0" x 16'-0" max, 8'-0" x 10'-0" min.
Rail/truck	16'-0" x 25'-0"
Transporter	22'-0" x 28'-0"

(5) Special equipment:

(a) Administration: Fixtures, furnishings, and equipment (FF&E), photocopy machine, exposure recording instrument, lunchroom equipment.

(b) Lockers, Toilets and Shower Stalls, Janitors: Lockers, metal toilet partitions, toilet, shower and janitor accessories, mirrors, sinks, and towel dispensers.

(c) Vertical Transportation: Freight elevator and passenger elevator.

2.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

2.5.1 SPENT FUEL, HLW, RHTRU, AND REPOSITORY OVERPACK PROCESSING

Spent fuel, HLW, and future RHTRU are processed in the R&H Building. The R&H Building fuel handling and processing areas consist of the following: receiving and inspection area, cask handling and decontamination room, cask unloading room, shielded process cells, drum handling and decontamination cell, in-building lag storage, cask loadout and decon room, transfer and discharge corridor, transporter entry/exit rooms, and repository overpack loading and discharge area. These areas are fully equipped to routinely receive and process casks of spent fuel, HLW, and future RHTRU. The equipment in these areas is designed to: (1) prepare casks for unloading from railcars or trucks; (2) perform inspection, identification, disassembly, consolidation, and packaging of spent fuel; (3) inspect and overpack HLW and future RHTRU, as necessary; (4) prepare the HLW canisters and RHTRU drums for storage; and (5) receive, process, and discharge repository overpacks. In addition, equipment is also provided to perform volume reduction of the nonfuel-bearing components generated by the disassembly of spent fuel.

The R&H Building is composed of two halves, which are essentially mirror images of each other. For the Clinch River site arrangement, the plane of symmetry is oriented in an east-west direction. Running parallel to the building on the northern and southern sides are railroad tracks and truck access ways. The processing cells open directly to cask unloading rooms in the north and south and to cask loadout and decon rooms in the east.

In each half, there are two shielded process cells, a shielded canyon cell, and a drum decontamination cell (see Figure 2-1). The cells on the northern side, primarily for processing PWR assemblies, are identified as Cells 1, 3, 5, and decon cell, respectively, whereas cells on the southern side are identified as Cells 2, 4, 6, and decon cell, and are primarily intended to process BWR assemblies. Additionally, each of the two shielded canyon cells (5 and 6) is capable of storing canisters of spent fuel and, in the east end of each cell, processing repository overpacks. Two cask unloading rooms are provided for each of the shielded process cells (1 through 4). Each pair of unloading rooms connects with the common receiving and inspection area via the cask handling and decon room. Two loadout and receiving rooms are provided for each of the shielded canyon cells (5 and 6). One, exiting to the east, is dedicated to the discharging (and, in the case of retrieval, receiving) of storage casks and drywell transfer shields. The other, exiting toward the rails to the north or south, is for discharging and receiving repository overpacks, and for receiving future RHTRU. The unloading and loadout rooms are directly below the process cells. Located near each end of the shielded canyon cells is a corridor connecting them to each other. The west-end corridor provides a passageway for a cart to transfer spent-fuel canisters from one shielded canyon cell to the other. The east-end corridor provides the same capability for the overpack upender handling HLW, future RHTRU, and overpack canisters.

The arrangement and functions of the northern and southern sides of the facility are identical, except that the southern half primarily processes BWRs as opposed to PWRs. Also, it has the capability of welding and ultrasonic testing (UT) of an overpack, canister HLW, or future RHTRU canisters. This capability is only required in one cell to meet the throughput requirements. Overpack canisters that originate in Shielded Canyon Cell 5 (north) are transferred to Shielded Canyon Cell 6 for welding and testing.

The southern portion of the facility contains two parallel shielded fuel processing cells (2 and 4), which are equipped to receive, disassemble, and consolidate spent-fuel assemblies, and shred and package nonfuel-bearing components. These two cells sandwich the decon cell, where nonfuel-bearing component drum handling and decontamination take place. The process flow for these cells is generally in a south-to-north direction. Shielded Canyon Cell 6 is equipped to complete spent-fuel processing, provide lag storage, process repository overpacks, and process overpack, HLW, and future RHTRU canisters. This includes packaging fuel rods; welding and ultrasonically testing canisters and overpacks; cutting canister ends; storing spent-fuel and overpack canisters; receiving, loading, welding, decontaminating, and discharging repository overpacks; and receiving, decontaminating, and discharging HLW and future RHTRU.

The processing sequence for spent-fuel casks is as follows: shipping casks, mounted either on railcars or trucks, are received in the incoming air-control vestibule and washed, if necessary, to remove road grime. The vehicle is then moved to the receiving and inspection area (see Figure 2-2).

MONITORED RETRIEVABLE STORAGE FACILITY
RECEIVING AND HANDLING BUILDING

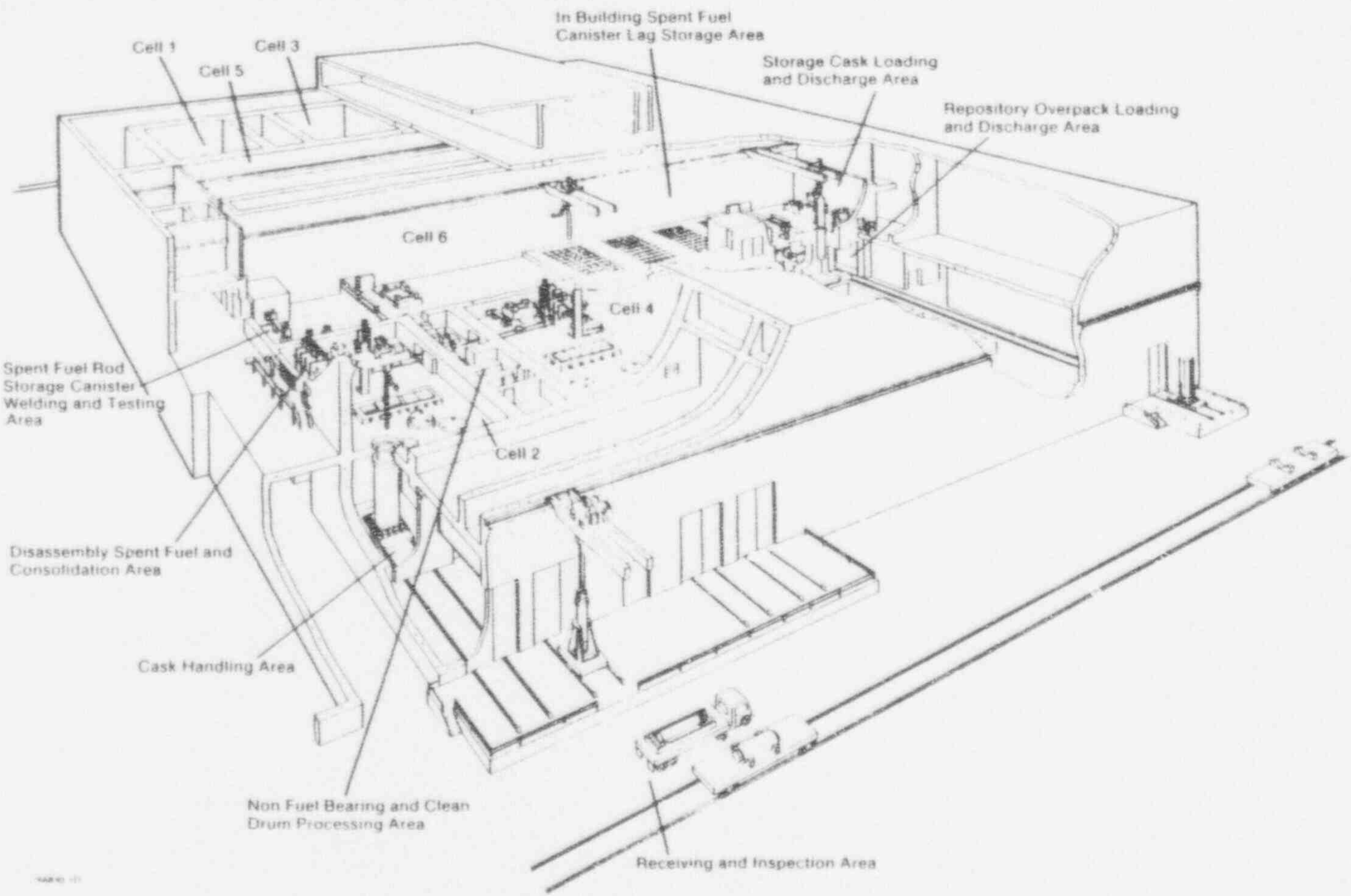
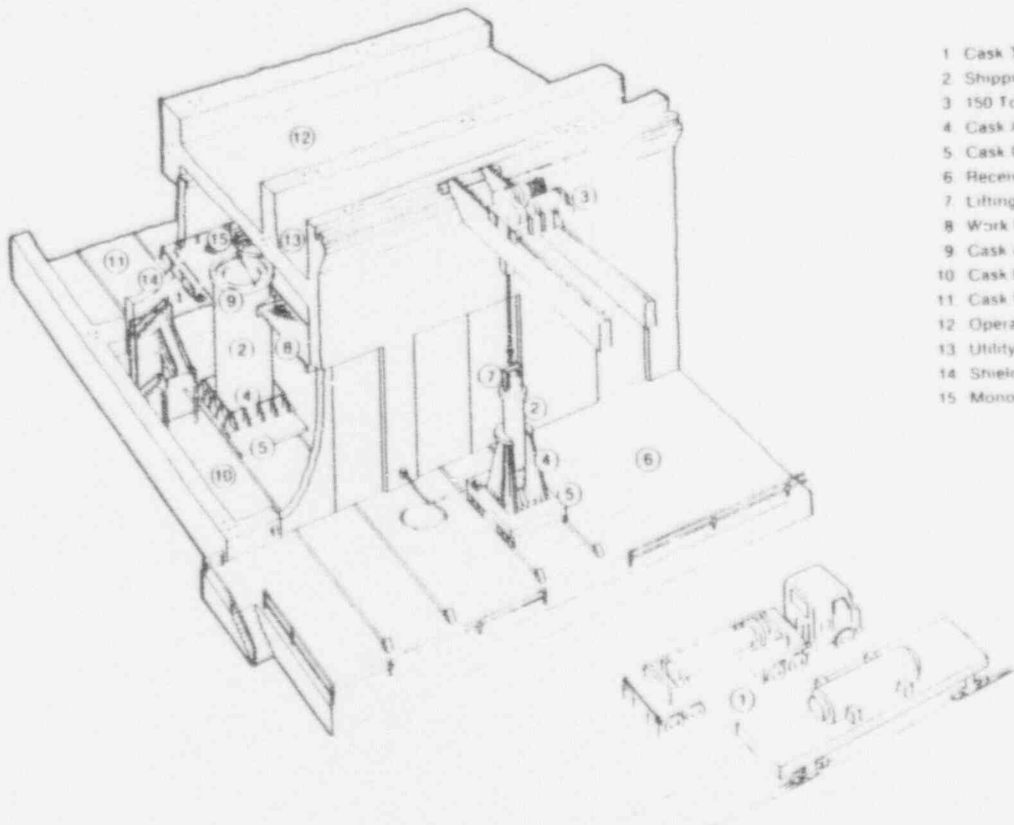


Figure 2-1

PARSONS

Monitored Retrievable Storage Facility Receiving and Handling Building

RECEIVING AND INSPECTION AREA



1. Cask Transport Vehicles
2. Shipping Cask
3. 150 Ton Bridge Crane
4. Cask Adapters
5. Cask Cart
6. Receiving and Inspection Area
7. Lifting Yoke
8. Work Platform
9. Cask Adapter for Contamination Barrier
10. Cask Handling and Decon Room
11. Cask Unloading Room
12. Operating Gallery
13. Utility Chase
14. Shield Doors
15. Monorail Crane

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Figure 2-2

The casks are removed from the vehicle and loaded onto cask carts. (Metal casks, which also serve as storage casks, are moved directly to the storage area after washing.) Casks are routed to the cask handling and decon room of the appropriate cells, as designated in Section 2.5.6.

In the cask handling and decon room, the casks are prepared for unloading. Preparations include gas sampling, gas pressure measurements, removal of the cask outer lid, external surface decontamination (if required), loosening of bolts on the cask's inner lid, and installation of a special adapter on the cask. The cask is then moved into the cask unloading room; final preparations are made for unloading into the shielded process cell.

In Shielded Process Cell 2 or 4, the spent fuel is inspected, identified, disassembled, consolidated, packaged in canisters, seal-welded, tested, and decontaminated. The canisters may then be stored in lag storage or offloaded directly into a sealed storage cask and transferred to the facility storage area. When required, spent-fuel assemblies may be packaged, sealed, tested, decontaminated, and stored without going through disassembly and consolidation.

In Shielded Canyon Cell 6, canisters of HLW and drums and canisters of future RHTRU are, if necessary, inspected, identified, overpacked, and stored in a lag storage pit in preparation for offloading. Otherwise, the canisters and drums are offloaded directly into a storage cask for transfer to the facililty storage area.

Both Shielded Process Cells 2 and 4 have facilities to reduce the volume of nonfuel-bearing components (such as grids and skeletons). Facilities are provided in the decon cell to supply clean drums and lids, and decontaminate and transfer drums full of shredded waste to Shielded Canyon Cell 6 for offloading to sealed storage casks or drywells.

The processing sequence of the repository overpack is as follows: The repository overpack is received in the incoming air-control vestibule via truck or railroad, cleaned (if necessary), and then moved to the east end of the receiving and inspection area. It is removed from the vehicle, placed on a dedicated cask cart, and transported into the canyon cell cask handling and decon room. The empty overpack is brought inside the east end of the shielded canyon cell, and placed into the welding/decon pit. Here, the repository overpack is loaded with spent-fuel or overpack canisters, welded, and decontaminated.

While the repository overpack is in the welding/decon pit, the cask cart has been loaded with a shipping cask and brought back to the handling and decon room. The repository overpack can now be lifted from the pit and placed into the shipping cask. The cask is sealed, decontaminated (if necessary), and surveyed for contamination. After being cleared, the cask is placed onto the transport vehicle and released.

Because of the vast differences in the processing sequences of shipping casks and repository overpacks, their descriptions are given separately. The spent fuel, HLW, and future RHTRU discussion follows immediately; repository overpack handling and processing are addressed in Sections 2.5.14 and 2.5.15.

2.5.2 SPENT FUEL, HLW, AND RHTRU DELIVERY

Spent-fuel assemblies, canisters of HLW, and/or drums and canisters of future RHTRU are loaded by commercial nuclear power plants into shipping casks that are transported either by rail or truck. The railcars or trucks are received at the MRS Facility, inspected, washed down (if necessary), and delivered to the receiving and inspection area (see Figure 2-2). The casks to be received are the NLI-1/2, the TN-125, and the transportable metal storage cask (the REA-2023). The rail casks (TN-125, REA-2023) are sized from 15 to 17 ft high by 8 ft dia. Loaded weight is up to 117 tons. The truck casks (NLI-1/2) are sized up to 16 ft high by 3 ft dia. Loaded weight is up to 38 tons. The payload varies from two PWRs or five BWRs per truck cask to 24 PWRs or 52 BWRs per rail cask.

In the receiving and inspection area, the railcars or trucks are parked opposite one of the eight cask handling and decon rooms. After visual inspection, including a seal-integrity check, transportable metal casks, which do not require unloading of their contents, are moved to an area where they are removed from the railcar, placed on a transporter, and moved to the storage area. Two sets of rails, recessed into the floor, extend the entire length of the receiving and inspection area. This arrangement can accommodate side-by-side parking of railcars or trucks. In accordance with the design capacity of 3,600 metric tons of uranium (MTU) per year, shipment of spent fuel and HLW to the R&H Building, it is expected that a total of six railcars and twelve trucks will be processed on any given day of operation. Of the six railcars delivered on any one day, four railcars are for repository overpack and the shipping casks for the repository overpack. The remaining two railcars are for spent-fuel casks to be unloaded. To achieve this process rate, the facility will operate 7 days/wk, 24 hr/day, all year around.

2.5.3 SHIPPING CASK AND VEHICLE WASHDOWN

The railcars or trailers loaded with the shipping casks are transferred from the Inspection Gatehouse (or lag storage area) to the incoming air-control vestibules by dedicated railcar movers or yard tractors. Once the railcars or trailers are brought into the incoming air-control vestibules, the car movers or yard tractors will immediately be released from the area. Fifth-wheel support dollies are provided to support and move the trailers. The railcar or trailer with the shipping cask is manually washed down, if necessary, by hand-held spray nozzles. Vinyl curtains are provided to prevent spraying of washing solution from one lane to another.

The shipping cask, together with the transport vehicle, is allowed to drip dry in the incoming air-control vestibules. Next, the transport vehicle is moved from the incoming air-control vestibules to the receiving and inspection area by a double-drum, reversible winch and rope-type car puller. The car puller is rated for 20,000-lb starting pull and 10,000-lb running pull at 22-fpm travel speed.

A local control console is provided to operate each car puller.

2.5.4 SPENT FUEL, HLW, AND RHTRU CASK UNLOADING FROM TRANSPORT VEHICLES

Unloading of the shipping casks from the road transport vehicles and transferring of the cask to the cask cart may be performed in two parallel operations. One operation prepares the cask cart to receive the shipping cask, while the other prepares the cask for unloading from the vehicle.

The cask cart is a 12-ft-wide by 18-ft-long, flatbed, motorized vehicle supported on twelve 14-in.-dia steel wheels, each wheel capable of supporting 15 tons. The cart is constructed of structural I-beams and flat plates, and is designed to carry loads up to 150 tons. The cart can be equipped with auxiliary adapters to mate with and support any of the reference casks, and to bring the top of each cask to the same elevation as the bottom of the contamination barrier at the closed position in the cask unloading room. Cart preparation includes the installation of the proper adapters, which are unique to each type of cask.

The cask to be unloaded is prepared by removing the personnel barriers, impact limiters, and cask restraints. A 40-ton mobile crane assists the removal and temporary staging of these articles. A 150-ton bridge crane, which can travel the full length of the receiving and inspection area, is fitted with the cask lifting yoke, and engages the lifting trunnions of the cask. The cask is lifted from the transport vehicle, transported, lowered, and positioned onto the cask cart with the appropriate adapter. The lifting yoke is removed. The loaded cart is then moved into the cask handling and decontamination room. (See Figure 2-2.)

Although the transportable metal cask may be unloaded at any of the four cells, it is normally expected to go directly to the storage area. To accomplish this, the rail transport vehicle, with the metal cask, moves to the receiving and inspection area of the R&H Building. Here, the cask is lifted from the vehicle by the 150-ton overhead bridge crane, then lowered onto a low-bed transporter, secured, and moved to the storage area.

The R&H Building receives, at a peak rate, 12 truck deliveries and 6 rail deliveries every day. To process these casks, two lifts per cask must be made (assuming that impact limiters, personnel barriers, and shipping restraints have been removed). This results in low crane usage (18 lifts per day); therefore, it was decided that a single crane in each receiving and handling area would be sufficient to support the required throughput rate.

The maximum identified load for this crane is the REA 2023 cask, loaded with consolidated fuel. Including the lifting yoke, the total weight of this load is 127 tons. Based on this, a rated capacity of 150 tons was selected for the crane. By stacking the vertical dimensions of a 150-ton crane, lifting yoke, cask, and required lift height, the bay height of 56 ft was established.

However, when this 150-ton bridge crane is out of service, a 40-ton mobile crane/transporter is provided to keep the R&H Building partially operating (processing truck deliveries only) until repairs to the bridge crane are completed. Rail shipments, which could not be handled by the mobile crane/transport vehicle, would be kept in rail lag storage until the bridge crane is repaired and ready for use. Under normal operating conditions, the bridge crane would still be used for handling all casks. The mobile crane/transport vehicle will be used to remove impact limiters, personnel barriers, and miscellaneous shipping restraints.

2.5.5 CASK PREPARATION FOR UNLOADING OF SPENT FUEL, HLW, AND RHTRU

A work platform and a 5-ton monorail hoist are provided in the cask handling and decontamination area. The platform enables personnel to gain access to the top of the cask. With a height lower than the cask, the platform has a hinged portion that swings up to accommodate passage of the cask.

The cask cart is positioned in the cask handling and decontamination areas. The hinged platform is lowered to form a walkway around the top of the cask. A contamination survey of the cask exterior is performed. If contamination is discovered above specified limits, the cask exterior is locally decontaminated. Gas samples and gas pressure readings are taken from the interior of the cask. Gas from the cask is vented through a controlled vent system to the HVAC system. The monorail hoist is used to install the contamination barrier adapter on top of the cask. The adapter is anchored to the cask lifting trunnions. The top of the adapter is a sealing surface that mates with the outer ring of the contamination barrier, compressing a gasket and thereby forming a seal between the shielded process cell and the cask handling and unloading room. With the adapter in place, the cask outer lid is removed by the monorail and set onto the platform.

Bolts on the cask inner lid are loosened; all but four bolts are removed and stored on the platform. The platform is then swung up to clear the cask. The cask is moved past a shielding door into the cask unloading room.

The preceding operations are normally "contact-handled" by personnel adequately suited in protective clothing. Beyond this point, the handling operations become remote.

The cask is positioned and locked within the "shadow-shield" below the entry port of the cell. The remotely operated contamination barrier is then lowered and mated to the barrier adapter already on the cask. The shadow-shield is lowered to completely enclose the top of the cask. The cask unloading room shield door is closed, thus completing the cask handling process.

2.5.6 UNLOADING OF SPENT FUEL, HLW, AND RHTRU

Transport vehicles go to one of the six cells, depending on the waste form to be processed. Normally, casks of PWR fuel go to Shielded Cells 1 and 3, casks of BWR fuel go to Shielded Cells 2 and 4, and casks of HLW canisters and future RHTRU drums and canisters go to Shielded Canyon Cell 5 or 6 directly. All four shielded cells (1 through 4) are capable of processing PWR or BWR fuel assemblies, if required, because each is individually equipped to unload and process PWR or BWR fuel assemblies.

Each entry port in Shielded Process Cells 1 through 4 has two shield plugs. The top plug, of steel, is 9 ft-5 in. dia. The lower plug, of lead, is 8 ft-2 in. dia. Plugs are split in two to keep the weight of each below 20 tons, which is the lifting capacity of the cell power mast crane. The plugs in Cells 5 and 6 are one piece because of the 35-ton capacity of the shielded canyon cell cranes.

To unload fuel assemblies from a cask, the shield plugs are raised and set aside by the power mast crane equipped with the appropriate lifting grapple (see Figures 2-2 and 2-3). The grapple on the end of the mast is replaced by the tool that unscrews the remaining four bolts on the inner lid. The lid is lifted by the same tool, and set aside on the cell floor. The bolt removal tool is replaced by the appropriate fuel assembly grapple which is unique to each assembly type. Closed-circuit television (CCTV) cameras and high-intensity lights mounted in the entry ports enhance visibility during fuel assembly transfer. The mast is programmed to position the grapple at any predetermined location within the cell or in the cask. Manual adjustment is also possible for fine positioning and manipulation.

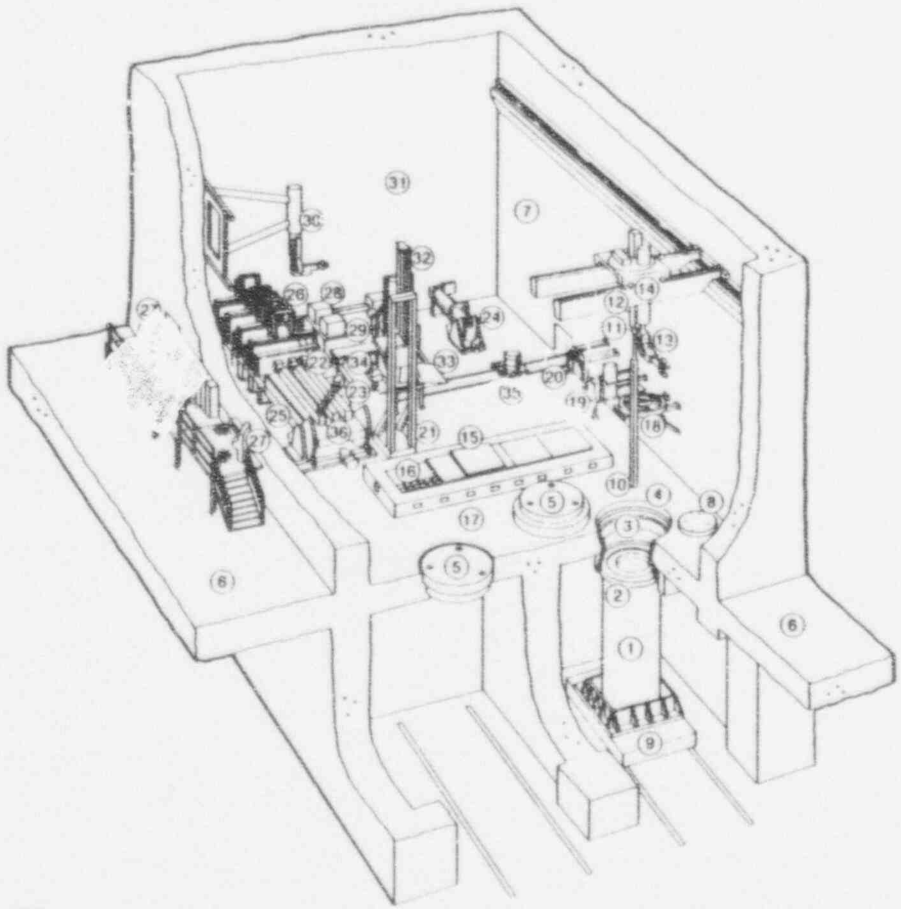
Each fuel assembly is removed from the cask, visually inspected for transportation damage, identified, and placed in the lag storage pit or on the disassembly equipment. Inventory procedures maintain data on all waste forms processed. The HLW canisters and future RHTRU drums are transferred to the discharge lag storage pits in a similar manner. Drums are transferred to this lag storage pit and placed in drum storage cages located in the east end of Shielded Canyon Cells 5 and 6.

The incoming lag storage pit is of modular design, with separate modules for PWR and BWR assemblies. Modules are interchangeable in the same pit space; therefore, pit space is adaptable to the storage requirements at hand: if more PWR assemblies have to be stored, more PWR modules are inserted into the pit. Maximum storage capacities are 180 PWR and 320 BWR assemblies (see Section 2.5.9 for the design details of the incoming lag storage).

Space in the discharge lag storage is permanently allocated as follows: twenty 83-gal drums; ten 26-in. canister overpacks; and nine 14-in. canister overpacks (see Section 2.5.9 for the design details of the discharge lag storage).

Monitored Retrievable Storage Facility Receiving and Handling Building

SPENT FUEL DISASSEMBLY AND CONSOLIDATION AREA



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1. Shipping Casks
2. Cask Adapter for Contamination Barrier
3. Contamination Barrier
4. Entry Port
5. Entry Port Shield Plugs
6. Operating Gallery
7. Shielded Process Cell #2
8. Shipping Cask Cover
9. Cask Cart
10. Spent Fuel Element
11. Spent Fuel Grapple
12. Power Mast
13. Manipulator
14. 20 Ton Hot Cell Crane
15. Lag Storage Covers
16. Lag Storage
17. Lag Storage Cooling Ducts
18. Port Grapple
19. Fuel Assembly and Pintle Grapples
20. Module Lifting Yokes
21. Laser Cutting System
22. Laser Cutting Head
23. Robotic (Auxiliary)
24. Intact Fuel Assembly Upender
25. Fuel Disassembly Station
26. Fuel Rod Consolidation Station
27. Process System Control Console
28. Maintenance Hatch Jacking Mechanism
29. Maintenance Hatch
30. Wall Mounted Manipulator
31. Shielded Process Cell Contamination Barrier
32. Secondary Waste Shredding System
33. Drum Lidding Station
34. Grid Infeed Chute
35. Drum/Filter Cart
36. Fuel Disassembly Module

Figure 2-3

2.5.7 SPENT FUEL, HLW, AND RHTRU PROCESSING

The shielded process cells and shielded canyon cells have four primary functions:

(1) To process BWR and PWR spent-fuel assemblies.

(2) To process HLW and future RHTRU drums and canisters.

(3) To process repository overpacks (see Sections 2.5.14 and 2.5.15).

(4) To store, in-house, 1,000 MTU of canisterized spent fuel.

The first primary function involves the disassembly, consolidation of fuel rods into bundles, packaging of the bundles in storage canisters, and volume reduction of the nonfuel-bearing components of the assembly. The fuel assemblies may also be packaged intact, bypassing the disassembly and consolidation operations.

The second primary function includes the transfer of canisters of HLW or future drums of RHTRU and canisters from the shipping casks directly into discharge lag storage or storage casks after the inspection and accounting procedures.

The four shielded process cells (1 through 4) and the decon cells may be set up to process either BWR or PWR fuel assemblies. For the conceptual design, Shielded Process Cells 1 and 3 are equipped to process PWR fuel and Shielded Process Cells 2 and 4 are equipped to process BWR fuel. The HLW canisters, future RHTRU drums and canisters, and overpack canisters are processed exclusively in the two shielded canyon cells. The shielded canyon cells are also equipped to accommodate overpacking of damaged containers, cutting of canisters, and repackaging of fuel rods. Drums of nonfuel-bearing components from the consolidation operations are processed in the decon cells.

The disassembly and consolidation equipment will accommodate any of the various PWR or BWR fuel assemblies. This equipment uses interchangeable modules dedicated to particular fuel assembly configurations. A full complement of these modules and tooling is stored in the maintenance area below the shielded process cells.

The consolidation equipment consists of three basic elements: the laser cutter for nozzle removal, the fuel disassembly system, and the consolidation system.

The laser cutter is composed of three subsystems: the laser generator system (LGS), the laser beam transport system (LBTS), and the laser focusing system (LFS).

The LBTS uses water-cooled mirrors, a hot cell window, a protective enclosure for the laser beam, and associated instrumentation to align and direct the laser beam from the LGS to the LFS. A 2-in.-dia laser beam from the LGS is transmitted through a 4-in.-dia, water-cooled, zinc selenide (ZnSe) window in the hot cell wall. The beam inside the hot cell is directed toward the LFS, which is completely enclosed in a rectangular duct. Clean nitrogen gas is forced through the duct to preclude particulate accumulation on the mirrors and prevent beam divergence caused by impurities in the beam transport environment.

The laser focusing system positions and focuses the laser beam. Ball-screw drives position movable tables along the three major axes. Four mirrors and two lenses receive, turn, and focus the beam on the workpiece. The LFS also has proximity sensors. The sensors measure the distance between the focusing mirror and the surface of the workpiece. Their signal, through feedback circuitry and control logic, controls the position of the focusing mirrors. This arrangement ensures that the focal point of the laser beam converges sharply on the workpieces. The final focusing mirror rotates 360 deg for internal tube cutting. External tube cutting is done in an analogous manner.

The spent-fuel disassembly equipment consists of three subsystems: a downender, the fuel assembly clamping module, and a dedicated robot. There is a specific clamping module for each type of PWR or BWR fuel assembly. The module positions and clamps a row of spent-fuel assemblies vertically. The downender rotates the loaded module to a horizontal position. Together, the module and downender provide the clamping and horizontal orientation necessary to extract fuel rods from the fuel assemblies.

The downender is a stainless steel box beam structure capable of accepting any of the various PWR/BWR clamping modules. Power, instrumentation, and control to the module are also provided. Rotation is accomplished through a sector gear and pinion-drive mechanism. A crud collection system envelopes the bottom of the downender.

The fuel assembly clamping module is a stainless steel box beam structure equipped with parallel rows of clamps, vertical combs, and horizontal combs on the front side of the housing. Locator pins and pneumatically actuated shot pins secure the module to the downender. Manifolds and instrument plugs on the downender mate with female ports and receptacles, respectively, on the module to provide power, instrumentation, and control. Lifting trunnions allow remote disassembly of the downender through the module lifting rig and the overhead crane in the shielded process cell.

The dedicated robot is mounted on a translational track and driven by a ball-screw drive. The robot removes the residual, nonfuel-bearing components. The disassembly of a 7 x 7 BWR fuel assembly requires the center rod to be rotated 45 deg to allow extraction. The rotation is accomplished through the revolution/pitch motions of the end-effector mechanism on the robot arm.

The consolidation system consists of gripper/carriage, horizontal and vertical combs, semicircular rod configuration structure, overhead dies, and strap lowering devices. The complete system provides extraction, lowering, reordering, and canistering of a consolidated bundle of fuel rods.

The carriage accepts any of the various PWR/BWR gripper modules for fuel rod extraction. It translates on guide rails driven by two ball-screw drives. A push mechanism at the rear of the carriage provides the final push of the consolidated fuel rods into a storage canister.

Three multiple grippers are mounted on a gripper module for PWR fuel rod extraction. The BWR extraction module contains seven multiple grippers. Grippers are pneumatically actuated and controlled through carriage manifolds.

Horizontal combs support extracted fuel rods to minimize deflection. The vertical combs also guide the rods while they are being lowered onto the strap lowering device.

Strap lowering devices provide insertion of fuel rods into the semicircular rod configuration structure for reordering/consolidation.

The final step in the rod reordering and consolidation process is to lower the overhead dies onto a fuel rod bundle to bring the bundle to a circular configuration.

2.5.7.A. PWR Fuel Processing

The PWR fuel assembly processing is primarily done in Shielded Process Cells 1 and 3. Here, the disassembly and consolidation equipment is fitted with the appropriate module and tooling for a PWR assembly before fuel assembly processing.

The power mast of the 20-ton hot cell crane transfers, in sequence, three PWR assemblies from the lag storage pit or directly from the shipping cask to the vertically oriented clamping module. The laser cutter is activated to remove the nozzle by cutting the guide tubes from the inside. The power mast removes the freed nozzle and deposits it into the shredder nozzle in-feed chute provided just for this purpose (nozzles are not shredded). The clamping module is then rotated to the horizontal position. Grippers securely grasp each fuel rod. All of the rods are then extracted simultaneously through the support grids until the rods have been separated from the grids. During extraction, the horizontal and vertical combs support the rods and maintain their arrangement. The disassembled fuel rods are then consolidated into a circular bundle, and pushed into a clean, empty canister. The nonfuel-bearing structure, which is secondary waste, is removed from the clamping module by the overhead crane and/or disassembly robot and deposited into the volume-reduction system skeleton in-feed chute on the shredder.

2.5.7.B. BWR Fuel Processing

The BWR fuel assembly processing is primarily done in Shielded Process Cells 2 and 4. Here, in preparation for processing, the disassembly and consolidation equipment is fitted with the appropriate modules and tooling for the BWR fuel assembly.

The power mast of the 20-ton hot cell crane transfers, in sequence, seven BWR assemblies from the lag storage pit or directly from the shipping cask to the vertically oriented clamping module. The laser cutter is activated to remove the nozzle by cutting, from the outside, the tie rods on the four sides of each assembly. When all seven upper nozzles are severed, the clamping module is rotated to the horizontal position. The dedicated robot removes each of the seven nozzles and deposits them in the shredder nozzle in-feed chute. The laser cutter is then positioned to cut the lower outer tie rods to remove the lower nozzle. Removal of the center rod requires that it be rotated 45 deg about its axis to disengage its locking detents from the grids. This is done by the dedicated robot. With the nozzles removed and the center rods rotated, the grippers grip each fuel rod and extract all rods through their support grids until the rods are completely separated from the grids. During extraction, the horizontal and vertical combs provide support to the rods and maintain their arrangement. Through a controlled process of removing the vertical and horizontal combs, the fuel rods are then consolidated into a circular bundle. A push mechanism then pushes the bundled rods into a clean storage canister similar to that used for PWR bundles.

The nonfuel-bearing components, which are secondary waste, are then removed from the clamping module and transferred to the volume-reduction system.

2.5.7.C. Intact Fuel Assembly Processing

The primary purpose of the R&H Building shielded process cells is to disassemble and consolidate spent-fuel assemblies. However, the cells are also equipped to handle intact fuel assemblies that will not be processed in the disassembly and consolidation station. The PWR or BWR intact fuel assemblies may be moved directly to the packaging stations in preparation for storage. Defective canisters (ones having defective welds) are unloaded, replaced with clean ones, and/or repaired instead of overpacked. This is accomplished by using the translational canister upender to move the defective canister to the cutting station. The cutting station is located adjacent to the ultrasonic test station. The defective welded end plate is removed by the cutter, and the canister is returned to the welding station for rewelding. Processing of the intact fuel assemblies or the canisters is accomplished with the intact and recovery upender.

The upender consists of a semicircular base and pneumatically actuated, hinged sides to form a cylindrical container when closed. A sector gear and pinion drive rotate the upender from the horizontal to the vertical position, or vice versa. A push mechanism, driven by ball-screws, is also provided for moving the processed material. Each of Shielded Process Cells 1 through 4 contains recovery upenders.

In operation, the upender is rotated to the vertical position, and the clamping module is opened. The power mast then transfers the fuel assemblies from lag storage to the clamping module. The module clamps the assemblies, and the upender is rotated to the horizontal position. The pushing mechanism then inserts the assemblies into a clean storage canister.

2.5.7.D. RHTRU and HLW Processing

The HLW canisters and future RHTRU drums and canisters are received and processed exclusively in Shielded Canyon Cells 5 and 6. HLW canisters are received at the repository overpack loadout ports in the east end of either Shielded Canyon Cell 5 or 6. They are lifted from the shipping cask and placed on the vertically oriented overpack upender. The package is downended, visually inspected, and then swiped. Undamaged canisters are decontaminated in the decon chamber, if determined necessary by the swipe, and then removed and checked again for contamination. Once the canisters are clean, they are upended, grappled by the 35-ton overhead crane, and placed into a storage cask, the transfer shield, or lag storage.

RHTRU drums are also inspected and decontaminated, but must be first loaded into drum cages located in the lag storage pits. They can then either remain there or be placed into a storage cask or the transfer shield. RHTRU canisters are processed in the same way as are the HLW canisters.

2.5.7.E. Overpack Operations

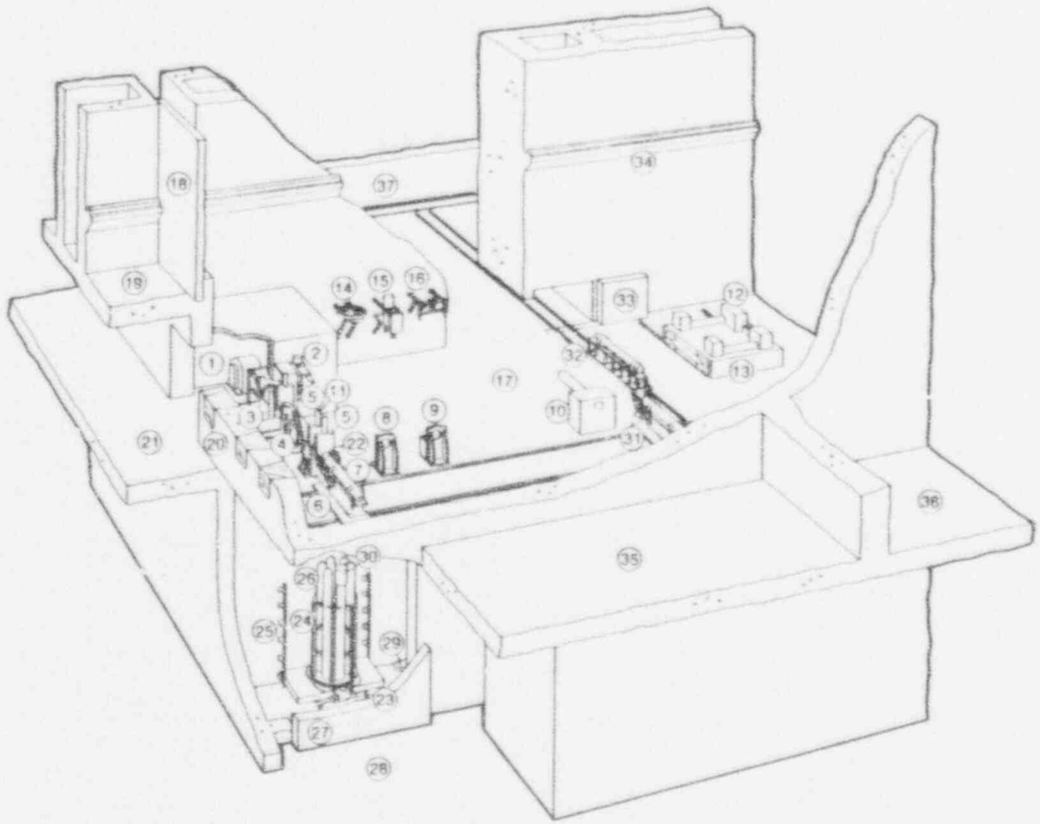
If a waste package (HLW, spent fuel, or other) is determined to need overpacking, the following operations will be performed. Using the overhead crane, the empty overpack canister is placed on the overpack upender, which has previously been rotated to its vertical position. The overpack updender is now downended and rotated so that its centerline is parallel with that of the welding station and the pintle end of the canister is facing the welder. The cart then translates along its rails until its centerline coincides with the welder centerline. The empty overpack is transferred into the welding machine. The upender moves away from the welder, rotates, and upends. The damaged canister is placed on the upender in a similar fashion, moved, and then transferred into the empty overpack already inside the welding machine. The filled overpack is transferred back to the upender, rotated 180 deg, and reinserted with the open end facing the welder. The overpack is now welded, decontaminated, and removed. As the package is removed from the welder, it is swiped and, if acceptable, placed into discharge lag storage, a storage cask, or the transfer shield.

2.5.8 STORAGE CANISTER SUPPLY, CANISTER UPENDERS, CANISTER LOADING, WELDING, TESTING, AND DECONTAMINATION

Shielded Canyon Cells 5 and 6, which service the four shielded consolidation cells (Shielded Cells 1 through 4), perform fuel rod packaging, seal welding, testing, and decontamination of storage canisters (see Figure 2-4). Similar operations are performed for overpacking canisters and drums. Also included are the shielded canyon cells in the storage vault and lag storage,

Monitored Retrievable Storage Facility Receiving and Handling Building

CANISTER LOADING AND WELDING AREA



1. Welding Power Generator/Equipment Room
2. Canister Lid Supply System
3. Canister Welding Station
4. Canister Decon/Helium Leak Test Chamber
5. Chamber Isolation Valves
6. Canister Upender No. 1
7. Storage Canister
8. Ultrasonic Test Station
9. Canister Cutting Station
10. Fuel Rod Bundle Push Rod System
11. Forge Press Restraint
12. Maintenance Hatch Jacking Mechanism
13. Maintenance Hatch
14. Plug Grapple
15. Pintle Grapple
16. Equipment Lifting Yoke
17. Shielded Canyon Cell #6
18. Maintenance Area Shield Door
19. Crane Maintenance Room
20. Observation Window
21. Operating Gallery
22. Clean Canister and Lid Supply Port
23. Carousel Lift Mechanism
24. Carousel Canister Rack
25. Guide Rail Lift Mechanism
26. Clean Canisters
27. Shield Door
28. Access Corridor
29. Lift Mechanism Hydraulic Pump System
30. Canister Lid Supply Support Tube
31. Canister Upender No. 2
32. Canister Pass-Thru Cart
33. Canister Pass-Thru Shield Door
34. 35 Ton Crane Rails
35. Shielded Process Cell #2
36. Decon Cell
37. Shielded Canyon Cell #5

Figure 2-4

offloading capabilities for all waste forms, and repository overpack processing capabilities. The major canister processing equipment includes the clean container and lid supply system, canister resistance welding system, canister upenders, canister pass-' rough cart, canister decon chamber, the canister cutting and ultrasonic test station, waste package storage, and the offloading ports (see Figures 2-4 and 2-6). Repository overpack processing is addressed in Sections 2.5.14 and 2.5.15.

2.5.8.A. Clean Canister and Lid System Supply

Both of the shielded canyon cells have clean canister and lid supply systems located in the western ends of the cells. In addition, each of the shielded canyon cells have canister overpack supply systems located in the eastern ends of the cells. The canister overpack supply system is of the same basic design as the clean canister supply system, except that these systems can accommodate a greater variety of sizes of containers.

The clean canister supply system consists of a carousel canister supply rack and a carousel lifting mechanism. The lifting mechanism is mounted permanently in a room below the cell. The carousel is a removable supply rack consisting of a base plate, central support tube, and side radial support arms with lifting trunnions and lateral canister support brackets. The rack can handle 12.75-in.-dia canisters, with their appropriate lids. For the canister overpack supply system, the rack can accommodate canisters from 12.75 to 26 in. dia and a specially designed cage to hold five 55-gal waste drums or a cage of 83-gal drums. Special lateral restraint brackets accommodate larger-diameter canisters when required.

The carousel lifting mechanism is a rotary table mounted on a scissors lift with its base bolted to the concrete floor (see Figure 2-4). Cam rollers on one end of the lift platform are attached to a pair of vertical guide channels on the cubicle walls. The guide channels provide lateral stability to the lifting mechanism. Guide pins on the top plate of the lifting mechanism are located to mate with the base-plate holes of the carousel supply rack. The pins position the supply carousel access port in the cell floor. A forklift truck, with custom-designed forks, loads and unloads the supply carousels.

2.5.8.B Canister Upenders and Carts

The spent-fuel canister upender is an electrically powered positioning cart for spent-fuel canisters. There are two rail-mounted spent-fuel canister upenders in each of the shielded canyon cells servicing the consolidation stations, canister welder, cutting, and UT stations.

The upender is constructed of tubular steel and has two major assemblies. The lower part of the unit is the support structure, which houses the drive packages that provide the canister upender with rotational and translational capabilities. The upper frame assembly has a bed of six pairs of canister transfer rollers, some of which are powered, mounted on a steel box structure. The box structure rotates azimuthally about a trunnion mount, which is powered by an electrical pinion and sector gear drive. The upper frame provides the translating, upending, and downending capabilities. Hold-down arms, mounted along the upper frame, are operated by linear actuators and serve to grasp the canister.

Another canister cart, located in the east end of the shielded canyon cells, is the overpack upender. It is situated on a set of rails and travels between the shielded canyon cells via a corridor similar to the travel of the pass-through cart. It is nearly identical in design to the spent-fuel upender, except that it possesses an additional capability. The overpacks, HLW, and future RHTRU canisters it will be handling are of different diameters. To enable these packages to be inserted into the welder concentric to it, the separation between the two sets of rollers is adjustable. On this upender, the upper structure is constructed in two halves, which ride on two linear bearings near the middle and wheels near the ends. The rollers are mounted on sections of tubular steel, whose distance apart is controlled by a ball-screw drive.

A third type of cart, called the canyon cell canister pass-through cart, is located in the west end of the shielded canyon cells. It is provided to transfer spent-fuel canisters between the shielded canyon cells if one of the welding stations malfunctions. If one fails, it is necessary to use the other welder to minimize throughput losses.

The pass-through cart is similar in design to the spent-fuel upender, although it is much less complicated. Because the spent-fuel upenders in each shielded canyon cell have rotational and upending capability, the pass-through cart has only powered transfer rollers and motivation capability.

When a spent-fuel canister is to be passed to the other cell, the spent-fuel canister upender is translated along its rails until its centerline coincides with that of the pass-through cart. The canister is transferred to the pass-through cart by use of the powered rollers. Once the canister is on the pass-through cart and secured by the hold-down clamps, the cart traverses the length of its rails through the corridor to the other shielded canyon cell. The other upender is oriented properly and aligned with the cart. Again the canister is transferred, using the rollers, and then secured on the second spent-fuel upender. The canister can now be rotated to the proper orientation and translated down to the welder. It is then welded, decontaminated, swiped, and carried away by the hot-cell crane for disposition.

2.5.8.C <u>Canister Loading</u>

The spent-fuel packaging process begins with the removal of the canister access port by use of the 35-ton power mast and the port grapple. The carousel is lifted and indexed to position a clean storage canister under the access port. Using a pintle grapple, the power mast engages the canister and transfers it to the upender. The canister upender, oriented in the vertical position with the hold-down arms in the open position, accepts the canister. The hold-down arms then actuate to retain the canister. With the pintle grapple removed and the power mast repositioned out of the way, the upender is rotated to the horizontal position, and then rotated 180 deg about its vertical axis. The upender is positioned along the guide rails so that the canister axial centerline coincides with that of the consolidated spent-fuel bundle retained in the spent-fuel consolidation station. With the alignment established, the transfer rollers move the canister axially toward the consolidation station until the canister's leading open end protrudes from the contamination barrier through an opening. The canister is locked into position with the seals closed from the opening around the canister.

With the bundled fuel rods and the empty canister aligned, the push mechanism on the consolidation equipment loads the rods into the clean storage canister. The loaded canister is retracted from the contamination barrier, rotated 180 deg, and positioned in alignment with the canister welding station. The chamber isolation valves are opened, and the canister is loaded onto the canister welding station for welding. The canister lid supply system transfers one lid to the canister welding station, and aligns it. The forge press backup plate, located just behind the canister, is lowered to capture the canister and lid between the forge press and the backup plate. The welding process can then begin.

2.5.8.D. Canister Welding System

The three canister welding systems in the two shielded canyon cells are essentially identical in design. The system located in the east end of Shielded Canyon Cell 6 differs from the two in the west end only in capacity to accommodate a wider range of canister and drum diameters.

The canister welding system is composed of three major pieces of equipment: the resistance welding system, the canister lid transfer and positioning system, and the canister air-lock tube.

The resistance welding system consists of a hydraulic forging ram, two copper electrodes, electrical bus bars, and associated power supply equipment. The hydraulic ram unit and its power supply are located in a shielded maintenance room adjacent to the cells. This room also stores the spare parts necessary for maintenance of the resistance welding system. The ram extends from the hydraulic cylinder through the wall of the maintenance room into the welding station. The end of the ram has a flat, circular electrode that mates with and provides current to the lid of the canister. Flexible copper straps connect the electrode to the copper bus bars. The bus bars run from the electrodes back to the power source. The other set of electrodes is connected to a chuck assembly, which, when closed about the canister, connects the electrodes to the outer surface of the canister. The chuck assembly is parallel to the forging ram, but separated from the ram by approximately 2 ft.

To accomplish the weld, the lid is pressed against the canister body by the hydraulic ram unit, and a high-current, low-voltage power pulse is imposed on the system. The electrical resistance at the interface between the lid and the body of the canister is sufficient to cause the metal to fuse momentarily while the axial force presses the parts together to complete the weld. This is the same process as a sheetmetal spot-weld; however, the electrical current and axial force requirements are greater because of the greater area being welded. Although obtaining the needed axial force is relatively easy, and the processes are well understood, power supplies capable of generating the short-time, high-current pulse of electricity are not well known. A 250-kVA "homo-polar" generator has been selected for this duty. At the outset of the welding cycle, the generator rotor must be at or above a critical velocity, which is based on the generator rotor diameter, the density of the excitation current field, the required duration of the power pulse, and the current flux density required in the weld. As the weld is being made, the rotor velocity decreases rapidly as its kinetic energy is transformed into electrical energy. There is no requirement for the generator rotor velocity between welding operations; therefore, because there is a long time between welding operations, a relatively small motor, between 50 and 75 he (approximately 65 kVA per generator), can be used to drive the homo-polar generator; bringing the rotor up to speed in time for the next weld is the only requirement. Because of the severe deceleration forces involved during the weld, the use of a hydraulic motor has been suggested.

The canister lid transfer and positioning system, which is mounted on the steel structure of the welding system, consists of a travel chute (through which the lids pass), two air-lock valves on the loading end of the chute, and a pneumatic lid-feed system.

In operation, a pneumatic cylinder pushes a lid from the container into the open end of the lid chute. Air-lock valves stop the lid at the top of the chute. The valves allow setting up the lid for welding without losing the argon environment of the welding system. Beyond the valves, the lid is gravity-fed through the chute until it reaches the chute bottom. The lid is then ready for welding.

The canister air-lock tube, which also doubles as the helium leak-test station and canister decontamination station, consists of a forge restraint, a heavy-walled cylinder, a chuck assembly, and two isolation valves mounted at both ends of the tube. The cylinder is fitted with valves, piping, and tubing that provide control and connections to the Freon decontamination system, inert gas supply, helium test equipment, and gas purging system. When a canister is inserted into the welding system, the chuck grips and securely holds the canister. The chuck also centers the canister and prevents its movement during the forging stage of welding. The heavy-walled cylinder connects the forge restraint to the primary barrier wall, and provides two functions: to maintain alignment of the centerlines of the chuck assembly and the forging ram, and to prevent the deflection of the forge restraint during forging. The heavy-walled cylinder is a two-piece, modular component.

With the canister in place in the air-lock tube and the isolation valves closed, the air is evacuated from the air-lock tube and backfilled with an argon-helium gas mixture. The inboard valve is opened and the canister is moved into the weld chamber for welding.

At the end of the welding cycle, the canister is retracted into the air-lock tube, and the isolation valve is closed. The argon-helium mixture is evacuated, and the canister is sprayed and the air-lock tube flooded with Freon for decontamination. After decontamination, the air-lock tube is evacuated and a helium leak test is performed. After the leak test, the canister is removed from the air-lock tube and moved to the ultrasonic test station.

2.5.8.E. Ultrasonic Test Station

In addition to the helium leak tests, an ultrasonic test of the canister weld is required to verify structural integrity of the weld.

The test equipment is mounted on a fixture adjacent to the upender rails next to the welder located in the west ends of Shielded Canyon Cells 5 and 6. It is mounted so that, when the upender moves to the test equipment, the axial centerline of the canister aligns with that of the test equipment.

The ultrasonic test equipment is a single unit assembly consisting of dual headstocks for the transducer and couplant packages. One of the headstocks is stationary, the other is rotating. The transducer and couplant applicator are mounted onto the rotating headstock. The couplant is pumped and deposited onto the canister end cap, and the transducer package performs the volumetric inspection. Power is supplied to the applicator pump and transducer package by a circular copper bus bar. The operation is fully automatic. The test equipment is periodically calibrated with standard test pieces.

In operation, the canister is loaded onto the upender from the welding system. The upender is moved on rails to align with the ultrasonic test fixture. The canister hold-downs are released, and the canister is moved into the test fixture by the power rollers on the upender. After testing, the canister is retracted onto the upender, positioned, and locked in place. The upender then rotates to the vertical position. The canister is removed by the power mast and pintle grapple, and moved to the in-building lag storage, storage cask, or transfer shield.

2.5.8.F. Canister Cutting Station

In case of an unacceptable weld on the storage canister, three canister cutters are provided in the facility; one in Shielded Canyon Cell 5, and two in Shielded Canyon Cell 6. The cutters in the west ends of Shielded Canyon Cells 5 and 6 are sized for spent fuel canisters only, while the third in the east end of Shielded Canyon Cell 6 can accommodate different overpack canister sizes. The canister cutting station is mounted on a fixture adjacent to the upender rails so that the axial centerline of the canister aligns with that of the cutting fixture.

The canister cutting station is a single-unit, fully automatic pipe lathe. The unit is an off-the-shelf item adapted for remote cell operation. It consists of two cylindrical headstocks: one stationary and one rotating.

The stationary headstock contains four electrically actuated clamping feet, which center the unit about the pipe. The rotating headstock contains the carbide cutting heads. The cutting-head blades are incrementally fed into the canister wall by a certain radial distance per revolution. Feeding is done by a ramp and cam follower assembly. At each revolution, the cam follower strikes the ramp and partially rotates; this action opens a small valve on the pneumatic feed line from the supply side to the blade-holding module. The resulting burst of pressure moves the blade a little farther. The rotating headstock rides on six 45-deg-inclined cam rollers, and is powered by an electric motor. The drive gear is on the backside of the rotating headstock. Blade speed and feed rate are adjustable.

In operation, the defective canister is moved to the canister cutting station by the upender. The upender is positioned so that the axial centerline of the canister aligns with that of the canister cutting station. The canister hold-downs are released, and the canister is moved into the cutting fixture by the power rollers on the upender.

After the cutting operation, the canister is retracted from the canister cutting station back into the upender, and locked. The canister is then moved to the air lock of the resistance welding system, and the welding process is repeated. The cap that was cut off the canister falls into a receptacle for processing later.

2.5.9 IN-PROCESS LAG STORAGE

There are two lag storages - the incoming lag storage and the discharge lag storage. The incoming lag storage provides temporary storage for the PWR and BWR fuel assemblies waiting to be processed. The discharge lag storage stores drum and canister overpacks before their shipment.

The incoming lag storage is of modular construction, with separate modules for PWRs and BWRs.

A module is constructed of angles and sheet metal welded into a matrix-like structure to accept 9 PWRs in a PWR module and 16 BWRs in a BWR module. Both modules are square, with equal widths, so either one can be fitted in the same space in the lag storage pit. Therefore, to get more PWR storage space, more PWR modules can be lowered into the pit. The maximum number of PWRs that can be stored in the pit are 180; maximum BWR capacity is 320.

Leaf springs are welded near the top of each module to fit the module snugly in the pit. The springs press against the pit walls and the channels separating adjacent modules. For safety considerations, a module does not hang from the top, but rests at the bottom. Under the module is welded a large-diameter pipe to which is welded a flange. The flange provides the bearing surface for the module to rest on. The flange rests on a machined support pad which has two parts. The first part is welded to the steel liner of the pit's floor. The second part is welded to the first, but after the following adjustment: the second part has an adjustable shoulder on which rests the pipe flange. The level of the shoulder is adjusted to ensure uniform mating with the flange. Then the second part is welded to the first. Around the horizontal shoulder, at a dimension equal to the inner diameter of the flange, is a wall that prevents the module from dislodging off the support pad. The leaf springs at the top and the support at the bottom ensure the module is secure in the pit.

Vent holes are drilled in the module's supporting pipe for cool air to cool the assemblies. Cooling is effected by natural convection. The cool air enters the pit through ten 12-in.-dia downcomers along one side and at either end of the pit. An equal number of exits are provided for the heated air along the opposite side of the pit. This complete separation of entries and exits prevents the heated air from recycling back into the pit through the downcomers.

The lag storage pit is covered on top by steel lids. The lids have lifting lugs sized to fit a port plug grapple for the overhead crane. The lid level is raised from the rest of the cell floor by a curb. Built into the sides of the curb are openings for the air downcomers and exits which are covered by protective screens. Also, the bottoms of the openings are raised a few inches from the floor to prevent the decontamination liquids accumulated on the process cell floor from spilling into the air passages.

The discharge lag storage is required to store the drum cage support apparatus with five loaded drums; the 14-in.-dia canister overpack; and the 26-in.-dia canister overpack. The weight of this equipment warrants thicker walls for the storage cells. A more predictable material flow eliminates the need for a modular concept of storage; therefore, space in the pit is permanently dedicated to one or the other of the above three items. The discharge lag storage accommodates four drum cages, nine 14-in.-dia overpacks, and ten 26-in.-dia overpacks.

To ease decontamination of the storage pit, the storage cells are removable in conveniently sized modules. The entire drum cage cell arrangement, along with its tubular support table at the bottom, is one module. The second module is four of the 26-in.-dia overpack cells; there are two of these modules with a total of eight 26-in.-dia storage cells. The third module is two of the 26-in.-dia overpack cells. The fourth module is three of the 14-in.-dia overpack cells; there are three such modules with a total of nine 14-in.-dia cells. The fifth module (the final one) is the tubular support table for all of the 9-, 14-, and 26-in.-dia overpacks.

As in the incoming lag storage, cooling of the drums and overpacks is effected by natural convection. There are four 12-in.-dia cool-air downcomers along each length of the storage pit, and two hot-air vents along the entire widths of the pit. Air inlets and outlets are covered by screens and raised from the cell floor level to prevent cell decontamination liquids from flowing into the pit.

A curb, elevated from the cell floor, is built around the pit; air inlets and exits are built into the walls of the curb. On top of the curb sit the lids that cover the pit. The covers have lifting lugs on them to provide a three-point lift for each cover section (there are two sections) and the lugs are configured to interface with the grapple of the port plug.

2.5.10 SHIELDED CANYON CELL LAG STORAGE VAULTS

The in-cell lag storage vaults in Shielded Canyon Cells 5 and 6 provide storage of the spent-fuel canisters.

A total of six storage vaults are in the shielded canyon cells. Each of five vaults has eight compartments, and each compartment can store 16 canisters. The sixth vault has seven compartments, and each of six compartments can store 16 canisters, whereas the seventh compartment can store 12 canisters. Thus, the total storage capacity of the shielded canyon cells is 748 canisters (approximately 1,000 MTU) of spent fuel.

The storage vaults are divided into compartments, and each compartment is provided with its own air supply plenum to ensure a sufficient amount of air flow around the canisters to remove the heat generated by the spent fuel in the canisters. The supply plenums are located at the bottom and the exhaust ducts at the top of the storage vaults for proper air flow and natural convection of heat from the canisters to the air. Each compartment is equipped with a rack system that supports the canisters at the bottom and guides them at the top to facilitate storage and retrieval.

The top of the storage vaults is covered with a concrete floor with holes on 3-ft centers. Each hole has a removable shielding plug with the lifting pintle identical to the one on the canisters. The centerlines of the holes and the rack storage matrix spaces are concentric to facilitate storage and retrieval of canisters.

The 35-ton shielded canyon cell crane with spent-fuel canister pintle grapple is used to lift the shielding plug of a storage space, and the plug is set aside on the cell floor between the storage spaces. The 35-ton crane with the same pintle grapple is then moved to the canister upender, which has already tilted a loaded spent-fuel canister to the vertical position. The 35-ton crane with pintle grapple picks up the loaded canister, moves it directly over the storage space (with shielded plug already removed), and lowers it into the rack through the hole in the concrete floor. Once the canister is fully supported at the bottom by rack, the pintle grapple is disengaged from the canister and retrieved from the hole. Next, the 35-ton crane picks up the shielding plug (that was set aside), and installs it over the hole; the pintle grapple is then disengaged.

2.5.11 PNEUMATIC TRANSFER SYSTEM

The pneumatic transfer system provides a safe, fast, and reliable means of transporting swipe samples from the shielded canyon cells and decon cells to the analytical laboratory for determining any presence of radioactive contamination deposited on the samples.

At the west end of each of the two shielded canyon cells at the second floor level is a sender/receiver terminal within the working range of the master/slave manipulator, which also performs the swipe tests. An exact duplicate of this system is located at the canister overpack weld station at the east end of Shielded Canyon Cell 6. In addition, two sender/receiver terminals are located in the two decon cell drum swipe locations. A separate length of stainless steel tubing connects each of the hot cell terminals to an opposite terminal. A total of five opposite terminals are located in a shielded glove box in the analytical laboratory.

The motivating gas used for this pneumatic transfer system is moisture-free, oil-free, compressed air supplied by the instrument air system at 100 psig and -40°F dewpoint. The pressure differential across the rabbit is 5 to 10 psi.

The swipe sample(s) is contained in a glass vial, then inserted into a polyethylene capsule carrier, which is held by a capper/decapper. The capper/decapper is a device provided for each terminal in the hot cells to facilitate pressing the cap onto or prying the cap off of the capsule carrier while held in the vertical position, with the aid of one manipulator only.

A 2-in.-ID transmission tube is considered adequate for this system, based on a glass vial size not exceeding 1-1/8 in. OD and 3-3/4 in. length, with a capacity of one or more swipe samples each, and a standard capsule carrier size of 1-7/8 in. dia by 4-3/8 in. length, overall dimensions.

The transmission tube is routed to the areas where operating personnel are not permitted to enter without supervisory controls to prevent exposure to high radiation dose rates. The transmission tube routed to the uncontrolled, contingent, and general operating area is shielded to reduce the radiation dose rates to ALARA levels.

When the loaded capsule carrier is ready for transfer, after the end cap is closed, the sending terminal is opened. Then the carrier capsule is placed in position, and the sending terminal is closed. These operations are done with the use of the remote manipulator in any of the hot cells, or through leaded gloves in the laboratory shielded glove box.

Movement of the capsule is initiated by the sending terminal. Safety interlocks are included so the transfer may take place only if both doors of the sending and receiving terminals of the same transmission tubing system are closed, and no capsule is present in the receiving terminal. Pressing the SEND button actuates both the air cushion/control valve at the receiving terminal to open to the vent line and the air cushion/control valve at the sending terminal to open to the compressed air line, thereby causing the motive air to push the carrier up and through the transmission tubing, and down to the opposite receiving terminal. The arrival of the carrier actuates the air cushion/control valve at the loading end to shut off the motive air flow and to vent the system to HVAC. At the same time, appropriate indicator lights are activated so that the carrier may be safely removed by the operator at the receiving terminal.

The control panel at each terminal includes manual ON and emergency STOP pushbuttons to control power to the system, a CLEAR light to indicate when the system is ready for transfer, and an IN TRANSIT light, which remains lighted when a carrier transfer is in progress.

Normally, after the removal of the glass vial with sample(s), the capsule carrier is loaded with a clean or new empty vial within the shielded glove box in the analytical laboratory. On the return trip of the capsule carrier, the glove-box terminal becomes the sender and the hot-cell terminal becomes the receiver. Each terminal, therefore, may function as either sender or receiver for the same two-way transmission tubing.

To facilitate better coordination between the hot cells and the laboratory, a communication system is integrated with the pneumatic transfer system.

In case a capsule carrier is wedged in the transmission tubing, the capsule carrier can be recovered at the sending terminal by increasing the pressure at the receiving terminal (5 psi higher than that of the sending terminal) through the pressure regulating valve. If the first attempt fails, the pressure is increased further by increments of 5 psi up to five times before the 40-psi blowoff pressure is reached. The recovered capsule carrier is then replaced with another that is not similarly worn out, and the operating pressures are readjusted to normal.

2.5.12 NONFUEL-BEARING COMPONENTS VOLUME-REDUCTION AND DRUM HANDLING SYSTEM

The disassembly of spent-fuel assemblies and the consolidation of fuel rods leave behind nonfuel-bearing components (such as nozzles, grids, and guide tubes), which require volume reduction for ease of handling. These components are packed into waste drums, decontaminated, and transferred to the shielded canyon cells for storage. This is done by the nonfuel-bearing components volume-reduction and drum handling system. (see Figure 2-5.)

The volume-reduction system consists of the following 10 subsystems:

(1) Clean Drum Elevator - A hydraulic vertical elevator to lift an empty drum and lid. The elevator structural frame is bolted to the concrete wall and in the recessed ceiling. The elevator lifts one drum at a time from the staging platform up through the ceiling and shield valve, 28 ft-5 in., for access to the decon cell.

(2) Drum Push Mechanism - A pneumatically actuated clean drum transfer mechanism. It is used to move a clean drum horizontally off the elevator platform and into a guidance cage. The push mechanism also advances all of the drums contained within the guidance cage.

(3) Shield Valve - A motor-driven, split-gate mounted on rails. It is used to shield an operator loading a clean drum onto the elevator before it is raised into the decon cell.

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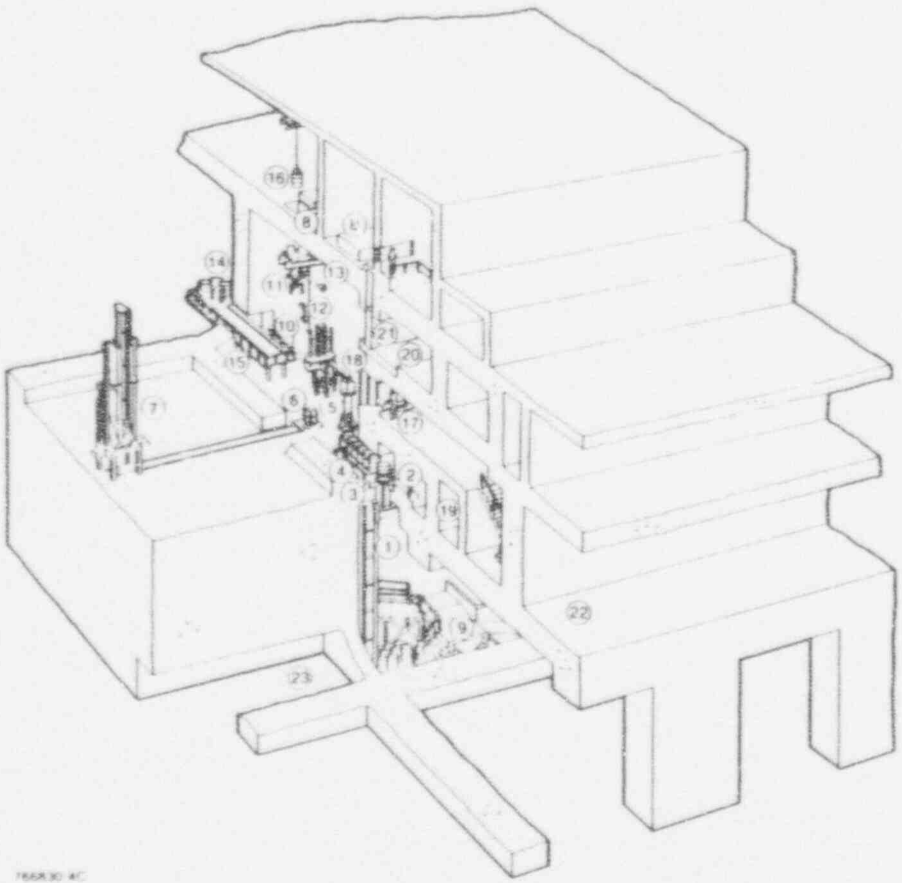
SECONDARY WASTE PROCESSING AND DECON SYSTEM



1. Clean Drum Elevator
2. Drum Push Mechanism
3. Shield Valve
4. Drum Guidance System
5. Jib Crane w/Drum Grapple
6. Drum Transfer Cart
7. Secondary Waste Shredding System
8. Maintenance Hatch
9. Ramp
10. Drum Decontamination Station
11. Drum Grapple w/Decontam. Station Lid
12. Drum Swipe Arm
13. Overhead Crane w/Manipulator
14. Filled Drum Transfer Cart
15. Filled Drum Transfer Platform
16. HVAC Filter Drum
17. Secondary Waste Processing and Decon System Control Station
18. Observation Window
19. Airlock
20. Crane Maintenance Room
21. Crane Maintenance Shield Door
22. Operating Gallery
23. Clean Drum Storage

Figure 2-5

(4) Secondary Waste Jib Crane - A motor-driven, rotary jib crane with a motor-driven drum grapple attachment on the boom end. The jib crane, with grapple attachments, services the drum guidance system and transfer carts. A clean drum is grappled, raised, and rotated to a transfer cart. The grapple assembly is lowered and raised by a guided, motor-driven linear actuator. The three-point grapple arms are also actuated by a motor-driven linear actuator.

(5) Secondary Waste Drum Slide and Guidance System - A stationary cage structure and drum separator mechanism. It guides and positions six 55-gal drums during clean drum introduction into the decon cell. The clean drums are advanced via the drum push mechanism and into the guidance system. Two drum separators, pneumatically actuated, position the outermost drum to be picked up and loaded onto a drum cart.

(6) Secondary Waste Drum Transfer Cart - A motor-driven cart, mounted on rails. It is used to transfer both empty and filled drums between the decon cell and the shielded process cell. The drum transfer cart also transfers a filter box between the decon cell and the shielded process cell. Four two-position posts accommodate either a drum or filter box. The cart will be positioned and remain in parked position at the shredding station in the shielded process cell.

(7) Secondary Waste Shredder System - A dual-motor-driven, low-speed, rotary shredder with material flow hoppers at in-feed and out-feed locations. It has a cylindrical skeleton in-feed chute with upper lid, sliding door, and grid in-feed chute from the upper hopper assembly. A lower out-feed chute and nozzle in-feed chute form the lower hopper. The lower hopper seals with the drum while material is being processed. A drum lidding station, motor-actuated, lid-crimping system is supported from the shredding structure. The drum lidding station is positioned in line with the drum cart.

(8) Secondary Waste Drum Decontamination System - A stainless steel chamber and integral grapple mechanism in which nonfuel-bearing drums are decontaminated. The decon station is located near the wall at the opposite end of the decon cell from the clean drum elevator. The chamber is composed of two parts - a vertical, cylindrical stainless steel shell and a combination lid/grapple. The grapple was designed so that it could be decontaminated along with the drum; in this way, a newly decontaminated drum will never be handled by a contaminated grapple. The lid has a gasket around its periphery that seals against the flange welded to the top of the shell. The bottom of the chamber is a standard elliptical head with a drainpipe welded to the center. The head shape provides for natural drainage. The interface between the head and the shell is also flanged. Inside the shell, there is a spray ring at each of two different elevations. Nozzles on each are pointed radially inward at varying angles. They are pointed downward so that all decon fluid and contamination will be washed off the top and down the sides to the floor drain. At the

bottom are four upward-pointing spray heads, which clean the bottom surface of the drum.

(9) Swipe Arm Assembly - An articulated arm that is used to swipe decontaminated nonfuel-bearing drums. This arm is bolted to the wall and is situated so that it can reach the centerline of the drum as it is removed from the decon chamber. Out from the support attachment is an elbow joint. The arm bends at the elbow joint to either extend toward the drum or retract to deposit the swipe into the rabbit. Near the end of the arm is a rotary joint to enable swiping of either vertical or horizontal surfaces of the drum. The actual swipe is held by a pinching-type mechanism that is operated by a linear actuator.

(10) Secondary Waste Filled Drum Transfer System - A drum transfer cart, traveling on an elevated platform, which transports filled drums into the shielded canyon cells. The platform begins in the middle of the decon cell, continues through a penetration in the wall, and is cantilevered into the shielded canyon cell above the spent-fuel upender rails. The transfer cart is a two-piece mechanism. The lower portion is a simple, square, all-welded box beam structure with two axles. The front axle is freewheeling while an integral motor/cable reel and brake assembly drives the other axle, and provides the motivation to the cart. The top portion is a removable circular pallet with space for five drums. This is the same number of drums required to fill a drum cage. The pallet is removable so that the shielded canyon cell crane is able to take all five drums to the lag storage area at the same time. The pallet connection is a breechlock, which is the same as all of the other connections to the overhead cranes.

Each of Shielded Process Cells 1 through 4 is equipped with a motor-driven, rotary shredder, which is located near the spent-fuel consolidation system. The fuel assembly skeletons are fed into the shredder through the vertical skeleton in-feed chute. Grids are fed into a tapered box on the front face of the upper hopper. Nozzles are fed into a tapered box below the shredder cutting chamber on the lower hopper. An empty drum is raised to seal against the lower hopper while materials are being processed.

A clean drum is loaded onto the elevator below the decon cell and then the operator exits. The shield valve in the decon cell floor is opened. The drum is elevated to the top of the shield valve. The drum push mechanism advances both the elevated drum and the five drums in the drum guidance system. The outermost drum is separated from the other drums by two pneumatically actuated pads. The jib crane and grapple attachment grip, raise, and transfer a clean drum onto a transfer cart. The cart and drum move into the shielded process cell to the shredding station. The contamination barrier door, located between the decon and process cells, is closed behind the cart after it passes to reduce contamination of the decon cell. The cart stops at the lidding station, where the drum lid is removed and held by the lid crimper. The cart and drum move below the shredder, and the drum is elevated to seal against the out-feed hopper. Once filled, the transfer cart moves under the lidding station, where the lid is crimped onto the drum.

The loaded waste drum is transferred from the shredding station to the decon cell by the drum transfer cart. The drum is lifted from the transfer cart, and placed on the decon cell floor. A total of five drums are processed in this same manner. Simultaneously, the drum transfer cart is moved to the end of the drum transfer platform in the decon cell. The overhead crane, fitted with the special drum lid/grapple, picks up one drum and moves it directly over the decon station. The drum is lowered into the decon station until the lid/grapple seats on top of the decon chamber. The drum is cleaned with Freon jets, and then dried with compressed air. The drum is raised into position for swiping, and the swipe arm is extended from the wall, at which time the surface of the drum is swiped. The swipe arm swings over to the wall, and deposits swipe in the rabbit, which is carried through the pneumatic tube system. The drum is placed into an unoccupied position on the pallet on the cart. This procedure is repeated until the cart has a full complement of five drums. The shield door to the shielded canyon cell is opened, and the cart moves the length of the platform into the shielded canyon cell. The 35-ton bridge crane lifts the pallet from the cart, carries it to the lag storage area, and places it on the floor. The filled pallet is released, and a second pallet is returned to the transfer cart. The cart moves back to the decon cell, and the shield door is closed.

2.5.13 CELL PORT PLUGS, HATCHES, AND JACKING MECHANISM

A plug reduces the gamma radiation and neutron flux to within acceptable levels (as specified in 10 CFR 20 and DOE Order 5480.1A) on the atmospheric side of the port. Furthermore, the plug seals the port so a slightly less-than-atmospheric pressure may be maintained inside the cell.

The plug consists of two layers of materials: the neutron shield and the gamma-radiation shield. The layers may be sandwiched together in a one-piece plug or split into a two-piece plug to bring each piece within the overhead crane capacity. An example of a two-piece plug is the intake port plug; an example of a one-piece plug is the repository overpack port plug.

The neutron shield is a layer of plastic (NS-3 manufactured by Bisco Products). The plastic is fire-retardant; it is procured as a pumpable thixotropic mixture, and poured in to conform to the size and shape of the plug. The initial set to a tough, nonflexible solid occurs within 24 hr; total cure is achieved in 28 days. The hydrogen content of the plastic is in the neighborhood of 5.41 E+22 atoms/cc (5.1% by weight). The plastic may also be impregnated with lead and boron fillers to enhance gamma and thermal neutron attenuation. The thickness of the plastic is sufficient to replace the neutron-attenuating properties of concrete.

The gamma shield is a layer of cast-carbon steel in one-piece plugs and a lead-and-steel combination in two-piece plugs. The thickness of this shield is sufficient to replace the gamma-attenuating properties of concrete.

For two-piece plugs, the top plug is provided with pads. The bottom plug is then placed on top of it.

The plastic layer is covered by a cover extending beyond the main body of the plug. This cover prevents the accumulation of crud in the annular gap between the plug and its seat in the concrete floor.

Each plug is coated with a zinc-impregnated epoxy to prevent rusting.

2.5.13.A <u>Maintenance Hatch</u>

A maintenance hatch plugs the port through which equipment is transferred between the maintenance cell and the shielded process cell. The hatch has been sized to allow the largest anticipated piece of equipment to pass through. The resulting size of the hatch makes it too big and heavy for the overhead cranes to handle. A dedicated jacking mechanism is, therefore, required to lift them, and to transport them out of the way of their seat in the concrete floor (see Section 2.5.13.B for the jacking mechanism). When in place, the hatch must perform the following functions: (1) reduce the gamma radiation and neutron flux to acceptable levels on its atmospheric side (these levels are specified in 10 CFR 20 and DOE Order 5480.1A.); (2) provide a contamination barrier between the shielded process cell and the maintenance cell below.

Functions 1 and 2 above are achieved in the same way as is done by the the repository overpack port plug (refer to Section 2.5.13 for the port plugs). Like the port plugs, the hatch has a cover around its top to cover the gap between the hatch and its hole in the concrete to prevent crud buildup.

2.5.13.B. <u>Jacking Mechanism</u>

The outloading port plugs and the maintenance hatches are too heavy for the overhead crane to lift; therefore, a dedicated jacking mechanism is provided to handle these. The jacking mechanism raises the plug or hatch, moves it to one side to clear the port, then carries it back over the port, and lowers it back into place. The jacking mechanism for a plug has three jacks; the jacking mechanism for the hatches has four jacks. The basic construction and operation of both the hatch and the plug jacking mechanisms are the same.

A jacking mechanism consists of a welded-steel structure supported by four wheels, riding on rails. Two of the wheels are precision wheels riding on precision rails, whereas the other two are flat followers on flat rails. One of the precision wheels is powered by an electric motor and gear reduction system to effect the horizontal translation of the plug. Vertical lifting of the plug is achieved by jacks, mounted on platforms on top of the steel frame, and connected together by shafting and U-joints. The jacks are powered by a single motor and reduction system.

In operation, the jacks lift the hatch or plug; then the motor connected to the precision wheel activates, and pulls the plug away from the port to the parking position, thus clearing the port for access. In their parking position, the jacks may either lower the plug or keep it suspended (the jacks are of the machine-screw type). Mechanical stops on the rails prevent the mechanism from rolling too far; also, limit switches, integral with the jacks, establish the limits of up and down travel of the plug.

All equipment on the jacking mechanism is covered by sheetmetal covers to reduce contamination by crud, and ease decontamination operations later.

Finally, the jacking mechanism is coated with zinc-impregnated epoxy to prevent rusting.

2.5.14 REPOSITORY OVERPACK HANDLING AND UNLOADING

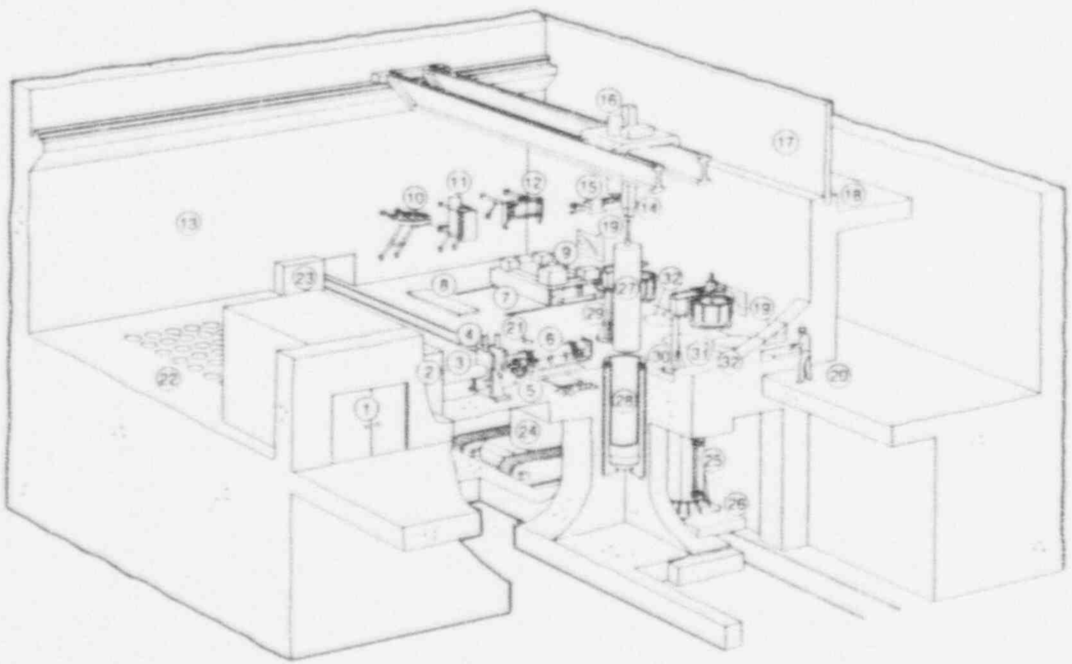
The third primary purpose of the shielded process cells is to handle, load, seal-weld, and ship offsite waste forms in a repository package. This package is to be subsequently placed in a permanent geological repository location. The repository overpack is processed in the east ends of the two shielded canyon cells (5 and 6). The repository overpack has been designed to handle spent-fuel canisters, overpacked spent-fuel canisters, high-level waste canisters, and secondary waste drums (see Figure 2-6).

The repository overpack arrives at the R&H Building as an empty single unit with a loose, weldable lid. The overpack is delivered via a truck or railcar. The overpack is passed through the vehicle washdown area, and enters the receiving and handling area by use of the same procedures as those for the spent-fuel casks specifically defined in Sections 2.5.2 through 2.5.4. The repository overpack is prepared by removing the impact limiters and overpack restraints. The 40-ton mobile crane or the 150-ton bridge crane is used to lift and position the repository overpack cask adapter on one of the dedicated cask carts used to service the shielded canyon cells (5 or 6). The cask adapter is, in turn, bolted to the cask cart, and the cask adapter doors are opened to receive the empty repository overpack. The cask adapter yoke is replaced with the repository overpack lifting yoke, and the repository overpack is transferred to the cask cart. The repository overpack is placed into the cask adapter, in a vertical position, through the open adapter doors because of crane height restrictions. Once the overpack is positioned, the crane disengages the overpack; the operator manually closes the adapter doors, and locks them via a base-mounted lock lever. Once the cask cart is inspected and the radiation survey has been completed, the vehicle is released from the R&H Building.

The repository overpack and cask cart are moved to the shielded canyon cell cask handling and decon room. The decon room monorail crane is used to load and install the repository overpack contamination control adapter to the repository overpack cask adapter. The crane disengages the control adapter, and the operator locks the control adapter to the cask adapter, using a series of toggle locks. All mating joints or interfaces on the repository overpack cask adapter and contamination control adapter have compliant seals to ensure an air-sealed enclosure. This sealed enclosure reduces airborne contamination during the transfer of the repository overpack to the shielded canyon cell.

Monitored Retrievable Storage Facility Receiving and Handling Building

CANISTER OVERPACK AND REPOSITORY OVERPACK WELDING SYSTEMS



1. Welding Generator/Equipment Room
2. Canister Welding Station
3. Canister Decon/Helium Leak Test Chamber
4. Chamber Isolation Valves
5. Canister Upender
6. Storage Canister
7. Exit Port
8. Lag Storage Cover
9. Exit Port Jacking Mechanism
10. Plug Grapple
11. Pintle Grapple
12. Equipment Lifting Yoke
13. Shielded Canyon Cell #6
14. Power Mast
15. Manipulator
16. 35 Ton Cell Crane
17. Maintenance Area Shield Door
18. Crane Maintenance Room
19. Observation Window
20. Operating Gallery
21. Clean Canister and Lid Supply Port
22. Lag Storage Canyon Vault Area
23. Canister Pass-Thru Shield Door
24. Storage Cask and Transporter
25. Repository Overpack Cask Adapter
26. Cask Cart
27. Repository Overpack
28. Repository Overpack Welding/Decon Pit
29. Repository Overpack Welding Head and Jib Support Structure
30. Repository Overpack Decon Head and Jib Support Structure
31. Repository Overpack Port
32. Repository Overpack Port Plug (Outer & Inner)

Figure 2-6

The repository overpack and cask cart are then moved to the cask unloading room to offload the overpack into the shielded canyon cell. To provide a sealed enclosure, the contamination barrier is lowered to contact the repository overpack contamination control adapter. The loading port shadow shield is lowered to provide the necessary shadow shield while the repository overpack is lifted into the shielded canyon cell. The main shield door is closed and personnel are removed from the cask unloading room before the shielded cell port plugs are removed.

The shielded canyon cell 35-ton power mast crane is used to lift the shielded canyon cell port plug and place the one-piece plug onto the cell floor. The crane engages the plug grapple by using a breechlock connection located at the bottom of the power mast. The grapple, with its three-prong hooks, is positioned for connection to the plug eyelets, and the power mast is rotated for engagement. The plug is lifted and set down on the floor. The crane plug grapple is exchanged for the repository overpack grapple. The crane engages the repository overpack, and lifts the overpack into the shielded canyon cell. The overpack is placed into the repository overpack welding station pit.

The repository overpack grapple is exchanged for the port plug grapple. The shielded canyon cell plug is replaced; this permits the cask cart with repository overpack cask adapter to be released from the cask unloading room. In parallel with the filling, welding, and decontamination of the repository overpack, the repository overpack cask adapter and cask cart must be exchanged for the repository overpack shipping cask. A detailed description of the repository overpack processing is given in Section 2.5.15. The filling operation and handling of the shipping cask and cask cart are described below.

Once the repository overpack has been staged into the welding/decon station, the overpack must be filled with the appropriate waste forms. The repository overpack (3-prong) grapple is exchanged for the repository overpack pintle grapple. The pintle grapple is used on the 35-ton crane to remove the loose overpack lid and place the lid on the floor. The pintle grapple is exchanged for the storage vault shield plug grapple, which is required to remove the shield plug and expose the spent-fuel canister. Once the shield plug is removed and set down on the floor, the crane is used to lift the spent-fuel canister and place it into the open repository overpack. The repository overpack has an internal structure that is used to guide and separate the canister. This structure is also used to transfer canister heat to the outside surface. The repository overpack is designed to hold four 12.75-in.-dia canisters or two 12.75- and one 14.0-in.-dia canisters. After the canisters are loaded into the repository overpack and the storage vault shield plugs are replaced, the shield plug grapple is exchanged for the overpack pintle grapple. The repository overpack lid is then lifted and placed onto the overpack container. This is the final step before the welding and decon process, which is described in Section 2.5.15.

The parallel operation of exchanging the repository overpack cask adapter for the repository overpack shipping cask is continued below. The shadow-shield door is retracted, the contamination barrier is raised, and the cask unloading room shield doors are opened. The cask cart is moved to the cask handling and decon room, where the contamination control adapter is removed from the repository overpack cask adapter by the monorail crane. The cask adapter is surveyed for contamination and decontaminated, if necessary, before release from this room. The cask cart is then moved to the receiving and inspection area platform for offloading of the repository overpack cask adapter. The adapter is unbolted, and moved to the component setdown area.

The shipping cask for the repository overpack is a single-unit, shielded cask, which arrives at the cask receiving and inspection area by means of the previously mentioned cask handling procedures. The cask adapter crane grapple is exchanged for the shipping cask yoke by use of the 150-ton crane. The shipping cask is lifted, turned to a vertical orientation, and placed onto the empty cask cart. The cask cart is then moved into the cask handling and decon room. The shipping cask outer lid is removed, and the inner lid fasteners are loosened. The contamination control adapter is attached to the top of the shipping cask. The prepared shipping cask is then moved into the cask unloading room, and engages the contamination control barrier. The shadow shield and shield doors are closed. The shielded canyon cell port plug is removed, and set down in the cell, as previously described. The cell crane engages a tool that unscrews the remaining bolts on the inner lid. The lid is lifted by the same tool, and set aside on the cell floor. The shipping cask is now ready for the receipt of the completed repository overpack.

The 35-ton shielded canyon cell crane, with a repository overpack pintle grapple, is used to lift the completed overpack from the decon pit to the shipping cask. The shipping cask with the repository overpack is prepared for release from the cask unloading room by replacing the inner lid, securing the inner bolts, and replacing the cell port plugs. The shadow shield and contamination barrier are retracted and the shield doors are opened. The cask cart with the shipping cask is then moved to the cask handling and decon room. The contamination control adapter is removed by use of the monorail crane. The remainder of inner lid closure fasteners are installed and tightened. The outer lid is installed, and secured to the cask. The shipping cask is surveyed for contamination and radiation levels. The cask is decontaminated, if necessary, and the survey is repeated before release to the cask receiving and inspection area. The cask is then transferred from the cask cart to the transport vehicle by the 150-ton crane with the special cask lifting yoke. The cask impact limiters and personnel barrier are reinstalled, and final preparations are made to release the shipping cask from the R&H Building.

2.5.15 REPOSITORY OVERPACK PROCESSING

Once the repository overpack has been staged in the welding/decon station, the waste form placed into the overpack, and the lid inserted, the welding process may be initiated. The purpose of the welding and decontamination station is to weld the lid to the body of the overpack, and then decontaminate it for shipment.

The welding and decontamination station consists of a deep pit, sized for the repository overpack and outfitted with spraying nozzles. Centering ribs are welded to the pit to ensure that the overpack is centered, particularly at the top, where the horizontal lid surface and the longitudinal axis intersect. This facilitates precise welding of the lid. (The bottom of the pit has been designed to accommodate a slightly bowed overpack.) Near the pit are located two jib cranes, one carrying the welding head and the other carrying the decontamination head. When the repository overpack is transferred in the cell, the jib cranes are in their parked positions to render free passage of the overpack supported by the cell crane.

The welding operation is next in sequence. The crane carrying the welding apparatus is swung into position over the pit, and the welding apparatus is lowered. After the welding is done, the crane is returned to its parked position. The crane with the decontamination head then swings over the pit, and the overpack is decontaminated and dried. Then the decon crane is returned to its parked position. Upon completion, the repository overpack is placed into the repository overpack shipping cask for final disposition.

2.5.15.A. <u>Welding Equipment</u>

The welding equipment consists of a jib crane and a welding head. The design and capacities of the jib crane are common to both the welding and decon heads, with its pivot point located adjacent to the overpack pit. The jib crane is capable of a 360-deg rotation, but need swing no more than about 135 deg between the overpack pit and its parking position. A shell that houses the welding equipment is supported by the end of the crane boom. The shell is suspended from the boom by actuators, which sit atop the boom.

Mounted on the inside of the shell wall is an internal 360-deg bearing gear assembly that meshes with a pinion powered by a vertically oriented motor. Bolted to the gear is a platform that contains the welding apparatus.

The welding apparatus is an electron beam welder. The electron gun is oriented vertically for the vertical weld of the overpack lid. The design of the gun mounting allows it to be tilted a few degrees clockwise or counterclockwise by a motor. At the same time, the gun can be translated back and forth, by a separate motor and a sliding plate on which the gun and its tilting apparatus are mounted. Thus, the gun can rotate around the overpack, translate back and forth horizontally, and also tilt a few degrees, thereby affording a precise aim for the electron beam. A typical welding sequence would proceed as follows, starting from the welding crane in its parked position:

The crane swings out over the pit. The actuator on the boom lowers the welding shell. The shell comes to rest on a ledge, which is a part of the pit. Built into the neck of the shell are inflatable seals. The seals are inflated; they contact the overpack, thus sealing off the shell environment from that of the cell. The shell is now evacuated, as required by the electron-gun manufacturer. The gun is, through visual and electronic/mechanical aids, aligned to the weld, and fired to commence the welding. The bearing gear begins to rotate at a preset controlled rate; this moves the gun around the weld. Limit switches prevent the gun from rotating past 370 deg. A CCTV camera mounted on the gun gives the operator a view of the welding in progress. After the welding, the seals are deflated. The shell is raised off the overpack. The crane swings back to its parked position.

Access doors are provided on the welding head shell for maintenance of the electron gun and the motors. Finally, the entire top of the shell is removable for extensive maintenance within the shell.

2.5.15.B. Decontamination Equipment

The principal moving features of the decon equipment are the same as those for the welding equipment; that is, a jib crane, an actuator riding atop the crane's boom, and a shell suspended from an actuator. In addition, a stabilizing rod attached to the shell slides up and down through a sliding joint on the boom. The stabilizing rod keeps the shell stable through the crane's movements, and also prevents the shell from developing a rotatory motion of its own when the actuator tends to turn the threaded rod. Inside the shell, however, there are no moving parts. The shell is outfitted with eight nozzles around the circumference at three elevations. A typical overpack decon operation would proceed as follows, starting with the crane in its parked position:

The crane is swung over the pit. The shell is lowered until it comes to rest on the ledge that is integral to the pit. The shell has, on its bottom flange, seals to prevent the decon solutions from splashing out into the cell. The pit is outfitted with spraying nozzles, eight around the periphery at four elevations, and two at the bottom pointing up. The piping coming to the nozzles is connected so that either Freon-113 or drying air can be diverted to the same nozzles. Freon-113 is turned on, and the overpack is sprayed. Then the drying air is turned on and circulated. Finally, through the same nozzles, the pit is partially evacuated to vaporize the Freon. The vacuum is then released. The shell is raised off the pit, and swung back to its parked position.

2.5.16 TRANSFER OF WASTE CANISTERS AND DRUMS TO SEALED STORAGE CASKS OR TRANSFER SHIELD

One operation in the processing of spent fuel, HLW, future RHTRU, or secondary waste is the offloading of waste canisters or drums into the sealed storage casks or transfer shields for subsequent storage onsite.

Preparation for this operation involves two parallel steps: the preparation for offloading of waste canisters and the preparation of the sealed storage cask and transporter or the transfer shield to receive the canisters.

2.5.16.A. Preparation of Sealed Storage Cask or Transfer Shield

Although the capacities and functions of the sealed storage cask and the transfer shield are different, their preparation and interfacing with the offloading port of the cell are essentially identical. The empty cask mounted on its transporter or the transfer shield mounted on its own transporter enters the loadout and decon room through the facility transporter entry/exit port and the transfer corridor. Each transporter is maneuvered so that the cask or transfer shield is aligned with the loadout port axial centerline and centered within the local shadow shielding. Once the transorters are positioned and locked, the contamination barrier is remotely lowered to mate with and seal on top of the cask or transfer shield.

2.5.16.B. Preparation of Waste Packages for Transfer to Storage

The final operation of all the processes performed in the shielded process cell is the transfer of canisters or waste drums into lag storage or directly into a sealed storage cask or transfer shield. Canisters or drums that reach this point in their processing have been inspected and decontaminated, and are eligible for release from the cell.

Drum storage cages, provided in two different sizes for 55- and 83-gal drums, are used for the packaging of drums in the lag storage pits in Shielded Canyon Cells 5 and 6. Each drum storage cage includes at least the following carbon-steel components: one 1-in. bottom plate, three 1-in. pipe uprights, one 1-in. cover plate with lifting pintle on top, and four 1/4-in. separator plates. All of the plates are equilateral triangles in shape, with a hole in each corner for the pipe upright to pass through. The uprights that form the cage around the stacked height of five drums are welded to the bottom plate, and attached to the top cover plate with three captive bolts. The five drums, when loaded into this cage, are separated from each other by a separator plate. Individual drums are handled by the 20-ton power mast crane with a drum grappler; the drum storage cage is handled by the 35-ton power mast crane with a pintle holder.

Loading takes place in the east end of Shielded Canyon Cells 5 and 6, beginning with the removal of the offloading port shield plug. The plug is raised and moved away from the port by its own jacking and lifting mechanism because the weight of the port plug exceeds the 35-ton power mast capacity. With this plug removed, the shield plug of the sealed storage cask is removed by the power mast and shield plug grapple. For the transfer shield, the upper gate is remotely opened to allow access for the waste packages. Transfer of the canisters is performed by the 35-ton power mast and the canister pintle grapple.

After the transfer process, the storage cask shield plug is replaced by the power mast or the upper gate of the transfer shield is remotely closed. The loadout port plugs are replaced, thus completing the transfer process.

2.5.16.C. Transfer of Waste Packages to Storage

1. Transfer Shield. After the transfer shield is loaded and its upper gate closed, the shield is moved from the loadout and decon room through the transfer corridor and out to the storage area via the transport entry and exit room.

2. Sealed Storage Cask. With the shield plug in place, the sealed storage cask is moved into the transfer corridor and positioned under a work platform. Here, the outer lid is lowered on top of the cask, and welded in place by automatic welding equipment. Weld inspection and subsequent painting of the outer lid complete the cask preparation. The cask is then moved through the transport entry and exit room to the storage area.

2.5.17 ONSITE-GENERATED HIGH-ACTIVITY WASTE

Onsite-generated high-activity waste consists of spent in-cell HEPA filters, spent first-stage testable HEPA filters, spent cartridges from cartridge filters, spent resins from high-activity liquid radwaste system, spent resins from low-level liquid radwaste system, and RHTRU evaporator bottoms slurry.

2.5.17.A. HAW HEPA Filters

HAW HEPA filters from shielded process cells are first removed and loaded into a stainless steel box, using the remotely operated electromechanical manipulator. Next, the stainless steel box, loaded with four HAW HEPA filters, is transferred to the decontamination cell by the transfer cart. The loaded stainless steel box is transferred from the decontamination cell to the remote-handling air filtration (RHAF) room through a hatch, and moved to a remotely operated HEPA filter compactor, where the filters are removed from the stainless steel box by the remotely operated electromechanical manipulator, and fed into the compactor for volume reduction.

The HEPA filter compactor is designed around four major sections: the horizontal transfer chamber, the vertical extraction chamber, and the horizontal compaction chamber; the fourth section is the gate and drum loading/unloading section. All compactor exterior components are made of a bolted, carbon-steel material, with interior operating components constructed of stainless steel. The compactor unit is mounted on a 6- by 13- by 2-ft-high, welded platform. The assembled weight of the compactor is approximately 10,000 lb. It requires a minimum floor area of 16 by 10 ft, and a height of 11 ft.

The hydraulic power unit is complete, self-contained, with a 3,000-psi hydraulic system, using a variable-displacement piston pump powered by a 10-hp motor. The pump delivers 10 gpm at 100 psi and 0.2 to 5 gpm at 2,800 to 3,000 psi, which is required for filter media compaction.

A HAW HEPA filter is placed into a filter carrier tray, which positions the filter. The filter is then fed into the extraction chamber. A vertical-extraction head assembly inside the extraction chamber cuts and strips the filter media from the filter frame, and pushes the media into the compaction chamber. Reverse travel of the filter carrier then extracts the filter frame, and allows for repeat operation, until three filters have been stripped into the compaction chamber. After three filters have been fed into the compaction chamber, the compactor cylinder ram is activated and the filter media are compacted against a closed gate unit located at the end of the compaction chamber. The compactor cylinder ram is then retracted, and a repeat loading of three additional filters is added to the compaction chamber. The compactor cylinder ram is again activated, and the six filter media are compacted in preparation for loading into a plastic-lined plastic drum; the drum has been positioned and locked on a horizontal-tilting, loading and unloading table.

The compaction pressure is released, and the compaction cylinder gate is opened. The compactor cylinder ram is activated, pushing the compacted filter media into the positioned plastic drum. The loaded drum is then tilted to a vertical position, where the plastic liner and plastic drum are sealed. This sealed plastic drum is then moved by crane to an area where it is lifted and placed in a plastic-lined, 55-gal, stainless steel drum. The plastic bag is sealed, and the final steel drum lid is installed.

The metal frames of HAW HEPA filters are sheared in a remotely operated, mechanical shear machine, and placed into 55-gal, stainless steel drums.

The clean, empty plastic drums, plastic-lined stainless steel drums, and stainless steel drums without plastic liners are brought into the drum introduction room on manually operated pallet carts, and manually loaded onto the electrically operated transfer cart. The empty drums are then moved into the RHAF room, where they are remotely removed and placed onto the loading table of the filter compactor.

The HAW HEPA filters in the filter banks of the RHAF room are remotely removed and loaded into a filter transfer container. The loaded container is transferred to the HEPA filter compactor by the remotely operated, electromechanical manipulator, where the filters are processed for volume reduction.

The filled stainless steel drums are remotely transferred via the transfer hatch to the decon cell, where the external surfaces of the drums are decontaminated, if necessary, and then moved into the shielded canyon cell by the filled drum transfer cart in the same manner as the nonfuel-bearing component drums. Once there, they are carried to the lag storage area, where they are loaded into the drum storage cage. The cage then either remains in lag storage, is placed into a storage cask, or into the transfer shield for subsequent storage.

2.5.17.B. <u>RHTRU Evaporator Bottoms Slurry</u>

The RHTRU evaporator bottoms slurry is collected in storage tanks located inside the HAW cell. A cement drumming station is provided to solidify the radioactive solutions in 55-gal, stainless steel drums with cement. The cement drumming station consists of a 12-in.-thick, steel shield wall; a drum processing assembly; a metering pump; gear reducers; motors; air cylinders; and air valves. The metering pump and the drum processing assembly are located on the hot side of the HAW cell. As many of the gear reducers, motors, air cylinders, and air valves as practicable are mounted on the service gallery side of the HAW cell for ease of maintenance.

The clean 55-gal, stainless steel drums are filled with a measured amount of cement outside the HAW cell, and moved into the clean drum introduction vestibule. Next, the remotely operated bridge crane in the HAW cell moves the 55-gal drums from the clean drum introduction vestibule to the drumming station through the hatch openings. The drum is lowered onto the transfer platform of the drum processing assembly. Once the drum is positioned, the entire filling and mixing sequence is automatic. The cap is removed, and a predetermined amount of solution or slurry is deposited into the drum. Air displaced during the filling is vented through an annular passage around the fill nozzle to the HAW cell, and the drum is recapped. The filled drum is then tumbled end-over-end so that the liquid waste and cement are thoroughly blended into a homogeneous mix, thereby normalizing the radiation level throughout the drum. The wetting action of the liquid displaces the air in the dry cement, shrinking the drum's contents. Therefore, a second filling of a predetermined amount of solution or slurry is automatically repeated to use the optimum volume of the drum.

Upon completion of the cycle, the drum is removed, using the HAW cell bridge crane. The weight of the drum is measured on a scale, the weight is recorded, and the drum is stored in the HAW cell for a predetermined period for curing of the contents.

The loaded drum is next moved onto a transfer cart, using the HAW cell bridge crane. Using the wall-mounted master/slave manipulator to determine contamination, a swipe sample of the exterior surfaces of the drum is taken. The transfer cart moves the drum into a decontamination chamber, where the external surfaces of the drum are decontaminated, if necessary, and then to a drum lift.

The drum lift transfers the drum vertically upward to the shielded canyon cell through a hatch opening; the drum is remotely moved by the shielded canyon cell crane, loaded into the drum storage cage, and stored in a sealed storage cask.

2.5.18 SHIELDED PROCESS CELL INSTRUMENTATION AND CONTROL SYSTEM

The shielded process cell instrumentation and control system is an integrated, distributed control system for the control, monitoring, and documentation of operations in the shielded process cells of the R&H Building. This system permits the local operators to control and monitor operations within each of Shielded Process Cells 1 through 6 and the decon cells. This system also provides for data storage and retrieval capability, as well as graphics generation for the work stations.

The instrumentation and control system (ICS) has been designed to provide the following functions:

(1) Control of all operating systems associated with the functioning of the shielded process cells, with the exception of primary power and HVAC.

(2) Monitoring (in real time) of all functional parameters of each operating subsystem.

(3) Interlock of all operating subsystems for protection of personnel and equipment, and to ensure material control.

(4) Production and maintenance of current documentation files on the spent-fuel inventory.

(5) Production and maintenance of programs for operations, data acquisition, and graphics.

(6) Production and maintenace of trend data analyses.

(7) Visual monitoring of operations inside each shielded process cell via the CCTV system, with the capability for recording any video input.

(8) Recording of ultrasonic weld inspection data with videotape recorders.

(9) Recording of the location of equipment (modules, spare parts, etc.).

(10) Establishment and updating of maintenance records for each equipment item.

This functional capability is accomplished by using a series of local control stations, located in the operating galleries, to form a distributed processing system. These local control stations use programmable logic controllers (PLCs) to provide real-time control of the process cell operations. The PLC is preprogrammed to perform certain sequential operations. All operations must be initiated via the work station operator. The PLC follows the preprogrammed instructions, while continuously scanning the input/output control for interlock ranges. The control signals, positional information, and process data from each of the local control stations that contains a PLC are placed on a common data highway. This permits the results to be shared by other local control stations, the central control room, and the backup control room. This system, therefore, represents a Local Area Network (LAN), which ensures a common data base and control information. The main data storage center is located in the central control room, with a duplicate set of equipment located a minimum of 1,100 ft away in the backup control room. These data-storage facilities provide permanent storage of the process cell activities. The system is configured so that, in a faulted event, recovery control of the cell operations can be performed from either the main control room or the backup control room. Supervisory control stations, used to monitor the cell operators, are located in the main control room. In addition, an engineering console is provided in the main control room for control program software development and checkout.

The local control work station (see Figures 2-3, 2-5, and 2-6) is located at each of the shielded process windows. The work station control capabilities and size vary from work station to work station. Four types of work stations are used to control the cell operations. A cursory block diagram of the work stations used for the control system is shown in Figure 2-7. This figure illustrates the basic components contained in the work station control consoles. The specific details of these components are defined in the I&C drawings and briefly explained in the following sections.

2.5.18.A. System Component Description

The instrumentation and control system used for the shielded process cells is divided into three main areas: the engineering work station with records management, supervisor stations, and operators work stations. The engineering work station and the supervisor stations are located in the central control room. The operator work stations are located in the operating galleries around the shielded process cells.

The engineering work station consists of a monitoring keyboard, programming keyboard, graphics generator, display generator, color CRT, a hard disc system, and a floppy disc system. These subsystem components are all connected to the processing unit that coordinates these functions. In addition, the data management aspects (such as the printer and magnetic tape recorder) are connected to the processing unit to monitor and record processing information. Because the engineering work station, with its processing unit, is connected to the data highway, information can be exchanged among all work stations and the supervisor stations. The engineering work station is used primarily for program (software) control, development, and storage. Initial program generation, distribution (downloading), and program updating are performed at the engineering work station. This work station is also capable of simulating the supervisor station when necessary.

Two supervisor stations are located in the central control room. These stations are connected to the data highway, which permits monitoring and control of the operator work stations, and contains the following equipment: distributed processing unit (DPU), keyboard, display generator, color CRT, CCTV monitor, CCTV secondary controls and selector switches, and a videotape recorder. The equipment permits the supervisor to monitor the shielded process cell activities and provide control of operations, if necessary. The main control function, however, resides with the operator work stations because the operators have immediate visual confirmation through the viewing windows. Supervisory keylocks are used to prevent control from the supervisor station unless the supervisor overrides the control function via special keys and/or codes.

The shielded process cells instrumentation and control system uses four basic types of control consoles (known as local work stations) and two types of support cabinets. The type "A" work station represents the most sophisticated console of the four basic types, and contains the following equipment: keyboard, display generator, DPU, color CRT, CCTV monitor,

R & H CONTROL BLOCK DIAGRAM LEVEL 2

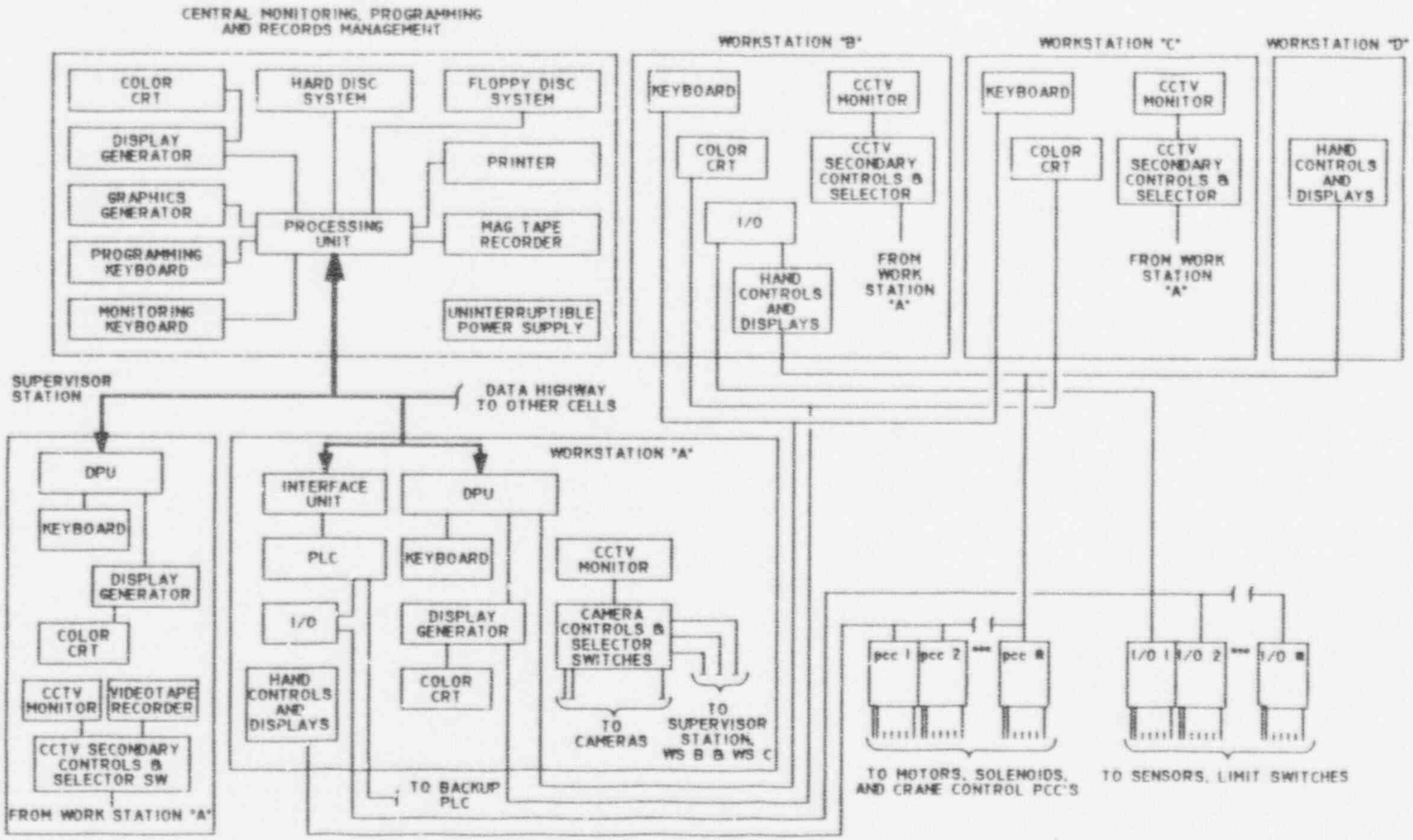


Figure 2-7

CCTV controls and selector switches, miscellaneous hand controls and indicator lights, one I/O rack (with one or more I/O modules), PLC, and interface unit. The type "A" work station is capable of handling all of the operations within one of the shielded process cells devoted to the disassembly and consolidation of spent fuel. The PLC at the type "A" work station provides primary support for operations at all of the other work stations (B, C, and D) assigned to that cell. Each of the type "A" work stations provides backup support for the other type "A" work station in the adjoining cell. For instance, the type "A" work station at the disassembly station of Shielded Process Cell 1 backs up the operations at the canister welding station located at the Shielded Canyon Cell 5 west end. This backup technique provides primary system redundancy.

The type "B" work station is a smaller version of the type "A" work station. The PLC, PLC interface, display generator, and DPU are absent from this type of work station. The control logic and graphics generation features are supplied from the type "A" work station. This technique reduces the hard wiring and duplication of equipment.

The type "C" work station represents a smaller version of the type "B" work station. This unit contains a keyboard, color CRT, CCTV monitor, and CCTV secondary controls and selector switches. The work station is a movable cabinet, and may be attached to any of several remote connections in the operating gallery when necessary. This unit is typically used for crane control functions.

The type "D" work station is a very simple control console, fitted with hand controls and indicator lights, and relies heavily on visual support. The unit is used typically as a secondary crane control console, and is mounted below the viewing windows.

Type "A," "B," "C," and "D" work stations interface with the two types of support cabinets defined as the I/O and power control center (PCC) cabinets. The I/O cabinets contain rack-mounted I/O modules and miscellaneous signal conditioners. The PCC cabinets provide motor control, solenoid valve control, power control, power conditioning, and malfunction protection. The use of the two different cabinets provides a separation between the instrumentation and power control equipment. In all cases, the work stations, I/O cabinets, and PCC cabinets are located in the operating galleries, not within the shielded process cells.

2.5.18.B Work Station Location Definition

Each of the four shielded process cells (1 through 4) would be controlled via three work stations, one of each type "A," "B," and "C" consoles. The type "A" work station is located at the spent-fuel disassembly viewing window. The type "B" work station is located at the spent-fuel consolidation viewing window. The type "C" work station is located at the spent-fuel unloading ports. The type "C" work station is connected between the two viewing windows to permit control at both windows by using only one work station. A cable management system permits console movement while protecting the cables. The type "A" and "B" work stations are mounted on movable, elevated platforms that are compatible with the height of the viewing windows. The movable platform/cable wall connection is designed to permit the platform and its associated work station to be moved away from the window to perform window maintenance.

Canister welding, which is performed in the west ends of Shielded Canyon Cells 5 and 6, requires one type "A" and one type "B" work station for each cell. The type "A" work station is mounted in front of the upender viewing window to provide primary control of the west-end crane, upenders, and canister inspection. The type "B" work station is in front of the canister welding viewing window to control the canister welding and leak testing chamber. This "B" work station is also used as a secondary control for the west-end, in-cell overhead crane.

A type "A" work station with one I/O and two PCC cabinets is used to control each of the two decon cells that are located between Shielded Process Cells 1 and 3 and Cells 2 and 4. This type "A" work station, which is located in front of a viewing window overlooking the decon cell operations, controls passage of two drum transfer carts into the adjacent cells. Control of these carts must pass from the decon cell to the "A" work stations that control Shielded Process Cells 1 and 3 for the shredder processing. Each of these type "A" work stations provides backup support for the other.

Around the periphery of Shielded Canyon Cells 5 and 6, at least four type "C" work stations are employed to perform in-cell overhead crane controls. This is particularly important during emplacement and retrieval of canisters of consolidated fuel from the 1,000-MTU vault storage locations.

A type "A" and a type "D" work station are located on the northeast viewing windows of Shielded Canyon Cell 5. These units would be used to control the repository overpack processing and the HAW drum transfer port.

A type "A" and two type "B" work stations are located on the southeast viewing windows of Shielded Canyon Cell 6. The type "A" work station is used to control the overpack upender and overpack canister testing stations. One type "B" work station is used to control the repository overpack weld/decon station in Shielded Canyon Cell 6. The second type "B" work station is used to control the overpack canister welder and decon station.

All I/O and PCC cabinets are located in the operating gallery at locations close to the shielded process cells, as required. The actual locations are defined on the detailed drawings.

2.5.19 MAINTENANCE OF IN-CELL EQUIPMENT

All of the equipment located inside the shielded process cells and shielded canyon cells becomes highly radioactive and contaminated because it is exposed to, and comes in contact with, spent-fuel assemblies, RHTRU drums, and HLW canisters. The preventive maintenance, repair, and replacement of in-cell equipment, therefore, require remote operations and accessibility, including ease of replacement, inside the cells.

The approach taken regarding the remote maintenance of in-cell equipment was to design highly reliable equipment. This reduces frequency of maintenance and replacement. Modularization of equipment was used for ease of remote replacement and to minimize maintenance time. Existing state-of-the-art technology was used, and equipment was provided with a single function to the extent possible. Equipment and controls are located outside the process cells, where possible, to avoid remote maintenance.

The design features to facilitate remote maintenance, repair, and replacement of in-cell equipment are described in the following paragraphs.

2.5.19.A. Spent-Fuel Disassembly and Consolidation Equipment

The spent-fuel disassembly and consolidation equipment consists of assemblies of modular groups of components. Each module can be remotely removed and replaced with a spare module by removing captive bolts and/or releasing clamps if a component within a module fails or malfunctions. A module lifting rig interfaces with trunnions on the modules for removal/replacement. Motor drives are accessible to the extent possible to allow visibility, disassembly, and tooling clearances. Drives are mounted on intermediate structural plates, which can be removed and replaced as modules. All major components and modules are designed with lifting bails, trunnions, locating pins, and remote-coupling devices.

2.5.19.B. Intact and Recovery Upender

The approach taken regarding maintainability of the intact and recovery upender was to design modular components for remote maintenance. Drive components can be removed and replaced by using captive bolts and disengaging locating pins. Access and visibility of remote, detachable interfaces are provided to allow ease of maintenance. Thus, if malfunctioning of a module is encountered, it is replaced with an identical module. All major components and modules are provided with lifting bails, locating pins, and remote-coupling devices.

2.5.19.C. In-Cell Overhead Cranes

There are a total of eight in-cell overhead cranes. There is one, rated at 20 tons, mounted in each of the four shielded consolidation process cells, and two, rated at 35 tons each, mounted in each of the two shielded canyon cells. Maintenance for all of these cranes is nearly identical and is performed in shielded maintenance bays located at the outer ends of each cell. For servicing, the shielded maintenance bay door is opened, and the crane is moved into the bay. This door is then closed, isolating the crane from the hot cell. A permanently installed manifold of spray nozzles that are remotely activated is used to decontaminate the crane, if necessary. Subsequently, the bay can be entered to perform further decontamination and the contact maintenance operations. Failed components can be removed through hatches located in the ceilings of the cells. The hatches, and the hoists above them, have been sized to allow an entire trolley to be replaced if necessary. A trolley would be replaced only if repairs made in the maintenance bay would jeopardize production schedules or personnel exposure limits. As noted above, there are four 20-ton and four 35-ton cranes. Within each rating, the crane trolleys are identical. From a maintenance standpoint, this is beneficial for the following reasons:

(1) Spare parts inventory requirements are minimized.

(2) Operators need to become familiar with a minimum number of designs.

Provisions have been made to ensure that the cranes can be retrieved should a failure occur in the cell. Two separate power supplies ensure that a single power failure will not cause a loss of the crane. In addition, winches have been provided for both the bridge and the hoist to ensure that the crane can be pulled back into the maintenance bay.

ALARA considerations have been incorporated into the maintenance of the cranes in the following areas:

(1) Where possible, equipment that requires maintenance is located in a lower radiation zone. For example, the retrieval winches are located in the crane maintenance bay rather than on the crane bridge.

(2) The design of routinely maintained components is required to incorporate features that permit rapid and easy servicing and/or replacement.

(3) All crane components are designed to facilitate decontamination and permit complete runoff of washdown solutions.

(4) The crane maintenance bay is sized to give operators adequate working space for maintenance operations.

(5) Surface scrapers are located on the telescoping section of the power mast. Each time the power mast is raised, crud buildup is removed from the crane and deposited in the shielded process cell.

In-cell maintenance activities are performed by using the telescoping mechanical arm mounted on the trolley of the overhead bridge crane. This arm has the capability of servicing all in-cell equipment. In Cells 1, 2, 3, and 4, a second, identical, mechanical arm is attached to a wall-mounted trolley, which traverses the length of the cell. The primary function of the second arm is to assist the overhead arm in servicing of the consolidation equipment. The two arms also have the ability to service each other. In Cells 5 and 6, the second arm is available because there are two overhead cranes in these cells. Use of these arms to perform in-cell servicing and repairs is both a time saving and an ALARA benefit.

2.5.19.D. Canister Welding Equipment

1. Welding System. The maintenance of the welding system (whether it be a homo-polar generator or an ac transformer package) is performed in the welding maintenance room. The components of the welding system that are considered to have the greatest probability of failure are located in the welding maintenance room. Manned entry is permissible, and maintenance activities can take place in the usual manner. Within the hot cell, however, maintenance is performed mainly by using a remotely operated manipulator. The components that may need servicing are the lid injection system, the forging restraints, and the electrodes. These components are all located at the welding station. The roof of the station is hinged to facilitate access for maintenance. The components are all of a modular design, and are held in place by bolts. The components will first be freed by the manipulator, removed from the station, and then replaced. Primarily, all components located in the cell are large, heavy-duty pieces that will need minimum maintenance or replacement.

2. Canister Air-Lock Tube. The canister air-lock tube is modularized to facilitate any maintenance operations that may be required. The top cover is made in two separate pieces. These are bolted to the bottom plate of the air-lock tube and to the various gate valves located along the air-lock tube body. One cover is between the entrance gate valve and the forge restraint valve. The other is between the forge restraint valve and the exit gate valve. These covers are bolted and sealed. The air-lock tube also interfaces with the inlet and exit lines for the gas purging, decontamination, and evacuation systems. These lines are of the quick-connect type for easy removal. Any maintenance required within the tube may be accomplished by removal of these components.

The three valves are independent units, and are rigidly held in place by support stands and bolted assemblies. The units can be individually removed, if required, by disassembling the fasteners before removal. It should be noted that the upper covers, along with the three valves, can all be removed at once by first unbolting the flange interface with the welding station wall and then unfastening the Freon drain line from the bottom of the tube. The unit is then free to be lifted and relocated. Probable components that may fail for the entire canister air-lock tube are the electrical drives, which are located outside the tube. The motors drive the rollers within the tube via spline shafts. The spline shaft that penetrates the air lock is the shaft of a flange-mounted motor. The motor itself is a sealed unit that is mounted and sealed to the outer surface of the air lock. This arrangement and configuration of the motor and drive are designed to provide a leaktight assembly of the motor/drive and air lock. Their removal and replacement is identical to the procedure described in the preceding paragraph. The overhead power mast is used to perform all maintenance activities.

3. Canister Air-Lock Tube Support Systems. The gas purging, decontaminating, evacuating, and leak-testing systems are all located outside the shielded process cell, except for the inner ends of the supply and drain lines. For this reason, all maintenance is manual.

4. Ultrasonic Test Equipment. This equipment is simple in design, but the physical size of some of its components makes maintenance with the manipulator difficult. Individual pieces can be removed and replaced with spare parts or the entire unit can be removed from the cell and replaced by an identical spare. The severity of the failure determines which maintenance operation is chosen. The transducer and couplet package are attached to a strongback carriage by flange-mounted bolts, which are easily unfastened and refastened by a manipulator. If the entire system should require removal, the carriage, along with all subcomponents, is removed from its support stand by removing the flanged nuts. Once the nuts are removed, the overhead manipulator needs only to grasp, move horizontally, and lift the carriage from the stand. The horizontal movement is necessary to clear the carriage from alignment pins, which are part of the support stand and aid in replacing the unit. Electrical quick connectors also have to be disconnected before removal.

5. Canister Cutting Station. The canister cutting system is maintained by removing it from the cell and replacing it with an identical unit. This is accomplished with the overhead manipulator. The unit is similar to the ultrasonic equipment; removal and replacement are identical to the procedures followed in the description of the system.

2.5.19.E. Upenders

The overpack upender is a large, but relatively simple, piece of equipment. Drive motors are used to: (1) drive the transfer rollers on the roller bed; (2) drive the wheels that transport the carriage across the cell; (3) rotate the upper carriage relative to the lower; (4) adjust the roller bed spacing; and (5) close and open the grippers mounted on the roller bed tubular frame. The upending package is used solely for raising and lowering the upper carriage containing a canister. All maintenance of the equipment takes place in the hot cell, with the overhead manipulator performing the required tasks. The electric motors are all removable from their mounts by removing three bolts oriented 120 deg apart. By making the bolts for all of the drives the same size, maintenance operations are further simplified. The drives for the transter rollers transmit their torque through spline shafts, and are easily removable. The upending package is also bolt-and-nut-mounted, and requires a similar procedure for removal as the other drive motors. The maintenance procedure for the spent-fuel canister upender and pass-through cart is similar but less complicated, as there are fewer parts on each of these machines.

2.5.19.F. Secondary Waste Volume-Reduction and Drum Handling Equipment

The secondary waste volume-reduction and drum handling system represents a combination of subsystems required to transfer secondary waste from the hot cells, reduce its volume, package it in 55-gal drums, seal the drums, return them to the decon cell, decontaminate and swipe the drums, and transfer them to the shielded canyon cells. Except for the initial positioning of clean drums and lids onto the clean drum elevator, all operations are performed remotely. This reduces the exposure to operators and integrates the operation of the entire system. Maintenance operations and techniques used to service the subsystems have been integrated to protect plant personnel, as well as to permit easy access to critical components. The key maintenance aspects of the secondary waste volume-reduction and drum handling subsystems are described in further detail below.

1. Clean Drum Elevator. The clean drum elevator system consists of a drum loading platform, elevator strongback, hydraulic cable cylinder, drum cage and a drum carriage. The elevator transfers a clean drum from the drum storage area into the decon cell for subsequent use by the shredding system located in the shielded process cells. The elevator strongback and drum cage is a modular welded-steel framework that is bolted to the concrete walls. The drum carriage is driven via a hydraulic cable cylinder for added reliability. Hydraulic support systems are located in the drum loading area. This area is acceptable for operator access and, therefore, no remote maintenance is planned. A dry lubricant is used on the drum carriage rollers, further reducing periodic maintenance. The drum carriage is the only moving part, actuated by the cable cylinder, which helps reduce the overall maintenance requirements.

2. Shield Valve. The shield valve consists of a stepped split-gate mounted on rails, two motor-driven linear actuators, and a valve-motor housing. The shield valve provides a barrier between the decon cell and the man-accessed drum loading area. The valve-motor housing top plate is bolted to the side members to allow access to the motor-driven linear actuators. This valve has few moving parts and is easily accessed should maintenance be required.

3. Drum Push Mechanism. The drum push mechanism consists of a drum pushing fixture actuated by a guided, standard pneumatic cylinder. The cylinder is housed in a shield wall located in the decon cell. A shield plug is inserted behind the cylinder in the wall to prevent streaming. The drum pushing fixture is removable from the cylinder end. Once the shield plug and front cylinder cover plate are unbolted, the cylinder can be unbolted from the support pads and removed for maintenance.

4. Secondary Waste Drum Slide and Guidance System. The secondary waste drum slide and guidance system consists of two box beam slides with vertical side supports and two guided, pneumatically actuated drum separating pads. A wear pad is fastened to the top surface of each of the box beam slides. This pad prevents wear of the structure once installed. The two drum separator mechanisms are fastened via captive bolts on an intermediate support plate to facilitate remote disassembly if required.

5. Jib Crane. The jib crane consists of a motor-driven boom, drum grapple, drum grapple assembly lifting mechanism, swipe arm, and pneumatic swipe sample transfer system. The jib crane components are modular to facilitate remote disassembly. The jib crane rotary drive is a C-face motor-reducer connection. The motor can be remotely removable via captive bolts. The grapple housing assembly and grapple drive are remotely removable via captive bolts, locating pins, and bails. The swipe arm is remotely removable should maintenance be required. The receiving portion of the pneumatic transfer system can be remotely removed for maintenance.

6. Secondary Waste Transfer Cart. The secondary waste transfer cart consists of a motor-driven cart on a single set of rails for transporting empty and filled drums to the shredding system. In addition to drums, the cart transports filter boxes in and out of the shielded process cell from the decon cell. The motor-drive assembly package is remotely removable as a module. The motor package is fastened to an intermediate baseplate, which is fastened via captive bolts to the cart platform. To eliminate crud traps, a housing envelopes the motor-drive package. A cable reel is attached to the motor housing to provide power and instrumentation to the cart.

7. Secondary Waste Shredding System. The secondary waste shredding system consists of a dual-motor-driven, low-speed shredder; skeleton in-feed chute and motor-driven closure system; pneumatic skeleton in-feed chute top lid closure; pneumatically actuated grid in-feed chute; out-feed hopper; pneumatically actuated nozzle in-feed chute; and a drum lid holding/crimping system. The in-feed and out-feed hoppers are bolted to the shredder. Each of these two hoppers can be remotely removed to permit removal of the shredder. The shredder is bolted to the structural framework for maintenance removal. Motors are intermediately mounted and can be removed via captive bolts, locating pins, and bails. Access to the grid and nozzle chutes is provided via a remotely removable lid on each of the two chutes. The lid holding/crimping system is bolted onto the shredder structure, allowing for remote removal should maintenance be required. Pneumatic actuators are bolted to intermediate baseplates, which are fastened, via captive bolts, to the structure of the mechanism. The overall system is modular to accommodate remote repair and component replacement to facilitate hot-cell maintenance operations.

8. Secondary Waste Drum Decontamination System. The structure has a two-piece, stainless steel chamber enclosing the inner plumbing. The upper portion is a thin cylindrical shell with flanges welded to both its top and bottom ends. The lower piece is a standard elliptical head with a flange welded to its open end. The shell and head flanges are bolted together with a gasket between them. The bolts are easily removed by the manipulator, and then the shell can be removed to expose all of the interior plumbing for easy access by the manipulator. The only components actually in the decon cell are pipes, nozzles, spray heads, and limit switches, all of which need infrequent maintenance, if any. Any valves, regulators, etc., are located in an area accessible to personnel. The lid/grapple assembly can either be repaired by the in-cell manipulator or moved into the crane maintenance bay.

9. Swipe Arm Assembly. This simple piece of equipment has two stepper motors and a linear actuator. If a failure occurs, the arm is easily unbolted from the wall and taken into the crane maintenance bay.

10. Secondary Waste Filled Drum Transfer System. The cart is a two-piece device. The removable pallet is an all-welded structure requiring little or no maintenance. It is removed from the cell via the maintenance hatch should repair be necessary. The powered section of the cart consists of a welded frame, a free-wheeling front axle, and a drive axle with an integral motor/cable reel assembly and a brake. In-cell maintenance can easily be

performed because the drive axle is located near the end of the cart. Both axles are bolted on, and can be removed by the manipulator. If the cart needs to be removed from the cell, the manipulator disconnects the electrical connection. It can then be carried out by the decon cell crane or the canyon cell crane, depending on which end of the platform the car is stranded. A winch is provided to haul the cart into the decon cell in case it fails in the wall penetration and is inaccessible to the crane. It is then removed by the decon cell crane.

2.5.19.G. Clean Canister/Container Loading System

The clean canister loading system is a combination of two subsystems required for transferring clean canisters or containers to the two shielded canyon cells for consolidation or overpack. Both of these subsystems are located in an intermediate room between the shielded process cells and the operating corridor. Because this is not a high-radiation zone, when the shield plug is installed, most maintenance consists of manual operations. Specific maintenance aspects of these subsystems are described below.

1. Carousel Canister Supply Rack. The welded, closed-section steel structure is designed with few moving parts to minimize service maintenance. The lateral support arms are designed for low maintenance, and are attached by bolts for easy removal or replacement. Dry bushings are used to eliminate periodic lubrication. The closed-box type of construction permits rapid decontamination.

2. Carousel Canister Lifting Mechanism. The lifting mechanism consists of a hydraulically actuated scissors lift, rotary bearing, and rotary motor drive system. The scissors lift is a modified standard industrial lift with an associated electric-hydraulic pump system. The scissors lift is permanently bolted to the floor. The pump system is located in a pocket in the concrete wall to protect the unit and permit access for manual maintenance. The lift has been designed with maintenance locks to permit easy access and protection for service personnel. The rotary bearing is a standard industrial bearing with greater capacity than required for longer service life. Lubrication fittings are included for the bearing that require only minor manual maintenance. The rotary drive motor is also bolted to the scissors baseplate to permit access for lubrication and/or servicing. Periodic inspections of this equipment may be necessary to verify lubrication fluid levels.

2.5.19.H. Repository Overpack - Welding and Decontamination Equipment

The welding equipment that requires maintenance in the welding apparatus is listed below, and the maintenance for each item or set of items is described.

1. Jib Crane Rotating Mechanism. The mechanism consists of a motor, a motor brake, and the double-reduction worm gear reducer. The equipment is located on top of the crane in an easily accessible location, and is designed for remote replacement.

2. Electron Gun. The filament cartridge for the electron gun must be replaced after approximately 40 hr of beam-on time. Inside the cartridge is the filament that generates the electron beam. The cartridge can be replaced remotely, but the filament cannot. Therefore, maintenance of the electron gun inside the cell is confined to the remote replacement of the cartridge. The cartridge can then be opened and its filament replaced in the crane maintenance bay. Access to the electron gun is provided by opening a round hatch located on top of the welding shell. A single tool, supplied by the electron gun manufacturer, is required for replacing the cartridge. This tool can be mounted to the manipulator arm without the need for special adapters.

3. Electron Gun Inclination Motors. Two motors align the electron gun by tilting and laterally translating the gun. Access to these motors is through the round hatch located on top of the welding shell and through which the electron gun is maintained. The motors and the motor mounts have been designed for remote replacement.

4. Turntable Motor. The motor rotates the bearing on which the electron gun is mounted. The motor is easily accessible from a second hatch located directly above the motor on the top of the shell. The motor has been designed for remote replacement.

5. Actuators. The actuators mounted on top of the jib crane, directly above the welding shell, require infrequent maintenance. The actuators are of the machine-screw type, thus eliminating the need for a motor brake to be maintained. Should the actuators and the rest of the shell lifting and lowering mechanism require maintenance, the entire arrangement is easily accessible and designed for remote maintenance.

The decon equipment requiring maintenance is listed below, and the maintenance for each item or set of items is described.

1. Jib Crane Rotating Mechanism. The mechanism consists of the motor, motor brake, and the double-reduction worm gear reducer. These are identical to those specified for the welding station, thus eliminating the need for storing a separate set of spare parts. Maintenance details for the equipment are identical to those defined in Section 2.5.19.H.1.

2. Actuators. The actuators mounted on top of the jib crane are identical to those for the welding station, eliminating the need for separate spare parts. For maintenance details of this equipment, refer to Section 2.5.19.H.5.

2.5.19.I. In-Process Lag Storage Maintenance

1. Incoming Lag Storage Maintenance. The incoming lag storage has no moving parts. Its maintenance is divided into two sections: cleaning and repair or replacement.

Cleaning of the lag storage entails periodic cleaning of the pit and the modules at regular intervals. The lag storage pit is designed to afford easy decontamination. There are few obstructions in the pit; however, these obstructions are well rounded to provide rapid drainage. Drains are provided to carry the decontamination liquids away. Not much contamination is expected because the pit is covered at all times when not being accessed. The downcomers are cleaned by simply flushing the decontaminant liquids through them. The bends in the downcomers are smooth and rounded, with a large radius, to prevent crud from lodging inside them, and to make the decontaminant liquids flow smoothly. The PWR/BWR modules are cleaned similarly by flushing with decontaminant liquids.

2. Discharge Lag Storage. The maintenance of this lag storage is similar to that of the incoming lag storage. The discharge lag storage modules are removable, but only to clean the pit or repair damage to them. Pit cleaning and damage repairs are done in the same way as the respective operations in the incoming lag storage (Section 2.5.19.I.1).

2.5.19.J. Jacking Mechanisms - Port Plugs and Hatches

The equipment on the jacking mechanisms that may require maintenance is listed below.

1. Motors. There is one jack motor on each mechanism. If the motor requires maintenance, it should be removed and replaced with a spare. Maintenance should be performed in the maintenance bay. The motor and each jack are covered by sheetmetal covers to reduce crud buildup. The covers are remotely removable.

The second motor on each jacking mechanism is the one that drives the trolley. This motor is located on the top of the trolley to make it easily accessible. Because the motor does not require frequent maintenance, any maintenance should be done by replacing the motor with a spare.

2. Jacks. The jacks are all of the machine-screw type. The jacks do not need maintenance other than protection from being bumped and/or damage from equipment being moved about by the overhead cranes. The jack covers also provide damage protection, but if damage to the jack occurs, it is recommended that it be removed from the cell and repaired in the maintenance bay. The jack is easily accessible for removal, and its attachment to the rest of the mechanism is through a remotely removable universal joint connected to a sliding shaft.

2.5.20 REMOTE HANDLED EQUIPMENT MAINTENANCE ROOM

Failed modules of equipment in the shielded process cells and the decon cells can be remotely replaced by identical modules. The failed modules are remotely transferred to the remote handled equipment maintenance (RHEM) room through the interconnecting hatches. The failed components of master/slave manipulators (such as jaws, boots, hooks, and other, smaller components) are remotely transferred to the RHEM room in a stainless steel transfer container. A hydraulic scissors-lift table is provided in the RHEM room that can be positioned under any one of the interconnecting hatches to facilitate lowering of the failed module or the transfer container. The shielded process and canyon cell overhead crane power masts are used to deposit the failed modules or the transfer container onto the scissors-lift table via transfer hatches. The RHEM room is provided with a remotely operated, 15-ton, overhead bridge crane with an electromechanical manipulator mounted on the same bridge to facilitate remote maintenance of large modules of equipment. The RHEM room is also equipped with viewing windows and master/slave manipulators to provide added capability for remote maintenance and repair of smaller components. A transfer cart is provided to move failed modules from the RHEM room to the adjacent equipment decon room, where they can be decontaminated and then transferred to the contact handled equipment maintenance room for manual maintenance and/or disposal. A shielded maintenance area is provided for servicing the RHEM room crane and manipulator.

Failed components, which cannot be decontaminated for contact-handled disposal, are remotely dissassembled by using remotely operated electric power tools, cutting torches, RHEM room bridge crane, electomechanical manipulator, and master/slave manipulators, and loaded into 55-gal stainless steel drums. The drums are then decontaminated, if necessary, and transferred to the shielded canyon cell, where they are loaded into the drum storage cage and stored in the sealed storage casks.

Partially decontaminated components requiring maintenance are transferred, using the RHEM room bridge crane and electromechanical manipulator, to a shielded repair glove box, where the components are repaired or disposed of. The gloveports are used to reduce the radiation exposure of the operating personnel to levels specified in 10 CFR Part 20.

2.5.21 HIGH-ACTIVITY WASTE CELL

The HAW cell is equipped with a remotely operated overhead crane and electromechanical manipulator for remote maintenance of the pumps, vessel agitators, HAW liquid evaporator, and vessels located inside the HAW cell. The pumps and agitators have special piping and electrical connectors to aid in remote removal for repair. The motor drive of the HAW liquid evaporator is remotely replaceable for maintenance. The failed equipment is transferred remotely from the HAW cell to the adjacent decon room by the HAW cell overhead bridge crane. In case of repair or replacement of the HAW liquid evaporator rotor, the evaporator is internally decontaminated in situ first, remotely removed, and transferred to the decon room by the HAW cell overhead bridge crane. The decon room is equipped with shielding windows and master/slave manipulators to facilitate remote decontamination of the failed equipment. Once the failed components are decontaminated to reduce the radiation to levels specified in 10 CFR Part 20, the components are transferred to the contact-handled maintenance room for repair or disposal.

2.5.22 REMOTE HANDLING AIR FILTRATION CELL

The remote handling air filtration (RHAF) cell is equipped with a remotely operated overhead bridge crane and electromechanical manipulator for remote changeout of HEPA filters. The spent HEPA filters are remotely removed from the housings by the RHAF cell overhead bridge crane/manipulator, and transferred to the HEPA filter compactor, where they are compacted and loaded into 55-gal stainless steel drums for storage. The actuators of exhaust air control valves and the HEPA filter compactor unit are remotely removed by using the RHAF cell overhead crane/manipulator. The failed components are then manually transferred to the decon room, where the components are decontaminated for subsequent contact-handled maintenance or disposal. Failed components beyond repair are loaded into 55-gal stainless steel drums with plastic liners, and stored as CHTRU waste.

2.5.23 MASTER/SLAVE MANIPULATOR MAINTENANCE ROOMS

The failed master/slave manipulators are removed from their wall penetrations and transferred to the master/slave manipulator maintenance (MSMM) room for repair. A manipulator removal cart is provided to support the master/slave manipulator during installation, removal, and transportation. A manipulator decontamination station is provided in the MSMM room to decontaminate the master/slave manipulators to reduce the contamination to levels specified in 10 CFR Part 20 before contact-handled maintenance. A repair rack with adjustable height is provided to support the manipulators during repair. Storage racks are provided to support the manipulators before and after repair.

2.5.24 RADWASTE AREA

The onsite-generated, low-level, solid radwaste is processed in the radwaste area. The radwaste area is equipped with five interconnected airtight enclosures, identified as (1) combustible material handling enclosure, (2) grout mixer enclosure, (3) day tank enclosure, (4) cement hopper enclosure, and (5) cement addition enclosure. A low-level spent HEPA filter storage room and a filter compactor enclosure are also provided in the radwaste area. All of the process equipment is located within these enclosures to minimize the exposure of the operating personnel to radiation and contamination during normal operation, maintenance, and repair.

2.5.24.A. Combustible Material Handling Enclosure

A 55-gal drum, containing the low-level combustible radwaste in plastic bags, is brought into the combustible material handling enclosure via an air lock, and placed onto a drum dumper unit. Powered roller conveyors are provided to move the drum from the air lock to the drum dumper unit. Next, the lid of the drum is removed by the operator, using glove ports, and the drum dumper unit is actuated to dump the combustible materials from the drum onto the floor of the enclosure. The empty drum is tilted back into its original position, the lid is installed, and the empty drum is returned via the air lock. The combustible material on the floor of the enclosure is manually divided into smaller portions, and filled into a 14-gal wire basket by an operator, using glove ports. The wire basket is introduced into the combustible material handling enclosure through an air lock.

2.5.24.B. Grout Mixer Enclosure

The 14-gal basket, filled with the combustible material, is transferred from the combustible material handling enclosure to the grout mixer enclosure by using a remote-operated monorail hoist. A bag-out port is provided in the floor of the grout mixer enclosure. An empty, 55-gal, stainless steel drum, lined with a plastic bag, is placed on a vibrator/scissors-lift table. The open end of the plastic bag is installed around the bag-out port; the drum is raised to mate with the port. Then the 14-gal basket, filled with the combustible material, is lowered into the 55-gal drum positioned under the bag-out port by using the remote-operated monorail hoist.

A vertical rotary paddle mixer is provided inside the grout mixer enclosure to mix measured amounts of sand, cement, and evaporator bottoms slurry. The mixed mortar is discharged from the mixer through a bottom discharge door, and fed into the 55-gal drum filled with the combustible material. Glove ports are provided in the sidewalls adjacent to the bag-out port to enable an operator to assist the flow of mortar into the 55-gal drum. The rotary paddle mixer was selected because of its reliability and ease of cleaning after mixing cycles. The mixing paddles and wall scrapers keep the interior of the mixing tank constantly clean and help discharge virtually all of the material mixed in the tank. The mixing tank is equipped with removable, abrasion-resistant steel liner plates that can be replaced to decontaminate the interior of the mixing tank.

2.5.24.C. Day Tank Enclosure

Sand and cement are stored in two separate day tanks housed inside the day tank enclosure. The storage capacities of the sand and cement day tanks are 15 and 27 cu ft, respectively, and provide a sufficient supply of sand and cement for filling six drums per 8-hr work shift.

The sand and cement are transferred from large storage silos, located outside the R&H Building, to the day tanks by means of a vacuum pneumatic transfer system. The vacuum pump of the pneumatic transfer system is located inside the day tank enclosure. The feeder hoppers of the pneumatic transfer system are attached to the day tanks with flexible sleeves. The discharge side of each day tank is equipped with a rotary feeder to control the feed rate and a slide gate valve to isolate the rotary feeder from the day tank for maintenance and repair.

The vacuum pneumatic transfer system was selected for transfer of the bulk of the sand and cement because of its safety and simplicity of operation. The pneumatic transfer system requires minimum maintenance. The rotary feeders provide an air lock to minimize the migration of contamination from the rotary paddle mixer to the sand and cement day tanks.

2.5.24.D. Cement Hopper Enclosure

A 10-cu-ft cement hopper is provided in this enclosure to weigh and feed the cement required for contaminated sludge processing. Cement is conveyed from the outside cement silo by the same vacuum pneumatic conveyor, which is in the adjoining day tank enclosure.

2.5.24.E. Cement Addition Enclosure

The cement addition enclosure is located below the cement hopper enclosure. A partially filled drum of contaminated sludge is received through the air lock, which is provided with glove ports and viewing window. The drum is moved on gravity rollers into the enclosure through a pneumatic sliding door. The powered roller conveyor moves the drum into position below the cement bin discharge valve. The 4-in. threaded cap on top of the drum is removed manually through glove ports. The preweighed cement from the cement hopper is gravity discharged into the 55-gal drum of contaminated sludge through the rotary feeder. A telescoping tube below the rotary feeder is used to minimize spread of cement dust. A process water hose is provided inside the enclosure to permit thinning of the contaminated sludge consistency, when required. The drum is tightly capped after filling with cement and returned to the air-lock compartment.

Outside this enclosure, a drum stacking truck transfers the drum filled with cement and contaminated sludge onto the drum tumbler, where mixing finally takes place.

2.5.24.F. LLW HEPA Filter Storage Room and Filter Compactor Enclosure

Approximately 100 HEPA filters are stored in the contaminated filter storage room. The HEPA filters are stored individually in a polyethylene bag inside a steel tote box. In the storage room, a compactor/baler machine in an enclosure compacts four 24- x 24- x 11-1/2-in. HEPA filters into a bale of 12-1/2 x 25 x 14 in. The ram of the compactor is operated by a hydraulic cylinder with a force of 70,000 lb. The feed and discharge doors of the compactor are pneumatic sliding doors. The HEPA filter in the polyethylene bag is fed manually through an air lock. The steel tote box will be reused for storing the filter. After the enclosure door is closed, the feed door of the compactor slides open. The operator uses the glove ports to push the filter into the compactor chamber. The ram compacts the filters, one at a time, until the chamber accumulates four compacted filters. A box is then placed against the discharge door of the compactor. The box is held in place when the door of the enclosure is closed. The discharge door slides open, and the ejector cylinders of the compactor push the compacted filters into the box. The discharge door closes, and a pneumatic cylinder pushes the box onto an upending table. The upending table which is actuated by an air cylinder swings the box to the vertical position with the lifting lug end on top. The box is lifted by a monorail and inserted through the compacted filter port into a 55-gal stainless steel drum. The drum will hold one box of four compacted filters. The drum sits on a lift table located at the basement floor level. When the drum is loaded, the lift table lowers the drum, and the polyethylene liner is heat-sealed for bag-out operation and then cut. The lift table is further lowered. The drum is covered with a lid and chime, and sent to an inspection station to check for surface contamination.

2.5.24.G. Drum Fill Area

A drum vibrator/scissors lift table is provided in the drum fill area under the bag-out port of the grout mixer enclosure to facilitate filling of the combustible material and mortar into 55-gal, stainless steel drums. The vibrator/scissors lift table consists of a grid-top, vibrating table with roller conveyor mounted on top of a hydraulic scissors lift table. The empty, 55-gal, stainless steel drum is lined with a 20-mil-thick, polyethylene plastic bag, and rolled on top of the roller conveyor. Next, the table is raised to an intermediate level and the open end of the drum liner bag is installed around the bag-out port. A stainless steel clamp is used to secure the bag under the port. The table is then lifted to fully mate the drum with the bag-out port. The drum is vibrated during the mortar-filling operation to ensure proper placement and adequate consolidation of mortar. The drum is lifted off the rollers and supported by the grid top vibrating table during vibration. The drum is lowered to the intermediate level after filling with mortar, and the bag is sealed by using a heat sealer.

The heat sealer is a thermal-impulse, heat-sealing machine consisting of two cantilevered sealing jaws with actuators supported on a trolley that can be manually moved on a monorail. The sealing jaws are normally stowed away from the bag-out port to permit unobstructed filling of the 55-gal drums. Once the drum is filled and lowered to the intermediate level, the drum liner bag is flattened in vertical plane, the sealing jaws are manually positioned over the flattened liner bag, and the sealing jaws are actuated to create a 1/2-in.-wide seal along the full length of the bag. The bag is trimmed at the centerline of the 1/2-in.-wide seal to allow lowering of the filled drum. The part of the bag attached to the bag-out port remains sealed in position until a new cycle is started.

Next, the drum is lowered, the lid and chime are installed, and the drum is transferred to the drum curing room. A drum lift is provided to move the drums from the pit area to the drum curing room above the pit. The drum lift is a platform that travels vertically in a guided framework. The top of the platform is equipped with a gravity roller conveyor to facilitate moving of filled drums. A hand truck, equipped with a gravity roller conveyor, is provided to move the drums in the pit area.

In the drum curing room, the filled drums are stored in vertical racks for curing of filled mortar. The racks are capable of storing the drums four levels high, using a drum stacking truck.

The drum stacking truck is an electrically (battery) operated walkie truck with a drum grapple that provides stacking cabability of filled drums in the racks.

The filled drums are inspected after a predetermined time of curing. An airtight enclosure with powered roller conveyors is provided to remove the lid of the filled drum so that the filled mortar may be visually inspected for excessive cracks. The lid is reinstalled, and the drum is moved out of the enclosure to the interrogator assay system to survey radiation and surface contamination. The drum is moved and stored in the filled drum storage area if the survey results are satisfactory. The drum exterior surface is decontaminated, if required, in a decon station if surface contamination is found as a result of the survey.

The drum decon station is a motorized, enclosed turntable with spray nozzles. The enclosure is provided with doors in the front for placing the drum on the turntable. The 55-gal drum is overpacked in an 83-gal overpack drum if the exterior surface contamination of the 55-gal drum cannot be reduced to allowable levels. An overhead monorail is provided to lift and place the 55-gal drum into the overpack drum. The 55-gal drums are stored in racks, stacked four high, in the filled drum storage area. The electrically operated walkie truck is used to stack the drums in the racks. Once the drums are accumulated in sufficient quantity, they are put on pallets and transferred to the onsite CHTRU storage facility for further storage. An electric forklift truck is provided to handle palletized drums in the filled drum storage area.

2.6 PROCESS (RADWASTE TREATMENT)

The systems for processing and treating liquid and solid radwaste are described in this section.

2.6.1. LIQUID RADWASTE SYSTEM

2.6.1.A. Functions

According to 10 CFR Part 72, Sections 33, 67, and 75, the function of the liquid radwaste system is to treat both low-level and high-activity effluents adequately for release in accordance with 10 CFR Part 20 and other applicable environmental requirements.

2.6.1.B. Feed

The feed to the low-level liquid radwaste system consists of radwaste collected from the low-level radwaste drains, the washdown collection sumps, the analytical laboratory drains, and the laundry radwaste drains. The feed to the high-activity liquid radwaste system consists of the radwaste collected from the high-activity radwaste drain. Capability to process low-level liquid radwaste in the high-activity liquid radwaste area is provided.

2.6.1.C. Product

The products from both the low-level and high-activity liquid radwaste system are treated water, evaporator bottoms products, and spent resins from the ion exchangers. The treated water is recycled to the deionized water system and the bottoms product is sent to the evaporator bottoms slurry tanks in the solid radwaste system. The spent resins from the ion exchangers in both the low-level and the high-activity liquid radwaste systems are sent to the high-activity solid radwaste system.

2.6.1.D. System Process Chemistry

In the mixed-bed ion exchangers, an interchange of ions of the same species is accomplished in a stoichimetrically equivalent proportion between a solid resin and ionic species in the evaporator overhead condensate.

The reactions are represented as follows:

$$mR^{-}X^{+}(s) + M^{m+}(aq) \longrightarrow (R^{-})_{m}M^{m+}(s) + mX^{+}(aq)$$

$$nR^{+}Y^{-}(s) + A^{n-}(aq) \longrightarrow (R^{+})_{n}A^{n-}(s) + nY^{-}(aq)$$

where R^{-} and R^{+} represent the basic structure of the anion exchange resin and cation exchange resin, respectively, containing single exchange sites.

2.6.1.E. Heating and Cooling

Steam is required for both LLW (low-level waste) Liquid Evaporator and Spare EVP-102A/B and HAW (high-activity waste) Liquid Evaporator EVP-151. Saturated steam is supplied to the evaporators at 50 psig. Cooling water is required for both the LLW evaporator overhead condenser and the HAW evaporator overhead condenser. Cooling water is supplied at 85°F and is returned at 100°F. Cooling water supply pressure is estimated to be 30 psig.

2.6.1.F. Low-Level Liquid Radwaste System Equipment Description

For major equipment information, refer to Table 2-2. The low-level liquid radwaste treatment system equipment consists of LLW Liquid Collection Vessels VES-100A/B, LLW Evaporator Feed Tank TK-101, LLW Liquid Evaporator and Spare EVP-102A/B, LLW Evaporator Overhead Condenser HEX-100, LLW Evaporator Condensate Hold Tank TK-103, LLW Ion Exchanger and Spare IX-100A/B, and LLW Steam Condensate Collection Vessel VES-106.

The liquid radwaste collection vessels have a capacity of 5,385 gal each, with a connection for a vessel vent system. The two vertical vessels provide at least 7 days of surge capacity for the LLW evaporator. The vessels are operated at atmospheric pressure and 110°F. The vessels are equipped with sampling, volume, density, and temperature measuring devices. Mechanical agitation is provided to keep solids in suspension. Provision is made to neutralize the contents of the LLW liquid collection vessels with nitric acid or caustic, as required. Defoamer is added by volumetric ratio control to prevent foaming.

Table 2-2 - Major Equipment for Low-Level Liquid Radwaste Treatment System

Item	Quantity	ID	Size	Capacity (gal)	Surge Capacity	Contents
LLW liquid liquid collection vessels	2	10'-0"	7'-6" T/Top	5,385 ea 10,770 total	7 days	Low-level liquid radwaste
LLW evaporator feed tank	1	3'-6"	7'-0" T/T	588	8 hr	Low-level liquid radwaste
LLW liquid evaporator and spare	2	1'-2"	10'-8" T/T Duty 388,000 Btu/hr each	-	-	Low-level liquid radwaste
LLW evaporator overhead condenser	1	0'-8"	4'-0" T/T Duty 390,000 Btu/hr	-	-	Evaporator overhead vapor
LLW evaporator condensate hold tank	1	3'-0"	10'-0" T/T	582	8 hr	Evaporator condensate
LLW ion exchanger and spare	2	1'-0"	6'-0" T/T	37 ea 74 total	-	Evaporator condensate
LLW steam condensate collection vessel	1	2'-0"	4'-0" T/T	110	1 hr	Steam condensate

T/T: tangent to tangent
T/Top: tangent to top

The LLW evaporator feed tank has a capacity of 588 gal, with a connection for a vessel vent system. The vertical tank is provided for better cont... of the feed to the evaporator. The feed tank provides at least 8 hr surge capacity at a flowrate of 0.74 gpm (1,066 gpd). This flowrate is the maximum flowrate to the evaporator. The tank is operated at atmospheric pressure and 110°F. The tank is equipped with volume, density, and temperature measuring instrumentation. Mechanical agitation is provided to keep solids in suspension. Defoamer is added by volumetric ratio control to prevent foaming.

The horizontal, thin-film evaporator has a feed capacity of 0.74 gpm (1,066 gpd). The thin-film evaporator was chosen instead of reverse osmosis because of its ability to handle the various types of dissolved or suspended solids expected. It can handle up to 30 wt% feed solids. The horizontal evaporator was chosen instead of the vertical evaporator because of its ease of maintenance. The evaporator consists of two major assemblies: the body and the rotor-separator. The liquid radwaste enters the feed nozzle next to the heated zone, and is distributed evenly over the inner circumference of the body wall by a distribution ring mounted on the rotor. The rotor blades spread the liquid radwaste in a thin film over the entire heated wall, and generate highly turbulent flow conditions. Volatile compounds, primarily water, are rapidly evaporated. Vapors flow through the internal entrainment separator, entraining droplets and returning them to the heated zone. Clean vapors, except for traces of detergent, are now ready for condensing. To prevent any liquid carryover from the evaporator, as well as to increase the decontamination factor, two mist eliminator pads are installed at the vapor outlet in the evaporator. A water spray nozzle is provided downstream of the first mist eliminator for flushing this pad in case of plugging. The second pad is expected to remain clean.

Nonvolatile components are discharged from the evaporator from the bottom outlet. The evaporator is operated at approximately -1.2 psig. The evaporator has a heat-transfer surface area of 21.6 ft^2. An installed spare evaporator is provided for onstream factor and reliability.

The LLW evaporator overhead condenser has a capacity of 362 lb/hr (8,688 lb/day) vapor. It is a shell-and-tube-type condenser provided for condensing evaporator vapor, consisting primarily of water. Vapors at approximately -1.2 psig and 208°F enter the tubes and are condensed by the cooling water, which is in the shell. The condensed vapor leaves the condenser at 110°F. The cooling water flowrate is approximately 26,000 lb/hr (52 gpm), provided at 85°F and returned at 100°F.

The LLW evaporator condensate hold tank has a total capacity of 582 gal. The horizontal tank is provided to collect the condensed evaporator overhead vapors. The hold tank provides at least 8 hr surge capacity at a flowrate of 0.73 gpm (1,051 gpd). The tank is operated at approximately -3.1 psig and 110°F. The tank has a connection for a plant air bleed and also one for a vacuum pump, which are used together to maintain the tank under a negative pressure. The tank is equipped with an internal entrainment separator, as well as pressure and temperature measuring instrumentation.

The LLW ion exchanger has a cation resin capacity of 42,000 grains/ft^3 and an anion resin capacity of 25,000 grains/ft^3. The vertical mix-bed ion exchanger is provided as a safety feature to further clean the condensate before it is sent to the deionized water system for recycle. In the exchanger, cation and anion resins are mixed in one bed. Trace amounts of detergent carried over from the evaporator have no impact on the activity of the ion exchanger. A filter is provided at the outlet of the ion exchanger to prevent carryover of radioactive resin fines with the treated water. A spare ion exchanger is provided for onstream factor and reliability.

The LLW steam condensate collection vessel has a total capacity of 110 gal with a jacketed connection for a vessel vent system. The vertical vessel is provided to collect the steam condensate return from the LLW liquid evaporator because the pressure is not sufficient to return the condensate to the condensate flash drum directly. The condensate will be pumped from the collection vessel to the flash drum. The collection vessel provides 1 hr surge capacity at a flowrate of 0.93 gpm (1,339 gpd). The vessel is operated at approximately 50 psig and 298°F. The vessel is equipped with pressure and temperature measuring instrumentation.

2.6.1.G. Low-Level Liquid Radwaste System Process Flow Description

The major sources of low-level liquid radwaste are the low-level radwaste drains, the washdown collection sumps, the analytical laboratory drains, and the laundry system drains. The flow diagram and material balance forming the concept of the process are shown on Drawing H-3-56790, Sheet 1.

The low-level liquid radwaste containing approximately 0.4 wt% suspended and dissolved solids is received and stored in the low-level liquid radwaste collection vessels. The flow rate of low-level liquid radwaste into the collection vessel is 1,300,000 lb/yr (160,000 gal/yr) at 110°F. Mechanical agitation is provided to keep the solids in suspension.

The liquid radwaste stored in the collection vessels is pumped to the LLW evaporator feed tank upon high level. The flowrate to the feed tank is 0.74 gpm (1,066 gpd), which is the maximum processing rate for the evaporator. Mechanical agitation is provided for the feed tank to keep the solids in suspension before being sent to the evaporator. A defoamer is added to both the collection vessels and the feed tank by volumetric ratio control to prevent foaming.

The contents of the LLW evaporator feed tank, containing about 0.4 wt% total solids (5,900 lb/yr), is pumped to the LLW liquid evaporator. The evaporator feed enters the feed nozzles next to the heated zone at a flowrate of 0.74 gpm (1,066 gpd). The feed is distributed over the heated zone in a thin film by the rotor blades. The volatile components, primarily water, exit the evaporator through the vapor outlet nozzle. The concentrated evaporator bottoms, containing approximately 25 wt% solids, is then pumped to the LLW evaporator bottoms slurry tank in the low-level solid radwaste system. When the evaporator is down, or when makeup water is needed in the solid radwaste, the contents of the LLW evaporator feed tank are sent to the solid radwaste system, bypassing the evaporator. Saturated steam at 50-psig pressure is used for the evaporation medium. Plant air is provided to maintain evaporator steam jacket pressure above the process pressure in case of equipment failure or loss of steam pressure. The condensate return line is equipped with a radiation monitor as well as an inline sampler (for laboratory analysis) to give an early indication of radioactive contamination caused by a leak from the process stream. If contaminated, a valve in the condensate return stream is closed and the liquid radwaste system is shut down. The contaminated condensate and the evaporator contents are drained to a sump. Then the LLW evaporator is flushed and decontaminated.

The vapors leaving the evaporator, primarily water vapor, are condensed by the LLW evaporator overhead condenser. The vapor enters the tube side at 208°F and is condensed to 110°F. The cooling water enters the shell side at 85°F and exits at 100°F. The vapor flowrate is approximately 362 lb/hr (8,688 lb/day), which as condensate is 0.73 gpm (1,051 gpd). The cooling water flow rate is 26,000 lb/hr, which is 52 gpm. Plant air is provided to maintain condenser cooling water pressure above the process pressure in case of equipment failure or loss of cooling water pressure. The cooling water return line is equipped with a radiation monitor as well as an inline sampler (for laboratory analysis) to give an early indication of radioactive contamination caused by a leak from the process stream. If contaminated, a valve in the cooling water return is closed and the liquid radwaste system is shut down. The contaminated cooling water and condenser contents are drained to a sump. Then the LLW evaporator overhead condenser is flushed and decontaminated.

The condensate leaving the overhead condenser is collected in the LLW evaporator condensate hold tank. The condensate enters at approximately -3.1 psig and 110°F. A plant air bleed in conjunction with a vacuum pump is used to keep the tank under negative pressure. As the liquid level goes down in the tank, plant air reduced to 1 psig is bled to keep the vacuum constant. When the liquid level increases, vapors are drawn off by the vacuum pump to maintain a constant negative pressure.

The evaporator condensate from the hold tank is pumped to the LLW ion exchanger for further cleaning and deionization. The LLW ion exchanger contains 2.4 ft^3 of resin, in a bed with 1 ft dia and 3 ft depth. The condensate enters the top of the LLW ion exchanger and leaves through the bottom. The pressure imposed by the feed pump forces the condensate through the bed. The condensate passes through the bed and any impurities, including those that are radioactive, are removed. When the resin is spent, either by radioactivity contamination or by loss of exchange capabilities, the resin is changed. Regeneration is not used because it generates liquid radwaste, which would have to be treated. In addition, the quantity of resin used is small, so regeneration is not cost effective. The spent resin is transferred by steam ejector, in slurry form, to the HAW solid radwaste system for disposal. The condensate passes through a filter to prevent radioactive resin fines carryover, and is then checked for contamination before it is recycled for deionized water. If contaminated, the condensate is returned to the LLW evaporator feed tank for reprocessing. If the condensate is not contaminated, but has high conductivity, it is sent to the cooling water return instead of the deionized water recycle.

2.6.1.H. HAW Liquid Radwaste System Equipment Description

For major equipment information, refer to Table 2-3. The high-activity liquid radwaste system consists of HAW Liquid Collection Vessel VES-150, HAW Liquid Evaporator EVP-151, HAW Evaporator Overhead Condenser HEX-150, HAW Evaporator Condensate Hold Tank TK-152, HAW Ion Exchanger IX-150, and HAW Steam Condensate Collection Vessel VES-155.

The HAW liquid collection vessel has a capacity of 5,006 gal, with a connection for a vessel vent system. The horizontal vessel provides the capacity for collecting the liquid radwaste generated during decontaminating the largest surface area of one of the hot cells. The spent decontamination solution from decontaminating one wall is then treated before the next wall is decontaminated. The HAW liquid collection vessel is operated at atmospheric pressure and 150°F. The HAW liquid collection vessel is equipped with sampling, volume, density, and temperature measuring instrumentation. Mechanical agitation is provided to keep solids in suspension. A defoamer is added by volumetric ratio control to prevent foaming.

The horizontal, thin-film evaporator has a feed capacity of 1.92 gpm (2,765 gpd). The evaporator for the high-activity liquid radwaste system is the same type as that used for the low-level liquid radwaste system, only larger. A larger evaporator size was chosen because of the hot-cell decontamination procedures. The shielded process cell walls are decontaminated in sequence, with the decontamination waste from each wall being processed before the next wall is decontaminated. The larger evaporator is used to process the waste as quickly as possible so that the decontamination procedure can continue. The evaporator has a heat-transfer area of 53.8 ft^2. Another feature of the evaporator is the two mist-eliminator pads, each with a spray nozzle, to ensure high decontamination factors. No spare evaporator is required because of infrequency of use of the high-activity liquid radwaste system.

The HAW evaporator overhead condenser has a capacity of 939 lb/hr. The condenser for the high-activity system is the same type as that used for the low-level system, only larger. Thus, the operating conditions and the operating procedures are the same. The cooling water flow rate is approximately 67,330 lb/hr (135 gpm), provided at 85°F and returned at 100°F.

The HAW evaporator condensate hold tank has a total capacity of 1,347 gal. The hold tank for the high-activity system is the same type as that used for the low-level system, only larger. Thus, the operating conditions and the operating procedures are the same. The hold tank provides at least 8 hr surge capacity at a flow rate of 1.89 gpm (2,722 gpd).

The HAW ion exchanger has a cation resin capacity of 42,000 grains/ft^3 and an anion resin capacity of 25,000 grains/ft^3. The vertical mixed-bed ion

Table 2-3 - Major Equipment for High-Activity Liquid Radwaste Treatment System

Item	Quantity	ID	Size	Capacity (gal)	Surge Capacity	Contents
HAW liquid collection vessel	1	6'-6"	18'-0" T/T[a]	5,006	7 days	High-activity liquid radwaste
HAW liquid evaporator	1	1'-8"	17'-0" T/T Duty 968,400 Btu/hr	-	-	High-activity liquid radwaste
HAW evaporator overhead condenser	1	0'-8"	8'-0" T/T Duty 1,010,000 Btu/hr	-	-	Evaporator overhead vapor
HAW evaporator condensate hold tank	1	4'-0"	13'-0" T/T	1,347	8 hr	Evaporator condensate
HAW ion exchanger	1	1'-0"	7'-0" T/T	43	-	Evaporator condensate
HAW steam condensate collection vessel	1	2'-6"	5'-0" T/T	214	1 hr	Steam condensate

[a]T/T: tangent to tangent

exchanger for the high-activity system is the same type as that used for the low-level system. Thus, the operating conditions and operating procedures are the same.

The HAW steam condensate collection vessel has a total capacity of 214 gal with a jacketed connection for a vessel vent system. The vertical vessel is provided to collect the steam condensate return from the HAW liquid evaporator because the pressure is not sufficient to return the condensate to the condensate flash drum directly. The condensate will be pumped from the collection vessel to the flash drum. The collection vessel provides 1 hr surge capacity at a flow rate of 2.3 gpm. The vessel is operated at approximately 50 psig and 298°F. The vessel is equipped with pressure and temperature measuring instrumentation.

No spare equipment is required because of the infrequency of use of the HAW liquid radwaste system.

2.6.1.1. HAW Liquid Radwaste System Process Flow Description

The major sources of high-activity liquid radwaste are the high-activity radwaste drains. The flow diagram and material balance forming the concept of the process are shown on Drawing H-3-56790, Sheet 2.

The high-activity liquid radwaste, containing approximately 0.1 wt% suspended and dissolved solids (1,830 lb/yr), is received and stored in the HAW liquid collection vessel. The flow rate of high-activity liquid radwaste into the collection vessel is 1,500,000 lb/yr (183,250 gal/yr) at 150°F. Mechanical agitation is provided to keep the solids in suspension.

The liquid radwaste stored in the collection vessel is pumped to the HAW liquid evaporator upon high level. The flow rate to the evaporator is 1.92 gpm (2,765 gpd) at atmospheric pressure and 150°F. This flow rate is the maximum processing rate for the evaporator. The evaporative process is the same as that for the low-level system. The concentrated evaporator bottoms, containing approximately 25 wt% solids, are pumped to the HAW evaporator bottoms slurry tank in the solid radwaste system. Saturated steam at 50 psig is used as the evaporation medium. Plant air is provided to maintain evaporator steam jacket pressure above the process pressure in case of equipment failure or loss of steam pressure. The condensate return line is equipped with a radiation monitor as well as an inline sampler (for laboratory analysis) to give an early indication of radioactive contamination caused by a leak from the process stream. If contaminated, a valve in the condensate return stream is closed and the liquid radwaste system is shut down. The contaminated condensate and the evaporator contents are drained to a sump. Then the evaporator is flushed and decontaminated.

The vapors leaving the evaporator, primarily water vapor, are condensed by the HAW evaporator overhead condenser. The vapor enters the HAW evaporator overhead condenser at 208°F and is condensed to 110°F. The cooling water enters the shell side at 85°F and exits at 100°F. The vapor flow rate is approximately 939 lb/hr, which as condensate is 1.89 gpm (2,722 gpd). The cooling water flow rate is 67,330 lb/hr, which is 135 gpm. Plant air is provided to maintain HAW evaporator overhead condenser cooling water pressure above the process pressure in case of equipment failure or loss of cooling water pressure. The cooling water return line is equipped with a radiation monitor as well as an inline sampler (for laboratory analysis) to give an early indication of radioactive contamination caused by a leak from the process stream. If contaminated, a valve in the cooling water return is closed and the evaporator and condenser are shut down. The contaminated cooling water and condenser contents are drained to a sump. Then the LLW evaporator overhead condenser is flushed and decontaminated.

The condensate leaving the HAW evaporator overhead condenser is collected in the HAW evaporator condensate hold tank. The condensate enters at approximately -3.1 psig and 110°F. Constant vacuum is maintained in the tank by the same type of system used for the LLW evaporator condensate hold tank.

The evaporator condensate from the hold tank is pumped to the HAW ion exchanger for further cleaning and deionization. The exchanger contains 2.75 ft^3 of resins, in a bed with 1 ft dia and 3.5 ft depth. The ion exchanger operating procedures are the same as those used in the low-level system. Regeneration of the bed is not cost effective. The spent resins are transferred by steam ejector, in slurry form, to the high-activity solid radwaste system for disposal. The condensate is checked for contamination before recycle for deionized water. If the condensate is not contaminated, but has high conductivity, it is sent to cooling water return instead of deionized water recycle.

2.6.2 SOLID RADWASTE SYSTEM

2.6.2.A. <u>Functions</u>

The purpose of the solid radwaste system is:

(1) To collect all solid wastes in the radwaste area and store them separately by their characteristics, such as combustibility and dose rate.

(2) To reduce the waste volume by compaction.

(3) To separate low-level waste (LLW) from CHTRU.

(4) To package the wastes in drums for storage with or without solidification according to the requirement at the waste storage facilities.

2.6.2.B. <u>Feed</u>

The solid radwaste system is divided into LLW/CHTRU and HAW radwaste systems.

The feed streams to the solid radwaste system (see Drawing H-3-56791, Sheets 1 and 2) are combustible radwaste, noncombustibles, spent HEPA filters and prefilters, and the evaporator bottoms slurry. Contaminated Freon sludge and filters from the laundry system, spent resins from the ion exchanger, contaminated sludge from the washdown collection sumps, and contaminated sludge from the welding stations are also fed into the system intermittently.

The composition of the LLW/CHTRU combustible radwaste is estimated in Table 2-4.

Table 2-4 - The Composition of the Combustible Feed

Combustible Radwaste	Rate (lb/yr)	Weight %
Cotton	2,100	14.0
Latex	600	4.0
Vinyl	4,300	28.7
Polyvinyl chloride (PVC)	4,400	29.3
Polyethylene	1,200	8.0
Paper	500	3.3
Miscellaneous	1,900	12.7
Total	15,000	100.0

The noncombustible radwaste consists of contaminated equipment, tools, and metal pieces that are produced in the MRS Facility.

HEPA filter assemblies for hot cells and the remote handled maintenance room consist of three groups of filters: (1) 2-stage in-cell filters, (2) first-stage testable filters, and (3) 2-stage final filters for Zones 1 and 2. The in-cell filters and the first-stage testable filters are considered to be HAW. Zone 1 and 2 final filters and a set of prefilters and HEPA filters located at the glove boxes in the radwaste area and in the analytical laboratory are considered to be CHTRU. Zone 3 and 4 final filters and all other contaminated filters are LLW.

The CHTRU and LLW filters are fed to the filter compactor/packaging unit (CPR-200) in the solid radwaste area, and baled and packaged in 55-gal drums.

The evaporator bottoms slurry from the LLW and HAW liquid radwaste systems are collected in the LLW and HAW evaporator bottoms slurry tanks, respectively, and used for grout mixing.

Spent resins from both LLW and HAW liquid radwaste systems are transferred by steam ejector to the spent resin slurry tank in the HAW solid radwaste system intermittently, approximately 4 times a year.

HAW noncombustibles are failed equipment, broken tools, and miscellaneous items from a hot cell or an equipment maintenance cell.

Both in-cell HEPA filters and the first-stage testable HEPA filters are considered HAW.

2.6.2.C. Product

The products from the LLW/CHTRU solid radwaste system are 55-gal drums containing radwaste, with or without grout. The combustible radwaste is solidified with grout, whereas the noncombustible radwaste and the compacted HEPA filters and prefilters are packaged directly in 55-gal drums. Grout is made of cement, sand, and evaporator bottoms slurry. The total number of drums is 265 per year with solidified radwaste and 11 per year with noncombustible radwaste. The number of drums with LLW or CHTRU filters is 249 per year. Also, there are 8 drums per year of solidified Freon sludge, sludge from vehicle washdown, and sludge from the washing stations. Freon sludge is solidified with a basic solidification process, using cement and some proprietary chemicals to enhance the hardening of cement. There has been no attempt to test Freon sludge for leachability requirements as specified in 10 CFR 61 because it is considered Class A waste rather than Class B or C waste. Only Class B or C waste requires leachability testing.

The products from the HAW solid radwaste system are 55-gal drums filled with solidified radwaste or compacted filters.

Spent resin slurry from both LLW and HAW liquid radwaste systems are mixed with dry cement and solidified in 55-gal drums. The total number of solidified resin drums is 12 per year.

The HAW evaporator bottoms slurry is mixed with dry cement and solidified in 55-gal drums. There are 21 drums per year of solidified evaporator bottoms.

Almost all of the HAW noncombustibles are assumed to be converted to low-level waste or CHTRU by decontamination.

The HAW HEPA filter frames are separated from filter media, sheared, and put into 55-gal drums. The filter media are compacted and placed into 55-gal drums. Total drums with filter frames and the media are 1,350 per year.

2.6.2.D. LLW/CHTRU Solid Radwaste System Process Description

1. LLW Evaporator Bottoms Slurry. LLW evaporator bottoms slurry with approximately 25 wt% solids, including dissolved solids, is pumped into LLW Evaporator Bottoms Slurry Tank TK-300 at a rate of 0.012 gpm (17.3 gpd).

The evaporator bottoms slurry is used to make grout for solidification of LLW/CHTRU combustibles. The total water required to make enough grout for the combustibles is 52,710 lb/yr. The total water in the slurry is 17,253 lb/yr; therefore, the balance is made up from the LLW evaporator feed tank. The 208°F slurry is cooled in LLW Evaporator Bottoms Slurry Tank TK-300 by mixing with makeup water. An agitator in the tank promotes mixing as well as keeping the solids in the slurry in suspension.

The slurry is pumped to the grout mixer by LLW Evaporator Bottoms Slurry Feed Pump P-300A/B. The pump is an air-driven, double-diaphragm pump.

2. LLW/CHTRU Combustibles. Combustible radwaste consists of smear papers, worn shoe covers, gloves from the glove boxes, lightweight vinyl gloves, worn coveralls and hoods, and disposable bags for HEPA filters and prefilters. The combustibles are placed into plastic bags and the bags are, in turn, placed into 55-gal drums. The drums are transferred to the combustible material handling enclosure. When enough combustibles are accumulated, they are taken out of the plastic bags and are placed into a 14-gal basket, and the 14-gal basket is placed in the center of a 55-gal drum. The purpose of the 14-gal basket is to hold the combustibles in the center of the drum during and after pouring the grout into the drum. The capacity of the 14-gal basket is 25% of a drum by volume. Up to 25 vol% of combustible CHTRU is allowed in containers, in accordance with MRS Facility Functional Design Criteria. A drum with a combustible-full, 14-gal basket is filled with grout up to 85% of the volume. The grout is made of 240 lb of cement, 30 lb of sand, and 24 gal of evaporator bottoms slurry. Enough grout to fill one drum is mixed at a time. During drum filling, the drum vibrator under the drum starts to operate to promote homogeneous filling. After a drum is filled, it is inspected for exterior contamination. If contaminated, it is sent to a decon station to decontaminate the exterior.

Noncontaminated drums are sent to the drum curing room, where they are allowed to cure for 3 days. After the 3-day curing time, the drums are moved to the inspection area, where the lids are removed and the cement is inspected visually. Free liquid, if any, is removed by wet vacuuming and is drained into a sump. Any drum having damaged cement (i.e., major cracks in the cement) is overpacked into another container before it is sent to storage.

3. LLW/CHTRU Noncombustibles. The noncombustible LLW/CHTRU radwaste consists of radiologically contaminated failed equipment, such as pumps, blowers, and tools. The noncombustibles are stored in 55-gal drums as they are generated, and the drums are inspected for surface contamination. If contaminated, they are decontaminated in the LLW/CHTRU drum decon station and sent to the drum interrogator. If drum surfaces are not contaminated, the drums are sent directly to the drum interrogator.

Contaminated cartridge filters from Freon Dry Cleaning Unit FDC-40 in the contaminated laundry are stored with noncombustibles in drums. The filters are received intermittently at a rate of 36 filters per year. The filters are normally wet when they are collected. The filters are dried in the Freon dry cleaning unit before they are stored in the drum. The materials in these drums are not immobilized by a filler material because they are noncombustible and do not contain free liquid.

Contaminated sludge from welding stations, contaminated laundry (dry cleaning), and vehicle washdown are transferred into empty drums, either by a pump or by gravity flow. The drum is taken into an enclosed area, in the LLW solid radwaste system, where cement is added and the drum is tumbled to form a homogeneous mixture. The drum is then processed the same way as other drums with solidified material. Eight drums of solidified sludge are produced in a year.

4. LLW/CHTRU Filters. Approximately 778 contaminated HEPA filters per year and 1,079 prefilters per year (except HAW filters) are collected in the contaminated HEPA filter collection storage. Four wooden-framed HEPA filters, or 20 prefilters, are compacted together in the filter compactor/packaging unit. The compacted filters are placed into 55-gal drums before being sent to an inspection station to check for drum surface contamination. Offgas from the compactor is passed through a local HEPA filter and sent to the HVAC exhaust system before being emitted to the atmosphere.

5. Drum Interrogator. All drums containing LLW/CHTRU radwaste are passed through the drum interrogator. The interrogator determines the presence of TRU material by gamma pulse-height analysis. Drums with TRU material (CHTRU) are sent to the onsite CHTRU storage facility. Drums without TRU material (LLW) are sent to a temporary storage facility before being shipped for offsite disposal.

2.6.2.E. HAW Solid Radwaste System Process Description

1. Spent Resins Slurry. Spent resin slurry with 20% resins by weight from the HAW liquid radwaste system is transferred by steam ejector to Spent Resin Slurry Tank TK-302; the slurry is transferred to the tank about twice a year. The slurry is pumped to a drum, which contains a predetermined quantity of dry cement, and the drum is then sent to the drum tumbler for mixing into a homogeneous mass. No problems are anticipated with "hot spots" on the drum surface, resulting from segregation of materials, because the drums are handled remotely. Afer solidification, the drums are sent for inspection, curing, and storage.

Also, spent resin slurry from the LLW liquid radwaste system is transported to Spent Resin Slurry Tank TK-302 about twice a year, and is processed the same way as HAW resins. The amount of slurry to the drum is equivalent to 24 gal of water in the slurry. Twelve drums of solidified spent resins are produced in a year.

2. HAW Evaporator Bottoms Slurry. HAW evaporator bottoms slurry with approximately 25 wt% solids, including dissolved solids, from the HAW liquid radwaste system is pumped into HAW Evaporator Bottoms Slurry Tank TK-301 at a rate of 0.0084 gpm. The slurry is at 208°F and is cooled to 100°F in jacketed piping with cooling water before entering the slurry tank. Plant air is provided to maintain cooling water pressure above the process pressure in case of internal pipe failure or loss of cooling water pressure. The cooling water return line is equipped with a radiation monitor as well as an in-line sampler (for laboratory analysis) to give an early indication of radioactive contamination caused by a leak from the process stream. If contaminated, a valve in the cooling water return will be closed and the condenser is shut down. Then the contaminated cooling water will be drained to a sump, and the jacketed piping will be flushed and decontaminated.

An agitator in the tank keeps solids in the slurry in suspension. The slurry is pumped to a drum containing a predetermined quantity of dry cement. Each drum, which contains 320 lb of cement and 32 gal of slurry, is transported to the tumbler. The drum is tumbled 360 deg so that the cement and slurry are thoroughly blended into a homogeneous mix. The total HAW evaporator bottoms slurry solidified is 21 drums per year. Drums with solidified evaporator bottoms slurry, as well as with solidified spent resin slurry, are remotely swipe tested for drum exterior contamination. If contaminated, they are decontaminated in the HAW drum decon station and then, along with noncontaminated drums, are sent to the drum curing area. When the drum contents are solidified, the drums are placed into the drum storage cage for onsite storage.

3. HAW Noncombustibles. The noncombustibles from the hot cells are highly contaminated and are remotely handled. They are sent directly to the decon station in the maintenance cell to reduce the surface radiation level below 200 mR/hr, which is the allowable rate for CHTRU. After decontamination, the noncombustibles are sent to the maintenance cell inspection station. Items whose surface dose rate is below 10 mR/hr are drummed in the contact handled cell and sent to the solid radwaste area. Items with surface radiation levels between 10 and 200 mR/hr are handled remotely. Others, with dose rates above 200 mR/hr, are sent to the HAW HEPA filter drum-filling station in the maintenance cell, and then to the onsite storage area. The material in the drums is not immobilized by a filler material because it is noncombustible and there is no free liquid.

4. HAW HEPA Filters. There are approximately 4,000 in-cell HEPA filters and first-stage testable HEPA filters contaminated each year. These filters are transferred remotely to the HEPA filter cutter/compactor room, where they are placed into the cutter/compactor. For a detailed description of the HAW HEPA filter cutter/compactor operation, refer to Section 2.5.17.A.

2.7 MECHANICAL PROCESS

2.7.1 DECON SOLUTION/DECON SYSTEMS

The decon solution preparation system (see Drawing H-3-56792, Sheet 1) prepares and supplies chemical solutions to the decontamination stations at different locations in the R&H Building. These chemicals are used, as necessary, in decontamination of the facility and equipment surfaces in order that radiation levels are minimized to reduce exposure to the operating personnel and for the decommissioning effort. In addition, the system may supply acid or caustic solutions, as needed, throughout the plant for neutralizing waste solutions.

This system consists of four 250-gal makeup tanks, with agitators and steam heating coils, and six 20-gpm pumps. The four tanks are filled with nitric acid, caustic, and two proprietary decon solutions: a nonphosphated liquid detergent (Turco 4324NF or equal) for areas with low-level contamination, and a phosphoric/citric acid decon agent (Turco 4512A or equal) that can be applied to hot cell surfaces as a foamed decontamination agent. These tanks can be used for other decon agents if necessary. The supply pumps are positive-displacement, air-driven, double-diaphragm pumps, which inherently provide constantly pressurized supply lines, ready to provide flow upon demand.

Other decon systems (see Drawing H-3-56792, Sheet 2) are provided for specific situations as follows:

- The drum decon spray package (SME-400) provides 1,200-psig demineralized water to perform external decontamination of low-level and HAW solid waste drums.

- The high-pressure portable spray package (SME-401) provides up to 10,000-psig demineralized water to perform decontamination of shielded process cell and ventilation duct surfaces.

- The high-pressure spray package (SME-402) provides 10,000-psig demineralized water for use in the maintenance cell decon room.

- The manipulator and tool Freon decon package (SME-403) is a glove-box-type unit for cleaning contaminated manipulators and other tools, using a Freon 113 spray.

- The electropolisher (SME-407) in the maintenance cell decon room may be used remotely to decontaminate tools and equipment to near-background levels of radiation, either for disposal or for reuse.

- The Freon decon package (SME-408) in the maintenance cell decon room may be used remotely to decontaminate small equipment.

- The drum Freon stations (SME-409A/B) in the maintenance cell are used to supply, receive, and process Freon 113 to the drum decon cell decon stations, where secondary waste drums are decontaminated.

Contaminated Freon and electropolisher sludges are drained to local radwaste drain sumps. Contaminated electropolishing unit filters are changed by remote manipulator, whereas the filters for the glove-box-type manipulator and tool Freon decontamination unit are maintained manually.

2.7.1.A. Cask Handling and Decon Rooms

Decon stations are provided at cask handling and decon rooms. Each station is provided with a decon supply line and utilities. The incoming contaminated casks are decontaminated (if required), using buckets and wipes, after unloading and before the casks are removed from the facility.

2.7.1.B. Shielded Process Cells

Two different tactical approaches are followed for decontamination of all remote hot cells, including the shielded process cells: routine remote light housekeeping and infrequent major remote decontamination campaigns. Light housekeeping involves electromechanical manipulator operation of a portable, in-cell shop vacuum cleaner for limited area removal of light surface dust. This operation is performed during a slack period of shielded process cell operation whenever a dust film or an accumulation of larger particles is visually observed. The purpose of this operation is to remove loose contaminants before they become firmly affixed to metal surfaces, as they may over long periods.

Major remote decontamination campaigns are carefully planned after it has been determined that manned entrance is absolutely necessary. The campaign is initiated with remote removal of all fuel and in-cell equipment to facilitate subsequent decontamination operations. The next operation is dry vacuuming of all accessible shielded process cell surfaces. This removes as much loose contamination as possible to minimize the volume of liquid waste generated during subsequent liquid decontamination. Then the portable foam ejector is connected to decontamination and air lines at a shielded process cell decontamination station located outside the shielded process cell. Foam concentrate is ejected from a drum and the resulting decontamination foam is conveyed through one of several wall penetrations into the shielded process cell. The electromechanical manipulator holds an attached flexible hose and directs the decontamination foam onto cell surfaces. After covering one area with foam, the operator waits at least 15 minutes, or until the foam no longer adheres to vertical surfaces. Then the remaining foam is vacuumed up by a wet vacuum unit, into a tank in which some anti-foam agent has been introduced to facilitate foam volume reduction. When full, the wet vacuum tank is drained into the shielded process cell HAW radwaste sump for transfer to the HAW liquid radwaste system. Processing foaming agent through the evaporator is believed to be practical as long as careful attention is paid to the addition of defoaming agents. There is, however, no known experience with the evaporation of foamed decontamination agents.

The final remote decontamination operation is a high-pressure spray rinse of exposed shielded process cell surfaces with 10,000-psi demineralized water. This is accomplished by bringing a high-pressure portable spray unit (mounted on a battery-driven pallet cart) and connecting it to a shielded process cell wall penetration. For criticality safety, the portable spray unit is equipped with a 500-gal-capacity decontamination rinse tank. To limit the amount of water that could be accidentally introduced into the lag storage pit, the spray unit tank is designed so that the fill connection and the discharge connection physically interfere, making simultaneous connections impossible. Thus, only 500 gal can be delivered before a manual disconnection/refilling operation is necessary. There is no possibility of accumulating liquid in the shielded process cell, as the hydrolaser will be set to operate at 10 gpm for cell decontamination, and the in-cell radwaste drain ejector is sized to empty the sump at a rate of 20 gpm. After reconnection, spraying can be started again. These restrictions apply to decontamination of the shielded process cells, the lag storage, shielded canyon cell, and the shredder drum decontamination station.

A flex hose with a hooded spray bar holding three discharge nozzles is attached to the interior connection of the cell wall penetration. The spray bar is held by the in-cell electromechanical manipulator. The electrical system of the crane is designed to prevent water entry and consequent damage. As an added precaution, the high-pressure jet should not be directed at crane electrical equipment.

The hood serves to limit the splash of impact and has guide rollers that contact the surface to position the nozzles the correct distance (4 in.) from the surface. All accessible surfaces of the shielded process cell are rinsed in this manner, with the water draining to the HAW radwaste sump.

Because the HAW liquid collection vessel is sized to contain only a fraction of the total liquid waste from a full shielded process cell decontamination, the decontamination operation must be sequenced to prevent overflow of the vessel.

In the normal course of operation, spent fuels are consolidated into a storage canister. After consolidation, the canister is transferred into the welding station decontamination/evacuation chamber, where it is sealed, leak-tested, and decontaminated. Liquid Freon 113, the cleaning and decontamination agent, is supplied from the Freon system, which recovers and reprocesses the solvent. A process description of the system is given in Section 2.7.6.

2.7.1.C. Maintenance Cell

The maintenance cell is a remote hot cell; its decontamination procedure exactly follows that of the process cells previously discussed in Section 2.7.1.B.

During normal operation of the maintenance cell, equipment coming from the shielded process cells for repair is transferred by crane to the maintenance cell located below the shielded process cells. All repairable equipment is decontaminated in a shielded room, using manipulators and one of the following: high-pressure water spray decontamination equipment, the electropolisher, or the Freon spray cleaner. Decontamination will continue until the equipment is acceptable for either contact or remote maintenance, or is sent to waste.

Unrepairable equipment to be disposed of is overpacked in drums, sealed, and decontaminated before shipment to the storage area.

2.7.1.D. Drum Decontamination Stations

These are semiautomatic decontamination stations used for drums containing immobilized low-level/CHTRU solid wastes, high-activity solid wastes, or secondary wastes. Each drum decontamination station has a motor-driven turntable inside a steel enclosure with a pipe manifold with spray nozzles. The drum is decontaminated by actuating the switches that turn on the turntable and the high-pressure (1,200-psi) water spray. One common drum decontamination spray package consisting of a water heater tank and a positive-displacement pump, supplies water to each of the drum decontamination stations, as needed.

2.7.1.E. Remote Handling Air Filtration Cell Equipment Decon

Decontamination solution is supplied to the equipment decontamination rooms on the third floor. A portable high-pressure spray washer is used for cleaning small equipment before it is contact handled for repair.

2.7.1.F. HVAC Duct Decontamination

Air ducts between the in-cell nontestable filter and the first-stage testable filters may be internally decontaminated to reduce radioactive particulate buildup along the walls. Exhaust flow must be stopped to perform decontamination. High-Pressure Portable Spray Package SME-401 is stationed in the operating gallery and supplies 10,000-psi deionized water to a flex hose with a jet-propelled spray head attached that is remotely positioned in the duct. When the pump is turned on, the spray head is propelled by the force of the backward-directed jet spray, pulling the flex hose into the duct as it cleans. Suitable access openings are provided in the duct to facilitate this operation. Drainage flows to HAW radwaste drain sumps, and is ejected to the HAW liquid radwaste collection vessel.

2.7.1.G. High-Activity Radwaste Cell

The radwaste cell is a remote hot cell; its decontamination procedure follows exactly that of the process cells previously discussed in Section 2.7.1.B.

Decontamination of equipment internals is accomplished by filling the equipment with decontamination solution from HAW Decon Solution Vessel VES-151. Existing system pumps are used to circulate decontamination solution through the equipment and back to Liquid Collection Vessel VES-150 for treatment in the HAW liquid radwaste system.

2.7.1.H. Crane Decontamination

Based on adherence to a monthly scheduled decon/maintenance, the cranes and bridge rails are calculated to have levels of contamination within those allowed for contact maintenance. The crane hook and manipulator jaws may have contamination levels above those allowed for contact maintenance. To accomplish crane decontamination, the jaws and crane hooks are detached and left in the hot cells, from which they may be taken by crane to the maintenance cell for decontamination and repair, if required. Then the crane and bridge are taken into the crane maintenance room for contact decontamination with mops and buckets or a permanently installed manifold of spray nozzles, which are remotely activated, is used to decontaminate, if necessary.

2.7.1.I. Manipulator and Tool Decontamination

Master/slave manipulators have detachable jaws that can be left in the hot cell. The rest of the slave is covered by an elastomer boot that is left in the cell during manipulator removal. The purpose of the boot is to minimize contamination of the slave mechanism, allowing the slave to be removed manually without the need for a remote in-situ decontamination step. The boots of master/slave manipulators in the shielded canyon cells are remotely replaced, using the bridge-crane-mounted electromechanical manipulators. The manipulator boots in the remote handled equipment maintenance room and high-activity waste cell are replaced from outside the cell with a special installation tool, using push-through technique.

Contaminated manipulators are removed from service by a bag-out operation and transported to the manipulator maintenance room for decontamination and repair. They are lowered into the Freon manipulator decontamination station, where the bag is removed and the manipulator decontaminated by high-pressure Freon spray. Small contaminated tools and equipment are decontaminated in a manner similar to the manipulators, but in the tool decontamination station.

These operations are conducted by an operator working through gloved access ports in the walls of the decontamination stations. The manipulator and tool Freon decontamination package consist of both of these decontamination stations, as well as a distillation and filtration unit to reprocess the spent Freon. Filter cartridges are changed out by hand, with a frequency based on either pressure drop or radiation level indications. Sludge accumulation, consisting mostly of grease and oils, is removed from the distillation unit by a bottom drain, is routed to a HAW radwaste drain sump, and ejected to the HAW liquid radwaste collection vessel.

2.7.1.J. Decontamination of Miscellaneous Low-Level Areas

Low-level contamination on room surfaces is removed by vacuum cleaners and mild detergent solutions applied with mops.

2.7.2 RADWASTE DRAIN SYSTEM

2.7.2.A. Low-Level Radwaste Drain System

The low-level radwaste drain system (see Drawing H-3-56800, Sheet 1) collects drainage from contaminated low-level areas and transfers this waste to the liquid radwaste system for treatment.

Low-level radwaste drainage in the MRS Facility comes from a number of sources in the R&H Building:

(1) Low-level liquid radwaste area and equipment
(2) Health Physics
(3) Cask-handling areas
(4) Low-level solid radwaste area and drum decontamination
(5) Analytical laboratory

(6) Final HEPA filter spray drain
(7) Manipulator maintenance room
(8) Safety showers
(9) Loadout/decontamination area
(10) Weld test and decontamination equipment room
(11) Laundry room (area decontamination)

All of these areas drain to one or more sumps. The final HEPA filter sumps, health physics, analytical laboratory drain sump, and the liquid radwaste equipment drains are closed vessels with hard-piped inlet, outlet, and offgas lines because these potentially contaminated sumps are located in accessible areas. The other sumps are of normal open design.

Because of the potential contamination level for all of the sumps of this system, pumpout is achieved with level-switch-operated steam ejectors, except in the case of the analytical laboratory. The use of ejectors increases reliability and decreases maintenance time and maintenance worker radiation exposure. The analytical laboratory sump is pumped with an air-driven, double-diaphragm pump instead of a steam ejector. This keeps the fluid temperature and corrosiveness of the solution very low. Automatic air purge of steam jets is provided.

The total average quantity of low-level radwaste delivered to the liquid radwaste system is estimated at 675,000 lb/yr, including the motive fluids used in jetting.

2.7.2.B. HAW Radwaste Drain System

The HAW radwaste drain system (see Drawing H-3-56800, Sheet 2) collects drainage from normally contaminated HAW areas and transfers this waste to the HAW liquid radwaste system for treatment.

HAW radwaste drainage in the MRS Facility comes from a number of sources in the R&H Building:

(1) Maintenance cell decontamination
(2) Shielded process and canyon cell decontamination
(3) Remote handling air filtration cells and equipment decontamination
(4) Crane maintenance decontamination
(5) High-activity waste cell decontamination and drainage
(6) Secondary waste reduction room decontamination
(7) Secondary waste reduction drum decontamination
(8) Solidified HAW drum decontamination
(9) Process cell exhaust duct decontamination
(10) In-cell equipment decontamination
(11) Cask offgas condensate from gas sampling and depressurization

All of these areas drain to one or more sumps. The sumps are of open design, with the exception of the equipment drains in the high-activity radwaste cell, which are of closed design with hard-piped inlet, outlet, and offgas lines.

Because of the contamination level for all of the sumps of this system, pumpout is achieved with level-switch-operated ejectors. The use of ejectors increases reliability and decreases maintenance time and maintenance worker radiation exposure. Steam is the motive fluid for these ejectors. Automatic air purge of steam jets is provided.

The total average quantity of HAW radwaste delivered to the liquid radwaste system is estimated at 1.5 million lb/yr, including the motive fluids used in jetting.

2.7.3 COMPRESSED AIR SYSTEMS

In the R&H Building, there are two compressed air systems: breathing air system and plant and instrument air system (see Drawing H-3-56799).

2.7.3.A. Breathing Air

The breathing air system in the R&H Building compresses, cools, dries, and purifies atmospheric air for distribution of breathable air for use in hoseline respirators. Air quality instrumentation is provided to monitor temperature, oxygen, and carbon monoxide content of the purified air. When these levels approach the limits of the Compressed Gas Association Commodity Specification for air, CGA G-7.1, Grade D, an alarm is sounded locally (near the user), informing him of the imminent shutdown of the air compressor, which will occur after an adjustable time delay. An additional local alarm warns the user of compressor failure. Five-minute emergency escape air bottles, supplied with the individual respirators, provide additional protection.

Intake air is filtered; compressed to 200 psig by a non-lubricated, air-intercooled, two-stage reciprocating air compressor or spare; and cooled by a water-cooled aftercooler. Condensed water is removed in a centrifugal-action water separator, the air receiver, and the water removal section of the air purifier. Carbon monoxide is removed in the purifier.

In addition to the supplied air system, an air pack bottle filling unit, SME-700, is provided to recharge SCOTT-PAK type breathing air bottles. This unit is completely self-contained, with a four-stage, air-cooled compressor, air purification system, fill station, controls, and air quality monitors. The unit is capable of refilling 45-cu-ft bottles at a rate of 6 bottles/hr.

2.7.3.B. Plant and Instrument Air

The plant and instrument air system compresses, cools, filters, and dries atmospheric air for distribution. Plant air is used for driving air tools, blowguns, etc.; instrument air is used for pneumatic valves, analyzers, dampers, and instruments.

The intake air is filtered; compressed to 150 psig by an oil-lubricated, air-intercooled, two-stage reciprocating air compressor; and cooled by a water-cooled aftercooler. Condensed water and oil are removed in a centrifugal-action water separator, the air receiver, and the 5-micron disposable cartridge prefilter and 0.03-micron disposable cartridge coalescing filter. Part of the compressed air stream is passed through a refrigerated dryer capable of furnishing 40°F dewpoint air to the plant air system. The remaining air passes through a 0.01-micron, activated-carbon adsorber, a heatless regenerative desiccant instrument air dryer, and a 5-micron disposable cartridge afterfilter. The instrument air, having a dewpoint of -40°F, is reduced in pressure to 100 psig and distributed throughout the building. An air line is taken off upstream of the instrument air dryer and supplies humidified air for the operation of "bubbler-type" level instrumentation.

2.7.4 VEHICLE WASHDOWN SYSTEM

Incoming vehicles and shipping containers are washed, as required, to remove road grime and mud before the vehicles are admitted for unloading of the containers (see Drawing H-3-56793).

Utility water and steam are used for this service. It is assumed that only 1% of the incoming vehicles may require washing.

A combination of utility water and steam are used for the vehicle wash during cold weather. The washdown water is collected in the area sumps, batch sampled, and analyzed for contamination before discharge to the process sewer. If contaminated, it is diverted to the low-level liquid radwaste system.

Sludge, silt, and mud that settle out and collect at the sump bottom are pumped and cleaned by use of portable vacuum equipment. Cleaning is done on a regular basis to prevent excessive accumulation of sludge in the sump.

Radioactive sludge is transported to the solid radwaste system, and disposed of as LLW by mixing with grout in the grout mixer. If nonradioactive, it is shipped offsite for disposal.

2.7.5 STEAM GENERATION SYSTEM

Refer to Drawing H-3-56795, Steam Generator System.

2.7.5.A. Boiler Feedwater

Softened water from BFW Storage Tank TK-650 is pumped to Deaerator DEA-651, using Deaerator Feed Pumps P-650A/B. The water is preheated to about 175°F after passing through Blowdown Heat Recovery Exchanger HEX-651.

Steam condensate coming from steam traps and continuous drainers from heaters, evaporators, and exchangers collects in a header that flows into Condensate Flash Drum DRU-658, where it is flashed. The condensate is then pumped to the deaerator and combines with the preheated soft water makeup. Stripping steam at the deaerator removes oxygen to less than 0.005 mg/L, including carbon dioxide, to minimize its corrosive effects. Water-treatment chemicals are also added upstream of the deaerator; e.g., sodium sulfite, phosphates, and antifoulants to prevent scaling in the boiler tubes and downstream equipment.

Each of the three boilers (BOL-651A/B/C) is serviced by a dedicated BFW pump (P-651A-C), with one common spare (P-651D) for all three. From the deaerator, the BFW pump delivers the water to the boiler through the economizer, which heats the boiler feedwater by using the sensible heat from the flue gases.

The boilers produce 50-psig steam that supplies the users in the R&H Building. Amine solution is injected at the boilers to combat corrosive effects on the downstream piping and equipment.

2.7.5.B. Boiler Blowdown

Continuous and intermittent blowdowns are maintained to keep the total dissolved solids level below 3,500 ppm. The continuous blowdown flows to Blowdown Drum DRU-651, then through the shell side of the blowdown recovery heat exchanger (heat is recovered by preheating the BFW to the deaerator) before it drains to the process sewer. The intermittent blowdown flows to Blowdown Drum DRU-652 before it drains to the process sewer.

2.7.5.C. Fuel System

No. 2 fuel oil is used as a primary fuel for the boilers, with natural gas as an alternate fuel. Fuel oil is atomized, using compressed air supplied by a small dedicated air compressor that comes with the boilers. The fuel to each boiler is supplied from a dedicated fuel oil supply pump that takes suction from Fuel Oil Day Tank TK-502. Part of the fuel oil is recirculated back to the tank. The fuel oil going to the burners is filtered (F-503A-C) to remove any solid particles that might interfere with burner operation. Refer to Section 23 for additional description.

2.7.5.D. Oily Sewer System

The oily sewer system collects off-specification oil that may be drained from the fuel oil day tank and any other miscellaneous oil drips. It drains to a collection drum located outside the R&H Building. Refer to Section 24 for additional description.

2.7.6 WELDING STATION CLEANING AND TESTING SYSTEM

The welding station cleaning and testing system provides the R&H Building with three welding stations for welding and testing of canisters filled with either spent fuel or HLW. Two welding stations are used to process spent fuel and the third is used to process HLW on an as-required basis. Capability for cleaning the canisters with Freon (R-113), recovering the Freon, and storing the Freon is also provided.

2.7.6.A. Process Description

Refer to Drawing H-3-56798. The sequence of operations is as follows:

(1) Fuel assemblies are disassembled, the rods are placed in the canisters, and the canisters are positioned in the decon/evacuation chamber in the the preweld mode.

(2) The chamber is closed and evacuated to an absolute pressure of 10^{-4} torr. Obtaining this pressure will require 10 to 15 minutes, using a combination of a diffusion pump and a two-stage mechanical booster pump in series.

(3) A mixture of argon and helium, 90% argon and 10% helium by volume, is fed into the chamber and thus into the canisters as well. The mixture is metered into the chamber until the pressure is at 1 atm. The mixture is made in-line by introducing the helium by ratio control.

(4) The canisters are sealed by welding the bottom plates onto the canisters.

(5) After welding is complete, Freon is sprayed onto the canisters to clean their external surfaces. The argon-helium mixture is then displaced from the chambers by filling the annular space with liquid Freon.

(6) Freon is drained from the chambers either by gravity flow or by nitrogen purge, if necessary, to the solvent surge drum.

(7) Leak testing is performed by evacuating the chambers (10 to 15 minutes) to an absolute pressure of 10^{-4} torr and testing the vapors removed from the chambers for helium. When helium is detected, it is leaking from the interior of the canister. Defective welding is cut and rewelded. For details, see Section 2.5.8.E.

(8) The above procedures are used for all three welding stations.

2.7.6.B. Details of Support Systems

1. Argon-Helium Supply. Argon liquid is delivered by truck and is stored in a cryogenic tank, Argon Storage Tank TK-421. Integral with the tank is Argon Vaporizer HEX-421. Vaporization heat comes from the ambient air.

The helium is delivered by truck in standard 330-scf cylinders under pressure. The cylinders will be stored as a portable bank consisting of 12 cylinders, yielding a 2-month storage capacity. The volume of helium required is small compared to the volume of argon.

2. Freon Supply. The Freon is received by truck. It is pumped into Solvent Storage Tank TK-422, an atmospheric tank protected by a vacuum-pressure

relief valve. From storage, Freon is then pumped to Solvent Feed Drum VES-420.

When Freon is required for the welding station, it is pumped by a high-pressure pump (250 psig) to the vacuum chamber by Solvent Feed Pump P-421.

After cleaning, the liquid Freon is drained by gravity, or nitrogen purge, if necessary, to Solvent Surge Drum VES-421.

3. Freon Purification. The Freon collected in the Freon surge drum is contaminated from cleaning the external surfaces of the canisters. In order to be recycled, the Freon must be cleaned. The Freon in the surge drum is pumped through Solvent Filters F-421A/B, to remove solid particulates, and then through Solvent Evaporator EVP-420. The Freon is evaporated to eliminate any remaining contaminants. The vapors are condensed by Evaporator Overhead Condenser HEX-422 and returned to the solvent feed drum to be recycled. The solid contaminants collect in the bottom of the evaporator and are removed intermittently into drums for disposal. The evaporator is electrically heated to avoid contact with the heating medium that might result from tube leakage.

4. Freon Recovery. The Freon vapors released from the storage tank, the feed and surge drums, and the evacuation chambers are collected and passed through Solvent Absorber VES-422A/B. The absorber consists of an activated-carbon bed that is used to collect the vapors that would otherwise be lost. When the absorber is saturated, it is steam regenerated and the Freon is recovered. The steam-Freon vapor mixture produced during regeneration is condensed by Solvent Recovery Condenser HEX-423. The condensed mixture is decanted by Solvent Separator VES-423. The recovered liquid Freon is returned to the solvent feed drum for recycle. The water is monitored for contamination and, if not contaminated, it is sent to the process sewer; otherwise, it is sent to the LLW drain.

5. Vacuum System. The two stations used to process spent fuel each have a dedicated vacuum pump system. The third station, used to process HLW, has a vacuum pump system whose pumps can be used as spares for the other two stations as well. Thus, three vacuum pump systems are required instead of four. Each vacuum pump system evacuates its chamber to an absolute pressure of 10^{-4} torr. The pump discharge is sent to the Freon absorbers to recover the Freon released from the chamber. When the chamber is evacuated to 10^{-4} torr absolute pressure, the canister is leak tested for helium. The helium leak detection is achieved with a high-vacuum pump drawing a gas sample through a mass spectrometer used for the detection of helium.

2.7.7 DEIONIZER

The deionizer (see Drawing H-3-56796) produces low-chloride, high-purity water used for decontamination solution preparation, decontamination rinse, and the laundry system in the R&H Building.

It has three equipment packages consisting of Deionizer Activated Carbon Filters F-620A/B, Cation and Anion Bed Deionizer Systems IX-620A/B, and

Mixed-Bed Deionizer Systems IX-621A/B; and auxiliary equipment consisting of Hydrochloric Acid and Caustic Soda Transfer Pumps P-620A/B and P-621A/B, Deionized Water Storage Tank TK-620, DI Water Filter F-621, and Deionized Water Supply Pumps P-622A/B.

Process water feed to the deionizer system passes through an activated-carbon filter to remove solid particles, organics, and free chlorine present in the water that could interfere with deionizer performance. There are two carbcn filters, one normally in operation and one spare.

After filtration, the water flows to the cation and anion exchanger vessels, where most of the minerals and salts are removed. When the resin bed gets close to its loading point, as indicatcd by a breakthrough appearing on the conductivity meter reading downstream of the two-bed deionizer, regeneration is initiated. One cation/anion bed deionizer is onstream while the other is regenerating.

The cation bed is regenerated with hydrochloric acid supplied by Acid Transfer Pumps P-620A/B; the anion exchanger resin bed is regenerated with caustic solution supplied by Caustic Transfer Pumps P-621A/B from a storage drum. Each regeneration is followed by a backwash to remove remaining regenerant solution in the bed. The liquid backwash wastes drain to the process sewer.

A mixed-bed ion exchanger downstream of the two-bed deionizer serves as a water polisher to further remove some of the remaining cations and anions to produce chlorine-free, deionized water. After leaving the mixed-bed ion exchanger, the water passes through an in-line filter to prevent carryover of resins. This stream and the treated water from the liquid radwaste reprocessing system are combined and stored in Deionized Water Storage Tank TK-620. One mixed-bed deionizer system is onstream while the other is regenerating.

The deionizers may be operated intermittently, depending upon the deionized water demand, the availability of recycled treated liquid radwaste water, and the tank inventory.

Deionized water is also required for spraying the final HEPA filters in the HVAC system. Deionized water is stored in the hydropneumatic vessels (VES-600A/B) that automatically release water for spray-cooling the final HEPA filters in case of a fire.

2.7.8 WATER SOFTENER SYSTEM

The water softener (see Drawing H-3-56797) is a two-unit ion exchanger system used for removing hardness from process water for boiler feedwater use. It is a standard vendor water-softener package, mounted on a skid, and comes complete with automatic timer, piping, and diaphragm valve, including control panel with operating lights and switches designed for automatic operation, and inlet and outlet water connections.

The package consists of a brine tank that holds the salt used for regenerating the ion exchange resin, an ejector that pumps brine to the bed during regeneration, and two ion exchanger vessels that operate alternately so that, when one vessel is in service, the other is in regeneration or standby mode.

2.7.8.A. Service Cycle

During the service cycle, hardness in the water (such as calcium and magnesium ions) displaces the sodium ion in the resin producing soft water. The water enters the softener from the inlet header to the service inlet valve, then into the distributor and laterals that spray the water evenly across the bed through the resin bed and through drains to the service outlet valve. The softened water then passes through the service meter that records and totals the volume of processed water flow. When the preset number of gallons of softened water has passed through the service meter, it sends a signal that switches the flow to the vessel on standby and starts regeneration of the bed that was removed from service. The meter is automatically reset in preparation for the next service cycle.

2.7.8.B. Regeneration Cycle

Once started, regeneration proceeds automatically. Brine is pumped by an ejector in the brine tank, using water. The dilute brine solution passes through the regenerant header into the regenerant distributor and out through the rinse outlet. During regeneration, the sodium ions displace the calcium and magnesium ions present on the surface of the resin, returning it to its original state. After a complete regeneration, it is followed by a fast rinse to flush out remaining brine to the process sewer drain. After completion of the rinse, the softener goes into the standby mode and is ready for the next service.

2.7.9 CONTAMINATED LAUNDRY SYSTEM

The contaminated laundry system (see Drawing H-3-56801) is designed to decontaminate clothing items, rubber goods, and respirators.

Contaminated cotton products are mainly Freon drycleaned, but they are periodically water washed after having been drycleaned to remove body odors and to reduce the buildup of water-soluble contaminants. Reusable rubber apparel, such as rubber shoes, is water washed in a washer/extractor. Respirators are cleaned in a commercial undercounter dishwasher.

2.7.9.A. Freon Drycleaning

Freon Drycleaning Unit FDC-400 operation is divided into two cycles: cleaning cycle and distillation cycle. Each cycle is described below.

1. Cleaning Cycle. Items to be decontaminated are placed in the cleaning chamber (drum) and, when the drum starts to turn, the Freon pump is activated and pumps Freon from the Freon tank through a bank of filters into the

drum. Air escapes from the machine through a HEPA filter, but Freon vapors are trapped in a carbon column.

Following the wash cycle is the spin cycle. The basket is rotated at high speed, removing excess solvent from the articles, thereby reducing drying time. Next, the drying fan is activated, forcing air across the thermostatically controlled heater element to heat the air before entering the drum. Warm air entering the drum circulates around the tumbling articles and evaporates the remaining solvent.

The Freon vapor is then drawn from the drum and a portion is drawn into the evaporator to recondense Freon vapors. During the entire dry cycle, the refrigeration unit operates to reclaim all of the Freon vapor.

2. Distillation Cycle. Because of the high solubility of organic compounds in Freon 113, cleaning by distillation is necessary. This operation is performed by a batch-distillation method. The contaminated Freon is pumped from the Freon tank into the still. Electric elements then heat the oil bath compartment under the still, and the heat is transferred through the chamber wall to the Freon.

The Freon (which boils at 117.6°F) volatilizes, leaving behind the compounds (water, detergent, and organic material) with higher boiling points. The volatilized Freon leaves the still and circulates through and around the evaporator coil, where the Freon is condensed to a liquid. The Freon, now free of contamination, flows back into the Freon tank.

Two major radwastes generated from the Freon drycleaning unit are sludge from the still and contaminated cartridge filter from the Freon supply system to the drum. Sludge is removed periodically by a portable vacuum pump into a 55-gal drum. The filter is replaced when the pressure gauge indicates high pressure drop across the filter.

When the level gauge at the Freon tank indicates that the Freon level is low, Freon from the 5-gal container is manually added to the tank.

2.7.9.B. Washer/Extractor

During normal operation, Washer/Extractor WSH-400 is used for decontaminating reusable rubber apparel and occasionally to wash the Freon-cleaned cotton items. However, when the Freon drycleaning unit is out of service, both rubber apparel and cotton items are washed in the washer/extractor.

Contaminated laundry, presorted based on contamination level at the point of origin, is bagged in disposable plastic bags that disintegrate in the washer, and is loaded into the washer/extractor manually. The machine goes through the preprogrammed cycle automatically when the program card is inserted into the machine. The controller for the washer/extractor interfaces with the controller for Liquid Metering Package SME-405 to inject an accurately measured quantity of the proper liquid agent (detergent, decontamination solutions, softener, acid, or bleach) into the washer/extractor at the correct point in the wash cycle.

After the wash and extraction cycle is complete, the laundry is manually removed from the washer/extractor and is dried in steam-heated Dryer DRY-400. Dried laundry is then passed through the laundry monitor to verify that the contamination level is at an acceptable level. If it is not, the washing cycle is repeated.

Respirators are also decontaminated in the laundry room. Used filter elements are removed for disposal; then the respirators are cleaned in a commercial undercounter dishwasher (WSH-401). Wet respirators are air-dried in drying racks and new filter elements are installed. The respirators are then tested for efficiency and, if not efficient, they are disposed of.

Cold water to the washer/extractor is supplied directly from the deionized water header. Header pressure of the deionized water is used as a driving force to the washer/extractor.

Hot Water Vessel VES-400 is filled with deionized water by the level controller. The vessel has an internal steam-heating coil to attain the desired hot water temperature of 170°F. The hot water vessel uses a regulated air pressure of 20 psig to pressurize its piping system on a continuous basis to provide the capability of intermittent high flow rates for filling the washer/extractor and respirator quickly.

Contaminated water from the washer/extractor and the respirator washer is collected in Laundry Effluent Collection Tank TK-408. As the tank level increases, the water is pumped through Water Filter F-408A/B to Filtered Laundry Effluent Vessel VES-401. The majority of particulates in the water are removed by the filter. The contaminated laundry system is operated less than 8 hr/day and VES-401 is sized to hold enough contaminated water generated in 8 hr. Therefore, at the end of each day's operation, a sample from VES-401 is taken and analyzed for contamination levels. If contaminated beyond allowable levels, all of the water in the vessel is diverted to the liquid radwaste system. If not contaminated, the water is sent to the process sewer system.

The filtered laundry effluent vessel is also pressurized with regulated air at 20 psig. When the water level in VES-401 is too high, excess water is sent to the liquid radwaste system.

2.7.10 COOLING TOWER SYSTEM

The cooling tower (see Drawing H-3-56794) is a standard vendor, field-erected, induced-draft, crossflow unit located near the R&H Building. It supplies cooling water to the condensers, coolers, and air-compressor after-coolers, including the refrigeration condensers for the air-conditioning units.

Water from the cooling tower basin flows to the common sump and is pumped to the R&H Building, using six Cooling Tower Pumps P-600A-F and a warehouse spare (P-600G). The pumps are sized for 2,150-gpm capacity each. The number of pumps is the same as the condensers to facilitate balancing of the system during normal operation, thus conserving energy.

Process Cooling Water Pumps P-609A/B supply the cooling water for process services through a separate header running from the cooling tower to the R&H Building. A dedicated cooling water supply line to the process users is designed to provide flexibility of operations, particularly during low turndowns, or during complete shutdown of the condensers and pumps during winter, while maintaining normal processing operations. The warm-water return from the coolers, air compressor, and condensers flows up the top of the cooling tower and into the inlet manifold. The warm water is distributed over the wet deck, cascades over the nonmetallic corrugated packings down into the sump, and is cooled by air flowing across the tower and up into the induced-draft fans. During the cooling process, the air absorbs heat and a small amount of water evaporates. Additional losses are caused by water entrainment in the air.

To maintain high operating efficiency and trouble-free operation for longer periods, it is necessary to protect the cooling tower, condensers, air compressors, and coolers in the circuit from corrosion and fouling by maintaining a well-balanced water chemistry through the application of corrosion inhibitors, antifoulants, and acid for pH control. The water-treatment chemicals are added to the system from Solution Makeup Tanks TK-601, 603, 605, and 607 and Chemical Metering Pumps P-601, P-603, P-605, and P-607.

Biocide is added to the water intermittently to kill microorganisms and prevent algae growth.

Water from the cooling tower is sampled and analyzed in the laboratory on a regular basis to monitor changes in water chemistry, and is used as a guideline for instituting corrective action when required.

2.8 INSTRUMENTATION AND CONTROL

2.8.1 INTRODUCTION

Described herein are the controls and instrumentation for the MRS conceptual design. Some of the instrumentation systems in the MRS Facility are classified as Category I. These systems are specified to meet only the seismic requirements of Category I because they will not be exposed to the other credible natural phenomena used as criteria for Category I classification.

The instrumentation and controls for the R&H Building provide for:

(1) Safe and efficient operation of handling and processing equipment throughout the entire facility.

(2) Safe shutdown integrity and data flow.

(3) Reliability, redundancy, modularization, and standardization, with components and subassemblies capable of being removed for inspection, maintenance, or replacement.

(4) Remote operation, when required.

(5) Transmission of information to remote locations.

Automatic monitoring, alarming, and surveying instrumentation is designed and used to limit occupationally related radiation exposures in controlled work areas to the values shown in DOE 5480.1A, Chapter XI, Section 4.a, or NRC 10 CFR 20, Sections 20.101 through 20.104, whichever is more restrictive, and the release limits of DOE 5480.1A Table 1 of Attachment XI-1 or NRC 10 CFR 20, Appendix B, Table I, whichever is more restrictive.

Perimeter monitoring, alarming, and surveying instrumentation is designed so that exposures to offsite personnel in uncontrolled areas are limited to the values shown in DOE 5480.1A, Chapter XI, Section 4.b.1, Figure XI-2 (people in uncontrolled areas), or 10 CFR 20, Sections 20.106 through 20.303, whichever is more restrictive, and the release limits of DOE 5480.1A Table 2 of Attachment XI-1, or NRC 10 CFR 20, Appendix B, Table II, whichever is more restrictive.

Other applicable documents include ANSI N2.3, N8.3, N13.3, N13.4, N42.18, and N323.

Controls for mechanized and automated remote handling and processing equipment allow the equipment to be controlled locally or centrally from either control room.

Safe shutdown and accountability data flow to the local shielded process cell operators and to the control room operators, and is maintained by continuously storing the instantaneous values of all important data in the Distributed Control System (DCS) memory. These data include information necessary to maintain records of the following:

(1) Inventory data regarding the locations of all SF, LLW, HLW, RHTRU, and CHTRU materials in the MRS Facility.

(2) Radiation monitoring readings obtained from the DCS via the radiation monitoring system.

(3) Criticality alarm and status information obtained from the radiation monitoring system.

(4) Seismic, environmental, and weather system data.

(5) Fire, sprinkler, and process alarm data.

(6) Process-variable data from the solid and liquid radwaste and cement drumming and filter compactor stations.

(7) HVAC operational and alarm status.

(8) Shielded process cell, shielded canyon cell, remote handled equipment maintenance room, remote handled air filtration cell crane, manipulator, and processing equipment status.

(9) Security and intrusion alarm data.

(10) Storage area status and data.

All of the controls for the above equipment are designed to be fail-safe; that is, loss of electrical power or instrument air will not cause an unsafe condition to occur. The DCS is powered by an uninterruptible power supply (UPS) so that none of the above information stored in the current or historical DCS memory is lost if electrical power is lost or interrupted.

2.8.2 RADIATION MONITORING SYSTEM

The continuous radiation monitoring system uses two redundant control terminals housing microprocessors, which serve as interfaces between the control room operators, the DCS, and the process radiation monitors. One control terminal is located in the R&H Building control room and the other is located in the Site Services Building control room. Each interfaces with colocated DCS control room equipment, respectively, so that failure of one control terminal or signal transmission line will not result in the loss of any of the protective functions of the radiation monitoring system. The control terminals perform engineering calculations on the detector signals to provide localized information on dose rates, alarm conditions, operational status, or criticality conditions. The automatic acquisition of historical data and the transfer of these data to a peripheral device or to the DCS may be initiated for any channel by the operator or, upon interrogation, by the DCS. System annunciators are included on the front panel to provide visual and audible indication of the composite status of the entire system.

System status, as indicated by the built-in annunciator, is defined by seven lights, in order of least to highest priority, as follows:

(1) NORMAL will be lighted if any channel in the system is in normal or alarm-off status.

(2) MAINTENANCE will be lighted if any channel in the system is in calibrate, maintenance, check source, standby, or flush mode.

(3) FAIL will be lighted if any channel is in a failed condition or if the redundant radiation control terminal is offline.

(4) TREND will be lighted if any channel is in trend alarm status.

(5) ALERT will be lighted if any channel is in alert alarm status.

(6) HIGH ALARM will be lighted when any channel is in high alarm or flow alarm status.

(7) CRITICALITY (red light) will be lighted when a criticality condition exists at any unit.

The system provides both audible and visible, local and remote alarms if any radiation detector indicates a trend, alert, or high alarm; these correspond to high rate of approach to alarm, alert alarm, and high alarm conditions, respectively. The system is designed to display the current status of any selected channel by front panel light indications of normal, maintenance, and failed conditions. If any detector fails, a unique audible and visible alarm is generated.

Table 2-5 shows the locations of all radiation monitoring system detectors for the MRS Facility. Many, but not all, of these detectors are located in the R&H Building. The signals connected to the radiation monitoring system control terminals are shown in column four. Some monitoring information (such as that from the portal monitors, fixed filter particulate air sampling systems, the emergency monitoring kit, portable survey instruments, floor monitor, hand and foot monitors, and the laundry monitor) do not need to be monitored continuously for plant control or alarming purposes, and so are only displayed and alarmed locally, as required.

Hand and foot, and/or portable instrumentation are available at all access points to locations containing radioisotopes. These instruments are used to detect personnel contamination. Portal monitors are used as a final check on contamination at selected locations.

The criticality alarm system provides a local alarm consisting of a red rotating beacon and a distinctive audible alarm to alert local operating personnel to the criticality and the necessity for immediate evacuation. The neutron-sensitive criticality detectors are arranged in groups of three in the areas of the shielded process cells having the highest potential for criticality. An alarm is initiated when two out of three detectors exceed the high alarm setpoint, if one detector of a group is out of service because of a failed condition and a second detector exceeds the setpoint, or if the criticality bit for a channel has been set and a high alarm or a failure status occurs in a second channel. A criticality alarm is initiated in 1 or 2 seconds for the optimum condition in which two high-count rate-alarms occur simultaneously.

The criticality alarms, along with all other radiation monitoring system high alarm setpoints, are transmitted via the radiation monitoring system terminals to the DCS, as described previously. The ^{6}LiF solid-state neutron criticality detectors are inserted in the two side walls and the floor of each shielded process and canyon cell and the walls of the in-cell lag storage vaults to form a group of three detectors at each location surrounding the process and in-cell lag storage and consolidation table stations. All of the radiation monitoring system detector locations for the MRS Facility are shown on Drawing H-3-56788, Sheets 1 through 5.

The electronics cabinets are accessible for maintenance from outside the cells. Some of the detectors within the shielded process cells, the radwaste

Table 2-5 - Radiation Monitoring System Detectors

Item	Description	Location	Connected to Radiation Monitoring System: Yes	Connected to Radiation Monitoring System: No	Remarks
1	Portal radiation monitors	Protected Area Gatehouse, R&H Building locker room exit gallery, two locations		X	
2	Continuous alpha air monitor, fixed filter	R&H Building, rooms occupied by personnel	X		
3	Continuous beta air monitor fixed filter	R&H Building, rooms occupied by personnel	X		
4	Fixed filter particulate air sampling system multi-point	R&H Building, rooms occupied by personnel		X	Analyzed by chemical laboratory multichannel analyzer (MCA)
5	Perimeter air monitors, particulate fixed filter	Perimeter "alarm zone"		X	Analyzed by chemical laboratory MCA
6	Continuous gamma area monitors	Operating and service galleries, shielded process and canyon cells, cask storage area, and exhaust filter rooms	X		
7	Criticality alarm system	R&H Building shielded process and canyon cells, lag storage areas	X		
8	Liquid effluent beta-gamma monitors	R&H Building liquid radwaste rooms, CHTRU and washdown sumps, retention tanks, decon rooms	X		
9	Stack offgas radiation monitor [system particulate iodine noble gas (SPING) monitor]	Each leg of R&H Building exhaust system	X		
10	HVAC offgas monitor (first-stage filters)	HVAC ducts, 3rd floor of R&H Building, analytical laboratory filter room	X		Same detectors as area monitors

Table 2-5 (Contd)

Item	Description	Location	Connected to Radiation Monitoring System: Yes	No	Remarks
11	Emergency portable radiation monitor kit	R&H Building health physics room and Site Services Building counting room		X	
12	Floor alpha, beta, and gamma monitor	R&H Building health physics room and Site Services Building counting room		X	
13	Hand and foot monitor	Air locks at exits to hot cells and laboratories		X	
14	Laundry inspection monitor	R&H Building laundry room		X	
15	Portable alpha, beta, and gamma survey instruments	R&H Building air locks, Site Services Building, and Gatehouses		X	
16	Shipping cask offgas line radiation monitoring system	R&H Building cask handling and decon rooms	X		On shipping cask offgas line, steam condensate return, and heat exchanger cold water return lines (for high-level gamma only).
17	CHTRU/LLW interrogation assay system	R&H Building drum inspection and decon room		X	
18	Multichannel analyzer (MCA)	R&H Building analytical laboratory counting room		X	
19	Personnel contamination monitor	Air locks at exits to hot cells and remote filter room		X	

filtration and tankage areas, the CHTRU and RHTRU solid radwaste, and the first-stage HVAC filter changeroom areas are designed for remote maintenance, using either manipulators or contact maintenance. The method used is determined by local radiation levels and administrative procedures. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

2.8.3 PROCESS CCTV SYSTEM

The process closed-circuit television (CCTV) system permits the monochrome viewing of handling and processing operations in the shielded process cells, the shielded canyon cells, the shipping cask unloading areas, and the storage cask loadout areas. All of the process CCTV cameras have pan, tilt, and zoom (PTZ) capability and are radiation-resistant because they are all located in high-radiation areas. They are also designed for remote maintenance or replacement by remote-handling equipment, when required.

Dedicated 14-in. CCTV viewing monitors are provided to aid the operator in performing the in-cell mechanical handling operations associated with fuel assembly removal from shipping casks, end fitting and fuel channel removal, movement into and out of lag storage, fuel pin consolidation, transfer of fuel bundles, insertion into canisters, canister welding, canister leak checking, and loadout of canisters into storage casks or transporter shields for transfer to the storage areas. Other in-cell operations for transferring and handling the HLW and RHTRU drums are aided by the process CCTV cameras located in the shielded canyon cells. Two cameras are located in each cask unloading area to aid the operator in the semiautomatic fuel assembly unloading operations. Two cameras are located in each loadout area to aid in positioning the canisters inside casks or transporter shields for transfer to the storage area. Drawing H-3-56787 is a block diagram of the process CCTV system.

As shown on Drawing H-3-56787, a 14-in. monitor is dedicated to an in-cell camera. The PTZ controls for these cameras are located at small control stations near the cell windows in the galleries. Additional limited-access PTZ controls are located in the R&H Building and Site Services Building control rooms. Six 17-in. monitors are located in ceiling-mounted fixtures above the DCS console in the R&H Building and Site Services Building control rooms. These monitors can be switched to any camera in the system, using the primary controls in the R&H Building control room or the backup controls in the Site Services Building control room. The control room supervisory monitors can be used in a scanning mode to view all or a selected subgroup of cameras sequentially, or to monitor an individually selected camera.

Switching is accomplished by means of a primary microprocessor-controlled switcher located in the R&H Building control room, which is backed up by a redundant switcher located in the input/output (I/O) cabinet room near the control room. All signal conditioning, monitoring, and switching equipment is designed to enable modular replacement of components for minimum maintenance downtime.

The locations of all process CCTV cameras are shown on Drawing H-3-56789, Sheets 1 through 4.

2.8.4 DISTRIBUTED CONTROL SYSTEM

All of the centralized process and utility monitoring control and alarm systems are contained in twc redundant, distributed control systems (DCSs). The control consoles and CCTV monitors for the primary system are located in the R&H Building control room. The identical equipment for the redundant DCS is located in the Site Services Building control room. To preclude the possibility of plant shutdowns caused by sabotage or failure of control room equipment, the redundant DCS is configured to assume control of all centralized plant operations automatically when initiated by a self-diagnostic command or by manual switchover. During normal operations, the DCS provides only supervisory monitoring and control of the spent fuel (SF), remote handled transuranic waste (RHTRU), and high-level waste (HLW) operations in the four shielded process cells and the two canyon cells. Local, interactive control of these fuel- and waste-handling operations is accomplished by means of individual cathode-ray tube (CRT), hard-wired control stations, and CCTV monitors located at the cell viewing windows. If necessary, the control room operator can perform a controlled shutdown of all in-cell SF, RHTRU, and HLW handling, consolidation, and other activities at the DCS console located in the control room.

The DCS operator consoles interface with shielded process cell and shielded canyon cell local control panels, and provide shutdown of certain process and cell functions and monitoring of all process and handling operations by means of a distributed input/output system. All site-support functions and utilities are remotely monitored and capable of being controlled by the DCS.

The operator consoles permit displays of current process status, process alarms, and radiation monitoring and alarms, and include the capability for control room operators to modify selected process operating parameters. The shielded process and shielded canyon cell supervisor is able to shut down the cell operations normally controlled at the shielded process and shielded canyon cell window locations by actuating controlled access switches on the operator console dedicated to that particular cell. These shutdowns are initiated by such occurrences as criticalities, process upsets, and administrative decisions.

Records for the results of sample analyses in the analytical laboratory and analyzer room; Health Physics personnel exposure records; HVAC, radwaste, and utility process status and alarms; accountability of stored waste materials; and shielded process and shielded canyon cell and remote handled equipment maintenance room status and alarms are kept in the DCS central memory.

The control room has data retransmission capabilities for providing remote locations with required process, alarm-status, monitoring, and trending information, and historical data.

The DCS operating system is programmed with operational safeguards so that the local CRT panel operator may only initiate certain assigned shielded process and shielded canyon cell operations by use of controls on the local process cell operating panel. Such operations as the movement of fuel bundles from the shipping cask to the upender, positioning of the laser cutter assembly inside a PWR bundle support tube, and the initiation of laser cutting may be begun by means of these controls. After initiation, the operational logic is automatically completed by means of programmable logic controllers (PLCs) mounted within some of the local operating panels.

Other, higher-level control parameters may only be changed at the control room console. At this location, such parameters as closed-loop analog setpoints and alarm trip points may be changed by supervisory personnel. Other, more critical parameters (such as closed-loop controller mode settings, signal conditioner and transmitter zero and full-scale settings, and counter and timer settings) may only be changed by properly authorized engineering and maintenance personnel, using controls that are not accessible to operating personnel.

Full graphics, annunciation, indicating, and recording capabilities are provided by the DCS. Information, in engineering units, is stored in the computer memory and is available for presentation in trending plots, alarm printouts, process-variable printouts, and graphics presentations. Historical data presentations and management reports are available in hard-copy form as obtained from rigid disk or magnetic tape memory devices.

Instrumentation is designed to provide for the inventory of all transuranic (TRU) material stored and handled within the MRS Facility. Serial numbers of all incoming shipping casks are recorded and checked against shipping records. In addition, the serial numbers and locations of all incoming, onsite-generated, and outgoing containers and their contents (spent-fuel bundles; HLW, RHTRU, HAW, LLW, and CHTRU drums; and waste-containing metal boxes) are recorded. These records are used to perform periodic physical inventories to confirm the presence of all materials within the R&H Building and the MRS storage facility.

Process, HVAC, solid and liquid radwaste, and all utility monitoring and control for the R&H Building are shown on the process and instrumentation diagrams (P&IDs) and the material handling drawings. Similar information for the support facilities and utilities is shown on separate P&IDs, as applicable.

The DCS interface with the support facilities consists of process-variable and alarm signal input monitoring only. No control is provided by the DCS for any of the support facilities, the CHTRU storage facilities, or the SF, HLW, and RHTRU storage areas. Control is provided to the support and storage areas outside the R&H Building by means of dedicated controllers and other hard-wired components wherever required.

The DCS is powered by the uninterruptible power supply (UPS) system that receives power from the emergency generators if normal, utility-supplied power is lost. In this manner, the DCS will remain operational long enough to maintain the safe operation or shutdown of all safety-related R&H Building systems if any Category I incident, criticality, or radiation excursion should occur. Direct-current (dc) power to all process transmitters, current-to-pressure converters, and other equipment, including logic components, is supplied by an auctioneered, redundant, primary 24-volt dc power supply system located in the R&H Building I/O cabinets. A drop in dc voltage by 10% or more causes an automatic switchover to the redundant dc supply located in cabinets in the I/O cabinet room.

All of the analog signals requiring a ground are connected to the R&H Building analog ground bus. This bus enters earth ground at only one point to preclude interferences caused by common mode, electromagnetic, and electrostatic interactions as much as possible. A separate digital system ground bus is provided for all of the discrete system components to similarly preclude interferences in these systems, and to prevent interactions with the analog circuits. This bus also enters earth ground at only one point.

The major system components for the DCS are shown on the MRS Instrumentation, Control, and Monitoring System Block Diagram, Drawing H-3-56786.

The DCS equipment is maintained by direct contact because all of the I/O cabinets, instrumentation, and control components are located in environmentally favorable areas that are accessible. Maintenance is accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

Detectors, switches, and final control system actuators that are located in radioactive areas are designed for remote manipulator replacement. Even though they are made of radiation-resistant materials, infrequent replacement will be required because of such phenomena as aging, wear, and unusual occurrences.

2.8.5 GENERAL-PURPOSE COMPUTER TERMINAL

A remote, general-purpose computer terminal with CRT, keyboard, send/receive (KSR) printer, and modems is provided in the R&H Building control room. This terminal is interconnected with the general-purpose computer in the Administration Building. Full computational and operating system software is included with this system. It is used by various departmental personnel for materials requisitioning; cask, spent fuels, and nuclear waste inventory control; maintenance control; engineering support; and scheduling activities.

2.8.6 CHTRU/LLW INTERROGATION ASSAY SYSTEM

The CHTRU/LLW interrogation assay system operates upon demand. It is designed to provide local operating personnel with characteristic emission rates for the purpose of discriminating between CHTRU and low-level, process-generated radwaste (LLW). All material is sorted according to drum surface dose rates.

The CHTRU/LLW interrogation assay system is a comprehensive, computer-controlled, low-level-waste assay system. This system combines highly sophisticated waste assay techniques with the power and flexibility of a computer-based multichannel analyzer. The system provides a thorough gamma analysis of nuclear waste containers by using a segmented gamma scan of the entire drum. Matrix corrections are performed by using a gamma transmission source. Reliable, self-monitoring components maintain system integrity. System operation is initiated by pushbutton or simple keyboard operation. The system prints complete nuclide reports, which can also be used as shipping manifests.

The drum scanning mechanism is designed to provide loading ease, drum stability, and dependability. A ramp and set of rollers combine to make sample loading easy. Once the drum is on the scanner's turntable, it is locked in place. A guardrail protects the detector and the transmission source from direct contact with the drum during and after loading. The turntable is supported by elevation drive screws and ball bushing rods, which provide excellent stability and minimal mechanism wear. Drums as heavy as 500 lb may be assayed.

To provide the best correction for sample and matrix inhomogeneities, the drum is positioned between a gamma transmission source and the detector, and is analyzed in vertical segments. The system rotates the drum a selected number of times per segment to produce an accurate assay. Computer-controlled stepping motors provide precise rotation and vertical translation. The motor control generates a stall alarm if the rotational speed of the drum becomes nonuniform, halting the mechanism.

Vertical segmentation is accomplished by horizontal detector collimation. A 2-in. collimator is provided for standard assays. A 1/2-in. collimator is available for higher resolution. Sensors verify collimator size. A lead shield protects both the sides and rear of the detector from background and transient radiation.

The monitoring system provides on-line self-diagnosis for the drum scanning mechanism, including a tilt monitor to prevent deformed drums from damaging the detector and source, a resolution check after each background analysis, and encoder feedback from all system motors. The monitoring system reports status to the computer and to a remote motor control panel, which allows operation of the scanning motors from a location other than the user terminal. Indicator lights on the panel show system status. A switch control panel allows the initiation of most system functions by simply pushing a button.

The system includes:

(1) A multichannel analyzer/computer terminal.

(2) A computer with 256-kilobyte memory, dual 400-kilobyte minifloppy disks, a 10-megabyte Winchester drive, and a multi-user, multi-task operating system.

Short- and long-form report formats facilitate recordkeeping. System software includes automatic peak search with multiplet resolution and quantitative isotope identification. Statistical analysis is performed on each nuclide identified. The system generates a report that may be used as a shipment manifest.

System operation is initiated by pushbutton or simple key strokes once the parameters are entered. The system is easy for the user to operate and provides a high level of flexibility and computational power for the system manager.

Nuclear Instrumentation Modules (NIMs) are used to provide more reliable analysis. Long-term detector stabilization is provided by a digital spectrum stabilizer. The loss-free counting module will correct for counting losses caused by high event rates or variable activity within the drum. All equipment is modular or on circuit cards for ease in performing contact maintenance.

2.8.7 CRITICALITY ALARM SYSTEM

The neutron-sensitive criticality alarm system operates continuously. This system, which is also described in Section 2.8.2, in conjunction with the radiation monitoring system, includes detectors, transmitters, visual and audible alarms, and centralized and remote instrumentation for alarm status indication, logging, printout, and retransmission of alarm status information to the radiation monitoring system control terminals and the DCS. System equipment conforms to the requirements of NRC Regulatory Guide 3.41 and ANSI Code N8.3.

The criticality alarm system is designed to alarm if two out of three neutron-sensitive criticality detector channels indicate high alarms or if one detector channel of a group generates a failure alarm and another channel indicates a criticality alarm. The criticality alarm system interfaces with the central terminal of the radiation monitoring system, through which the following functions can be performed:

(1) Request current data on any detector in the system.

(2) Command a check source to operationally test any detector.

(3) Be visually and audibly alerted to any status changes, such as maintenance or failure conditions or trend, alert, high, and criticality alarms.

(4) Display history files maintained for each detector.

(5) Display and edit channel parameter files for all detectors to select calibration constants and alarm setpoints.

If any detector fails, a unique audible and visible alarm is generated.

2.8.8 AIR SAMPLING SYSTEM

The radioactive airborne particulate sampling system operates automatically and continously, and conforms to the following codes, regulations, and standards: ANSI N13.1 and N42.18; 10 CFR 40-61, 10 CFR 72, and 10 CFR 51-7602, Part 51; and NRC 1.21, 4.1, and 4.15. It includes fixed-air sampling systems for collecting and sampling the air of areas occupied by personnel where the airborne radionuclide concentration might exceed maximum permissible concentrations. The central system is designed to have full redundancy of air pumps with motors on standby power. The pumps provide a minimum air flow at 1 scfm at a pressure drop of 20 in. of water across each sample head when all sample heads are in operation, plus a 15% reserve capacity.

The vacuum system for the air sampling system consists of two central vacuum stations backed up by a third station, drawing air through small-pore filters so that airborne particles are deposited on the filter surfaces. The filters are changed periodically, and the amount and type of radioactivity deposited during the sampling period are determined. The resulting concentrations determined by this procedure are compared with radiation concentration guides obtained from DOE 5480.1A, Table 1, of Attachment XI-1 to aid in limiting the occupational exposures of plant personnel.

The vacuum system for the air sampling system is centralized. Particulate collection filter assemblies are located as near the point of measurement as practicable. Sample heads are located to facilitate filter collection and changing. They are located 6 ft above the floor to provide near-representative samples of airborne concentrations in a worker's breathing zone. All sample heads are detachable and have flow metering and regulating devices. Air collected through air monitors and samplers is discharged into the building filtered exhaust system upstream of the last bank of HEPA filters.

2.8.9 LABORATORY ANALYZERS

The laboratory analyzers (consisting of a multichannel analyzer having alpha, beta, and gamma analysis capability; gas chromatograph; mass spectrometer; and infrared analyzer) are located in the analyzer room adjacent to the analytical laboratory. They are used for all routine and nonroutine analyses of process and environmental gas and liquid samples.

Analyzers are also used in making up standard samples for calibrating other process in-line and off-line analyzers and monitors located throughout the MRS Facility. A CRT terminal, keyboard, and printer located in the analyzer room are used for data interchange with the DCS.

2.8.10 SHIPPING CASK MONITORING SYSTEMS

After removal from the shipping cask, the intact or previously canistered spent fuel assembly and the HLW and RHTRU canisters are identified and checked for exterior surface contamination, temperature, and gross radiation level.

The shipping cask radiation monitoring system monitors the offgases from shipping casks upon their arrival and interconnection with the R&H Building sample system piping. Although this is a dry gas monitoring system, a possibility exists that some entrained water may be transferred into the shipping cask during the cask-loading operation. The vapor treatment system in the R&H Building is designed to condense out up to 10 gal of high-temperature water vapor that is transmitted to the radiation waste system. Any residual water remains in the cask during the return shipment of the cask. The gases are monitored on an as-needed basis for gamma emissions before releasing the gases to the offgas system. This fixed system is designed to monitor, indicate, and alarm. Signals are transmitted from the shipping cask radiation monitoring system via a data acquisition module to the radiation monitoring system control terminals, which communicate with the DCS.

The detector assembly is a lead-shielded and collimated detector that views the offgas line downstream of the vapor-treatment system for gamma radiation. The detector is an energy-compensated Geiger-Mueller (GM) tube. Proper operation of the detector and counting circuitry may be verified by actuation of the check source mechanism, which is installed in the detector assembly. The check source contains 0.5 micro Ci of ^{90}Sr - ^{90}Y. When a check source command is requested, voltage is applied to the check source solenoid. Rotary action of the solenoid moves the radioactive source in line with a small hole in the detector mounting block. The beta radiation from the source, which is normally shielded from the GM tube detector, shines through the hole, striking the detector, and causing an up-scale reading. Removal of voltage to the solenoid allows the solenoid spring to return the radioactive source to its normally shielded position.

In general, the detector assembly is maintained by contact maintenance procedures because the background in the offgas line will normally be at low levels. In case background builds up to a level high enough to affect monitoring system readings, the offgas line may be flushed with appropriate decontamination solutions by manual procedures. The ambient background in the two condenser rooms, where the detector assembly is located, will normally be at levels low enough not to significantly affect maintenance work on the system.

The GM tube detector and check source are mounted in the same assembly. For access to this assembly, the 3-in.-thick lead shield must be removed. This shield is held in position by four bolts. Once the shield is removed, the detector assembly may simply be pulled from the center shield for maintenance or replacement.

2.8.11 SEISMIC MONITORING SYSTEM

The seismic monitoring system is made up of a multichannel, centralized, FM recording, magnetic tape acceleration system designed to detect and record strong local earthquakes. The monitoring and recording system and the playback system meet the requirements of NRC Regulatory Guide 1.12, Instrumentation for Earthquakes. Three triaxial force-balance accelerometers (one at ground level, one on the second floor, and one on the third floor) provide signals to the recording system located in the R&H Building control room. The acceleration range is ± 1 g and the system is started within 100 msec by means of a triaxial trigger located on the control room recorder panel. A second triaxial switch is located near the ground-level accelerometer. The triaxial switch on the control room panel consists of three orthogonal acceleration transducers, which are individually adjustable from 0.005 to 0.05 g, to start the recording system. The similar triaxial switch located at ground level may be set at an acceleration of one-half the safe shutdown earthquake (at the operating basis earthquake value) for use as a seismic alarm into the DCS.

The recording system is self-actuating when a strong local earthquake exceeds a predetermined level of ground acceleration. When this level falls below the preset level, the system automatically returns to the previous standby condition to prepare for any succeeding earthquakes.

The seismic system is contact-maintained because none of the system components will be located in high radiation fields or exclusion areas. Modular replacement of circuit cards and components facilitates rapid repair and short downtimes.

2.8.12 METEOROLOGICAL INSTRUMENTATION SYSTEM

The meteorological instrumentation system is a complete system for measuring wind speed, wind direction, ambient temperature, barometric pressure, relative humidity, and precipitation. Four complete sets of measuring instruments are located inside the alarm zone, one at each corner of the MRS exclusion area. This system is designed to meet the requirements of 10 CFR 72.72(b)(3) to determine the effects of natural weather phenomena on the storage facilities and buildings. The weather-variable signals are collected by an intelligent communication module at each of the four locations, and transmitted to the microprocessor-controlled central station in the R&H Building control room by means of dedicated lines and modems. The central station collects the data from the remote sites, reformats, and sends the data on to the peripheral devices and the DCS. A dedicated printer and keyboard provide an operator interface to the central station terminal in the R&H Building Control Room.

Contact maintenance is used for this system. Modular replacement of components and circuit cards is used, resulting in short downtimes for repair.

2.8.13 CANISTER MONITORING SYSTEM

After processing, welding, and decontamination, the canisters containing consolidated fuel are tested for leaks by using a helium-leak detector. They are then removed from the welding chamber and visually inspected through the leaded-glass window and by means of a CCTV camera. Further checks include an ultrasonic weld test, a surface contamination swipe test, a surface temperature measurement (using a thermocouple probe), and a gross radiation level measurement (using a fixed ion chamber). All of this information will be stored in DCS memory for later presentation in management and engineering reports, charts, and graphic presentations.

2.8.14 EXHAUST MONITORING SYSTEM

The HVAC system within the R&H Building is controlled and monitored by the DCS from the central control room or, alternatively, from the Site Services Building control room. Instrumentation is designed to fail in a safe mode in case of loss of pneumatic or electrical power, the occurrence of Category 1 incidents, or safety-related events. Air sampling capability is provided in each leg of the exhaust systems by means of test ports. The exhaust air particulate distribution is determined in this manner by laboratory analyses of these samples. Test ports are located before and after the prefilter and for each stage of the HEPA filters. The first stage of testable HEPA filters from the shielded process cells is equipped with radiation area monitors. Locally indicating differential pressure gauges are provided across each testable filter stage.

All filtered exhaust air streams are discharged through three main horizontal legs to the common exhaust stack. In each leg of the system, the exhaust stream is sampled and monitored for particulate radioiodine and fission product noble gases, primarily ^{85}Kr, and the flow rate is measured. The source of any contamination detected in any of the three legs is determined by analyzing grab samples taken downstream of the last bank of HEPA filters. The stack monitoring system is on standby power to preclude interruptions in offgas monitoring in case normal system power is lost. All filtered exhaust air streams are discharged to the common exhaust stack.

2.8.15 UTILITY MONITORING SYSTEMS

The steam boiler offgases are sampled and monitored at the boiler stack for CO, CO_2, SO_2, NO_x, O_2, and hydrocarbons. These gases may be present in varying quantities as a result of steam-boiler fuel oil combustion.

2.8.16 EVACUATION ALARMS

Separate and distinct audible and visible alarms are provided for process, security, criticality, radiation, fire, and building evacuation. They are initiated automatically or manually from the R&H Building control room or Site Services Building control room, as required by the alarm scenario.

2.8.17 RADIOACTIVE PROCESS STREAM AND SOLID RADWASTE MONITORING AND SAMPLING

Continuous monitoring of liquid radwaste tanks, vessels, sumps, and lines, as well as solid radwaste containers and operations, is accomplished by the continuous radiation monitoring system. All potentially contaminated effluent streams are monitored before release. The data are transmitted to, and stored in, the DCS memory.

A sample connection is provided on all collection tanks, vessels, and sumps for sampling the liquid contents. All samples are analyzed by the R&H Building analytical laboratory. In high-radiation zones, these grab samples are taken remotely, and transported to the laboratory in shielded containers or by means of a pneumatic transport ("rabbit") system from within the shielded process cells and shielded canyon cells.

2.9 PIPING

The piping systems in the areas of Category I structures are designed to withstand the Design Basis Earthquake (DBE) and the Operating Basis Earthquake (OBE).

The piping systems in the areas of Non-Category I structures are designed to meet the UBC seismic requirements for Zone 2 and an importance factor of 1.5.

Ventilation zones (defined in Table 2-6) are referred to in the requirements for drains, piping, valve locations, etc.

The design life of the piping systems is 40 yr, maintainable or replaceable to extend life in at least 20-yr increments.

The building service galleries, utility chases, and piping are designed to accommodate additional piping and services at some future time.

2.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

The potable water system supplies cold and/or hot water to the points of potable water usage, such as lavatories, sinks, toilets, showers, electric (drinking) water coolers, kitchen units, vending machines, emergency showers, and eyewash stations. The hot and cold water piping is insulated. Refer to Section 2.9.2 for type of insulation.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered.

Potable water is supplied at 100 psig to the process water system. The potable water system is separated by reduced-pressure principal backflow preventers from the process water system to prevent any possibility of contaminating potable water. The backflow preventers meet AWWA C506 requirements.

A pressure regulator reduces the potable water system pressure to 80 psig to comply with DOE Order 6430.1, Chapter V, Section 15c(1)(c).

Hot water is supplied at 110°F to comply with DOE Order 6403.1, Chapter V, Section 15c(3) by a steam water heater. The dishwasher is provided with an electric booster to obtain the required 180°F water. Drinking water is supplied by an electric water cooler.

Personnel decon showers and sinks are provided in the Health Physics area and supplied with hot and cold potable water. Drains from this Ventilation Zone 3 area are connected to the low-level liquid radwaste system.

Safety showers and eyewash stations that comply with ANSI Z358.1 are provided throughout the building at all equipment decon rooms, in the analytical laboratory, in service galleries, in Health Physics storage rooms, in operating galleries, in liquid and solid radwaste areas within reasonable distance from the decon stations, and in chemical handling areas, and are supplied with cold potable water. Drains from these Ventilation Zone 2 and 3 areas are connected to the low-level liquid radwaste system.

Safety showers and eyewash stations that comply with ANSI Z358.1 are provided for the battery rooms, steam generators and cooling tower chemical treatment areas, aqueous and chemical decon solution makeup area, materials receiving and storage room and adjacent corridor, and are supplied with cold potable water. Drains from these Ventilation Zone 4 areas are connected to the process sewer.

Drains from restrooms, the lunchroom, and other, similar areas in Ventilation Zone 4 are connected to the sanitary sewer.

Plumbing fixtures meet requirements for the physically handicapped.

Piping runs are concealed in ceilings, walls, and furred spaces in the administration area of the building.

Valves, fixtures, and equipment are readily accessible for operation, inspection, and maintenance.

Pipe hangers and supports are provided in accordance with the provisions required by MSS SP 69 and designed so that thermal expansion and contraction occur in the direction desired and spaced to maintain pipe alignment, prevent grade reversals, and prevent sagging of more than 0.1 in.

The roof drainage system discharges into the site storm drainage system.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

2.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas (if available) are connected to the MRS Facility distribution system. Fuel oil and fuel gas usage for the building are metered. Fuel piping systems are in accordance with NFPA standards, Factory Mutual, Kemper Insurance, and Industrial Insurers requirements.

Equipment and funnel oily drains are provided in the lag storage generator room, mechanical equipment penthouses, and Steam Generator Building, and are connected to the MRS Facility oily sewer system.

In Ventilation Zone 4 areas, floor and equipment drains (including boiler blowdown and nonoily equipment drains from the Steam Generator Building, cooling tower blowdown, floor and equipment drains from the cooling tower chemical building, battery/UPS rooms, chiller equipment room, aqueous and chemical decon solution makeup area, compressor room, and mechanical equipment rooms) are provided and connected to the MRS Facility process sewer system.

Sumps are used for floor and equipment drains in Ventilation Zones 1, 2, and 3 because these are designed to preclude criticality safety where necessary, permit the use of ejectors to pump out drainage, which increases reliability and decreases maintenance time and maintenance personnel radiation exposure as compared to other types of pumping. This design is selected because it permits most drainage piping to be kept exposed for visual examination and maintenance, in compliance with 10 CFR 72, Subpart F, Section 72.74. Decommissioning is also simplified, as none of the contaminated floor drain piping is buried in the concrete slab, in compliance with 10 CFR 72.76.

Floor drains with loop seals are used only in noncontaminated areas where drains are connected to the oily sewer or process sewer. These drain systems are buried in the concrete slab, where required.

In Ventilation Zone 1 areas, floor drains are open-type sumps. These sumps are installed in the shielded process cells and canyon cells, remote handled equipment maintenance room, and high-activity radwaste cell for liquid decon collection, and in the high-activity radwaste cell for HAW/RHTRU equipment drains collection. Steam ejectors with automatic air purge are installed at these sumps to pump drainage to the HAW liquid radwaste system.

To preclude criticality possibility in the shielded process cells, removable spools, with upstream and downstream valves for isolation, are furnished in all systems to the shielded process cells. The spools are connected to complete the system installation only during decon, and are disconnected during regular operation.

In Ventilation Zone 2 areas, floor drains are also open-type sumps. These sumps are installed in the remote handled HEPA filter room, the crane maintenance rooms, and the HAW/RHTRU drum decon room. Steam ejectors with automatic air purge are also installed at these sumps to pump drainage to the HAW/RHTRU liquid radwaste system. Sumps are also provided in the canistered fuel lag storage vaults. These sumps will be drained by using a portable pump, when necessary.

All other floor drain sumps in the Ventilation Zone 2 areas or rooms have steam ejectors, with automatic air purge, installed to pump drainage to the low-level liquid radwaste system.

In Ventilation Zone 2 areas, equipment drains are closed-type sumps that are vented to the vessel offgas system.

Equipment drains are hard-piped to the sumps because these potentially highly contaminated sumps are located in accessible areas. Steam ejectors, with automatic air purge, are installed at these sumps to pump drainage to the low-level liquid radwaste system.

In Ventilation Zone 3 areas, floor drains are normally open-type sumps. Steam ejectors, with automatic air purge, are installed at these sumps to pump drainage to the low-level liquid radwaste system.

The incoming air-control vestibule (receipt and washdown areas) floor drainage is collected in the washdown collection sumps. It is monitored for radioactivity and, if contaminated, is pumped to the low-level liquid radwaste system to comply with 10 CFR 72, Subpart F, Section 72.74. If noncontaminated, it is released to the process sewer.

Laundry effluent is collected, filtered, and monitored. If the effluent is contaminated, it is pumped to the low-level liquid radwaste system. If the effluent is not contaminated, it is released to the process sewer.

Analytical laboratory sink drains are hard-piped to a closed-type sump that is vented to the vessel offgas system. An air-driven, double-diaphragm pump is installed at this sump to pump drainage to the low-level liquid radwaste system.

Piping systems are designed to take advantage of gravity flow. Also, process piping systems are designed so that pockets or traps are eliminated, wherever possible, and the piping can be flushed and drained for decon. The prevention of pipe plugging and clearing of plugged lines has been considered in the design of the process piping systems. Flushing connections are provided where required for this purpose and for decon of the systems. This minimizes exposure of operating and maintenance personnel to radiation, as required by 10 CFR 72, Subpart F, Section 72.74.

Changes in direction of process piping are made with bends, where practicable, preferred over long-radius elbows except for solids transport lines, where blinded tees and laterals are used to prevent erosion. Eccentric reducers are used in process piping systems, installed with the flat side down to avoid formation of traps.

Piping systems that handle radioactive and corrosive materials are of butt-welded construction. Flanges and/or unions are kept to a minimum, and are installed only at equipment connections and where necessary for maintenance. Flanges have been located to minimize the consequences of contamination from leaks. Special piping connectors and jumpers, suitable for remote handling, are installed in areas of high-level contamination. This permits the removal of piping valves and equipment for decon and maintenance or replacement, using remote handling equipment. Notches, cracks, crevices, and/or rough surfaces that might retain radioactive materials are avoided in the installation of radioactive process piping systems.

All of the above minimize exposure of operating and maintenance personnel to radiation, as required by 10 CFR 72, Subpart F, Section 72.74.

All welding is in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code, as modified by ANSI B31.1, in compliance with 10 CFR 72, Subpart G.

Gaskets are Grafoil by Union Carbide. Teflon is not used for gasket material in process piping systems or as a component part of any valve or other piece of equipment subject to radiation.

Bolting for stainless steel systems is of galling-resistant bolting material, Nitronic 60 or equal.

Piping is arranged so that piping containing fluids (process or utility) is located below electrical conduit, where possible, and also provides clear overhead access to equipment.

Vessel vent piping is designed so that inadvertent transfer of solutions or slurries into the ventilation system is prevented.

All in-cell piping is stainless steel to facilitate decontamination.

Piping systems that contain contaminated gases or liquids are isolated from noncontaminated (clean) systems by check valves, block valves, and quick disconnects installed in the noncontaminated system at the intertie to the contaminated system.

Contaminated piping systems are constructed of corrosion-resistant materials, and are located for easy accessibility wherever practicable. The design allows the collection of effluents from leaks without releasing the effluents into personnel access areas or the environment, complying with DOE Order 5480.1A, Chapter XI, 4, f (ALARA).

Piping is arranged in arrays and sized (bore diameter) to comply with criticality safety requirements of 10 CFR 72, Subpart F, Section 72.73.

Piping located on or near floors, including the pipe supports, is configured so as not to impede the rapid cleaning or decontamination of floors and removal of deposits of solids and flushing or otherwise moving slurries to floor drains or floor-drain sumps, in compliance with 10 CFR 72, Subpart F, Section 72.74.

Valves are installed in the stem-up orientation and so that removal or maintenance of the valve can be performed without dismantling the associated piping, wherever practicable. In-cell valves are of the butt-welded, all-metal, packless type, with a metal bellows seal, have optimum corrosion resistance to process and decontamination solutions, and the ability of all component parts to withstand radiation.

Air-operated valves are installed to allow free drainage of the valve body. Care is taken in the location of the valves to permit ease of access for maintenance and to minimize the consequences of contamination from leaks.

Valves in the process cells and in the HAW/RHTRU radwaste system, installed in the remote handled equipment maintenance room, are installed in "jumpers" that are fabricated with special piping connectors to permit maintenance or replacement by using remote handling equipment. All valves not functionally required to operate directly on nuclear material are located outside the cells. Valves in utility systems are not valved in the cell.

Quick disconnects are provided in the shielded process cells, the shielded canyon cells, and in the remote handled equipment maintenance room for utility connections. These are designed to be used by remote handling equipment. Quick disconnects are different for each utility system to preclude connection to the wrong system.

All of the above comply with DOE Order 5480.1A, Chapter XI, 4, f (ALARA).

Piping passing through concrete shielding walls is embedded in the concrete without sleeves. The piping is fabricated with the necessary offsets to prevent the streaming of radiation through the penetration, complying with 10 CFR 72, Subpart F, Section 72.74. The pipe is not in contact with any rebar or embedments. Stainless steel lines, embedded directly in the concrete, have been protected against chloride contamination.

Sleeves are provided where piping passes through masonry, concrete walls (except shielding walls), floors, and roofs. Sleeves are galvanized pipe and of sufficient length to pass entirely through walls, partitions, or slabs. Sleeves are sloped to drain toward process areas. Pipe penetrations through firewalls have the space between the pipe and sleeve packed and sealed with suitable caulking compound for fire stopping. Allowance is made for expansion and contraction of steam lines and other systems requiring allowance for thermal movement.

Breathing air is supplied to the liquid and solid radwaste areas, weld/test and decon equipment room, loadout and decon rooms, service gallery and equipment decon rooms, high-activity radwaste area, remote handled equipment maintenance room, cask handling and decon rooms, manipulator maintenance decon rooms, exhaust filter rooms, remote handling air-filtration cells, shielded process cells, and crane maintenance rooms.

Hose couplings and manifolds are designed to prevent the connection of respiratory protective equipment to any system other than the breathing air system.

Vessels and equipment in radioactive systems are located in separate shielded cells or enclosures, as required for the radioactivity level, to protect operating and maintenance personnel from radiation exposure, in compliance with 10 CFR 72, Subpart F, Section 72.74.

Ease of access and sufficient space around the equipment are provided for ease of operation and repair or replacement of equipment.

The systems have been arranged to be decontaminated when access is required.

Valving and instrumentation have been located, wherever practicable, outside shielded process cells, shielded canyon cells, or enclosures, and are in areas of lower radiation levels to reduce personnel exposure.

Curbs have been placed at entryways to shielded process and shielded canyon cells or enclosures and around equipment to contain any spills or leaks and to localize spread of contamination. Ramps are provided at doorways to assist in handling equipment over curbs during maintenance or replacement.

This curbing will also contain and localize the spread of firewater from fire-protection sprinkler systems for a limited time, depending on the volume of firewater released and the ability of the radwaste collection system to handle the volume.

Piping systems have external insulation applied for heat conservation and/or process control (hot), for anticondensation when the temperature in the system is less than the dewpoint temperature of ambient air, and for personnel safety.

The insulation (coverings and linings) conforms to the requirements of NFPA 90A, has a flame-spread rating not exceeding 25 when tested in accordance with ASTM E84, and is fuel contributed and smoke developed under 50 when tested in accordance with ASTM E662. All insulation material is 100% asbestos-free.

Calcium silicate, Expanded Perlite, and/or mineral wool are used for heat conservation and/or process control and personnel protection. Fiberglass 25 ASU material is used for anticondensation insulation. Elastomeric insulation is used for refrigerant piping insulation. All insulation surface-exposed areas, except in shielded process cells, shielded canyon cells, and the remote handled equipment maintenance room, are fitted with aluminum jacketing.

Piping in the shielded process cells, shielded canyon cells, and remote handled equipment maintenance room is not normally insulated. Where insulation is required, it is fitted with stainless steel jacketing.

Insulation and jacket covering areas or components that requires periodic inspection and/or servicing are installed to permit the rapid removal and reassembly of the insulation and jacket.

Piping systems and components important to safety are designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions in compliance with 10 CFR 72, Subpart F, Section 72.72(c).

Piping systems are designed to withstand the effects of natural pheonomena, such as earthquakes and lightning. Regulatory Guide 1.61 damping values and Regulatory Guide 1.122 floor design response values are used in seismic analysis.

Pipe hangers and supports are provided in accordance with the provisions required by MSS SP 69, and are designed so that thermal expansion and contraction occur in the direction desired, permit adjustment after installation while supporting the load, and spaced to maintain pipe alignment, prevent grade reversals, and spaced to prevent sagging of more than 0.1 in.

Springs used in variable or constant-effort-type supports are designed in accordance with MSS SP 58.

Piping identification is color coded in accordance with ANSI A13.1. The piping contents and flow of material are indicated by adhesive markers.

The complete installation is in compliance with ANSI B31.1.

2.10 ELECTRICAL

2.10.1 POWER SERVICE

2.10.1.A. R&H Building

(1) Building power is obtained from six double 4.16-kV normal primary feeder configuration systems. One double-ended, 4.16-kV indoor load center unit substation, with one standby feeder, load shed to standby loads, feeds all 5-kV motor loads. Five double-ended, dry-type, indoor load center unit substations, with three tie feeders to three standby unit substations, transform the primary voltage to 480Y/277 volts, 3 phase, for all low-voltage power loads. For each substation, either normal feeder is rated to carry 100% of the substation load. If one of the primary feeders fails, power will switch to the alternate feeder automatically with minimum delay transfer time.

(2) Special motors rated 250 hp and above are controlled by a 4.16-kV, metal-clad motor control center with fused vacuum contactor-type motor controllers. The motor control center and switchgear include transfer trip control interlock equipment with sequenced load shedding and reacceleration.

(3) If simultaneous failure of both normal primary feeders occurs, power is provided by four 4.16-kV primary feeders from the standby generator system. Three single-ended, dry-type, indoor load center unit substations transform the primary voltage to 480Y/277 volts for critical power and lighting loads. The standby unit substations are located in rooms separate from the normal power unit substations. Standby power is provided to the HVAC filtered exhaust fans, UPS battery chargers, selective lighting, and other air-conditioning loads. The standby power system is provided to permit continuance of predesignated operational functions for extended periods of time. Power for air-conditioning units for the computer rooms is derived from the standby power system.

(4) A UPS system is provided for neutron criticality monitoring and alarms, radionuclide monitoring and alarms, air monitoring and sampling systems, fire alarms and supervision circuits, security surveillance system, access control, personnel decontamination system, and distributed control instrumentation system.

(5) Four battery changer/inverter units are installed and each rated at 50% of the maximum UPS load. The inverter output is 480Y/277 volts, 60 Hz, 3-phase, connected to a UPS bus from which all UPS loads will be derived. The battery bank is rated 125 volts if capacity is 300 A or below, or 250 volts if capacity is above 300 A. The ampere-hour capacity of the battery is sufficient to sustain the entire UPS load for a period of 10 minutes with a final volts per cell not below 1.75.

(6) Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels are used for receptacle circuits and intermittent lighting circuits.

(7) The entire power distribution system is coordinated for selective fault protection. Electrical equipment and installation use NEMA-1 type enclosures for indoor use.

2.10.1.B <u>Steam Generator Building and Cooling Tower</u>

(1) Building power is obtained from one double 4.16-kV normal primary feeder configuration system. One double-ended, dry-type, indoor load center unit substation, with one tie feeder to one standby unit substation, transforms the primary voltage to 480Y/277 volts, 3 phase, for all power loads. In the substation, either normal feeder is rated to carry 100% of the substation load. If one of the primary feeders fails, power will switch to the alternate feeder automatically with minimum delay transfer time.

(2) In case of simultaneous failure of both normal primary and alternate feeders, power is provided by one 4.16-kV primary feeder from the standby generator system. One single-ended, dry-type, indoor load center unit substation transforms the primary voltage to 480Y/277

volts for all critical power and lighting loads. Both unit substations are located inside one prefabricated powerhouse located near the Steam Generator Building and the cooling tower. Standby power is provided to permit continuance of predesignated operational functions for extended periods of time.

(3) MCCs for the Steam Generator Building are located within the building. MCCs for the cooling tower are located within the prefabricated powerhouse.

(4) Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels are used for receptacle circuits, intermittent lighting circuits, and small single-phase loads.

(5) The entire power distribution system is coordinated for selective fault protection. Electrical equipment and installation conform to NEMA-1 type enclosures for indoor use.

2.10.2 POWER DISTRIBUTION

Electric power is distributed throughout the R&H Building, Steam Generator Building, and cooling tower by means of bus ducts, cable trays, and a rigid/flexible conduit system. Feeder circuits are terminated in motor control centers, loads center, or panelboards for further distribution to equipment loads.

Standby power is provided to selective loads by separate unit substations, motor control centers, and panelboards. Circuits for normal and standby power loads are segregated for service reliability.

Radial-type circuit arrangement with selective circuit protection is provided for all of the secondary distribution systems.

2.10.3 GROUNDING SYSTEMS

2.10.3.A. Buildings and Cooling Tower Ground Systems

A ground loop, with ground rods, is installed around the building. The ground resistance does not exceed 5 ohms. The power system ground is connected to the ground loop. All electric motor frames, metal frames of switchboards, motor control centers, lighting panels, and transformer frames are grounded to the electrical building ground loop by means of a separate, insulated, green-colored ground conductor.

2.10.3.B. Transformer Neutral

The transformer neutral and the grounding conductor are connected to the nearest available, effectively grounded metal water pipe and the building ground system. The ground resistance of ground rods does not exceed 5 ohms.

2.10.3.C. Electric Motor Frame

The electric motor frames and ground terminals of special-purpose receptacles are grounded by means of a separate grounding conductor installed in the conduit enclosing the branch circuit conductor serving the motor. Metal frames of switchboards, motor control centers, lighting panel cabinets, and the transformer frame are grounded via a separate grounding conductor and connected to the effectively grounded, metallic, cold-water line and the building grounding system.

2.10.3.D. Instrumentation Computer Ground

A separate and insulated grounding system, with a single-point connection to the electrical power grounding system, is provided.

2.10.3.E. Lightning Protection

Lightning protection is provided for the R&H Building in conformance with NFPA 78 Standards, NEC, and LPI-175. The lightning protection system is connected to the building ground loop. All exposed, large metal equipment and materials, as well as metal structural frames, are bonded to the building system ground loop.

2.10.4 LIGHTING

In all process areas, the voltage level for lighting is 277 volts and the lighting fixtures are of the high-intensity discharge (HID) type. In offices and maintenance areas, lighting fixtures are 277-volt fluorescent or 120-volt incandescent for small, infrequently used storerooms, with local switching. All outside lighting is 277 volts and of the HID type. All fixtures employ high-efficiency ballasts of the energy-efficient, high-power-factor type. Outdoor lighting is controlled by solar-compensated, time-switch control with manual and/or photocell override. Shielded process cell and shielded canyon cell lighting is provided by internally mounted fixtures capable of removal by remote-controlled manipulator to facilitate relamping without exposing personnel to excessive radiation fields.

A battery-type emergency lighting system is installed to provide safe and orderly shutdown of operations and safe egress during a total power outage. Emergency lighting is by individual unit equipment at stairways, corridors, control rooms, processing and storage areas, and exits. Wiring for the emergency lighting system is in conduits separate from normal power or lighting circuits. Emergency and exit lighting circuits are fed from panelboards served by the standby power system.

No local switches are provided for emergency lighting circuits; all switching is at the distribution panelboard only, with the minimum number of circuit breakers between the power source and the final subcircuit. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

Illuminated exit signs are installed at all emergency exits, passageways, and corridors as required by NFPA Life Safety Code No. 101. The exit signs are internally illuminated, with translucent globe or letters, as approved by the Underwriters' Laboratories, Inc., for the service.

Illumination levels in the interior are 50 footcandles (ft-c) at task level for work stations, 30 ft-c at walking surface in general work areas, 10 ft-c at walking surface in nonworking areas, and 350 ft-c in the shielded process and shielded canyon cell areas. When higher levels of illumination were determined to be needed for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

2.10.5 COMMUNICATIONS

2.10.5.A. Fire Alarm and Detection System

The electrically supervised, noncoded, zoned, fire alarm system includes a fire alarm control panel, smoke detectors, fire sensors, manual fire alarm stations, annunciator panel, standby batteries, connections to the sprinkler system, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and the Security Building. The annunciator panels are located in the R&H Building and Site Services Building control rooms and their air-control vestibules. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA-101 Life Safety Code.

2.10.5.B. Public Address System

A public address system is installed in the R&H Building and Site Services Building for paging. The system is provided with paging zones, as follows:

Zone (1) "All-call"; this zone covers all areas of the R&H Building and has priority over all other zones.

Zone (2) Ground level and first mezzanine level.

Zone (3) Second level and second mezzanine level.

Zone (4) Third level.

The public address system provides a paging sound level of approximately 6 db above background noise. Sound variance "high-low" is consistent within 3 db for all large paging areas. The public address system is accessed through the telephone system by code and at selected locations.

The public address system employs the latest solid-state devices with all speaker cables installed in conduit.

2.10.5.C. Intercommunication Systems

Hardwired intercommunication systems are installed in the R&H Building for communications from the R&H Building and Site Services Building control room consoles and the shielded process cell and shielded canyon cell consoles. The intercommunication systems consist of a master station and several slave stations. Calls can originate from either location. Components use solid-state circuitry and are installed in a rigid conduit system.

2.10.5.D. Telephone System

A telephone system is provided within the R&H Building with the Electronic Private Automatic Branch Exchange (EPABX) located in the Site Services Building. Telephone station equipment is installed in all offices, conference room, laboratories, control room, operating galleries, and the main electrical equipment room. All station equipment cables are installed in rigid conduits and terminated in telephone cabinets, which serve as distribution centers for the telephone system within the R&H Building.

2.10.5.E. Door Alarm and Access Control System

A door alarm and access control system is provided for the R&H Building to monitor all exterior doors. The system consists of a central processor with internal memory system, keyboard and display, and external printer and data logger. The remote sensors are of the proximity type and are connected to the controller via coaxial cable. Any entry is graphically displayed at the security console in the Security Building AMS and the Protected Area Gatehouse.

2.10.5.F. Radio Paging System

A VHF radio paging system is provided for the R&H Building. The system consists of a central VHF-signal radio transmitter, antenna, and remote receivers carried by selected key personnel. The system allows wireless individual paging of key personnel within the MRS Facility, including exterior areas.

2.10.5.G. Building Warnings and Evacuation System

The R&H Building is equipped with audible and visual alarming systems to alert personnel and the public of abnormal or hazardous conditions. The visual devices include sealed-beam, rotating or flashing beacons with red-colored lenses. The audible devices include bells, horns, and outdoor warning sirens.

The audible and visual warning devices are actuated automatically or manually from the control room of the R&H Building.

2.11 HVAC

2.11.1 GENERAL

Heating, ventilating, and air-conditioning (HVAC) systems are provided to maintain the required temperatures, ventilation, and contamination-control environments within the R&H Building. Temperatures are controlled as required for the processes performed in the area served, and for the efficient performance of the operating personnel.

In the R&H Building, the ventilation and confinement control provides the essential part of the final and internal confinement systems, and acts as a barrier to minimize the spread of contamination. The ventilation confinement zones for the R&H Building are described in Table 2-6.

Table 2-6 - Ventilation Confinement Zones

Zone	Definition	Typical Locations
1	Process zone Highly contaminated area, restricted access zones	Shielded process cells and canyon cells Bare fuel lag storage Glove boxes (including spent filter processing enclosures within solid radwaste) Drum transfer corridor Remote-handled maintenance equipment room Overpack High-activity waste
2	Restricted access zones Potentially contaminated areas	Shielded process cell service galleries Radwaste treatment facility Shipping cask preparation, decontamination, and unloading rooms Crane maintenance rooms Cask loadout and decontamination Contact-handled maintenance rooms Equipment decon rooms Drum/canister transfer rooms Final and remote-handled HEPA filter rooms

Tabe 2-6 (Contd)

3	Operating zones Not normally contaminated	Operating galleries Canistered lag storage vaults Process area corridors Air locks and air-control vestibules Laundry Changerooms Storage rooms Personnel decon rooms Filtered exhaust fan rooms Analytical laboratory and health physics area Solid radwaste area (except spent filter processing enclosures, which are considered as large glove boxes) Weld/test and decon equipment room
4	Unrestricted access zones	Administrative areas Lunchrooms Unregulated support areas Restrooms Electrical equipment rooms Supply air fan room(s) Control room Chiller room UPS/battery room Compressor room Receiving and inspection area Vehicle entry vestibule Vehicle exit vestibule

Static pressures within the various zones with respect to atmosphere will nominally be as follows:

Zone 1: -2 to -4 in. H_2O gauge
Zone 2: -0.75 to -1.5 in. H_2O gauge
Zone 3: -0.5 to -0.7 in. H_2O gauge
Zone 4: +0.05 to +0.1 in. H_2O gauge

In addition to the confinement zones and static pressures listed above, additional incremental zones are also provided in order to differentiate between hazards within the same zone. Shielded process cell operations will be isolated from the cleaner operations and maintained at a minimum 1 in. wg lower pressure than clean operations. In addition, the "clean" shielded process cells will be maintained at a minimum of 1.5 in. wg lower pressure than the lag storage vaults.

The release of radiological and nonradiological particulates, aerosols, fumes, and vapors to the environment is controlled to concentration levels as low as reasonably achievable (ALARA), and will meet all applicable regulations and standards. This control is maintained during normal operations and postulated accidents, including those caused by natural phenomena. The contaminants are further confined to specific areas within the building to prevent dispersion of the materials into areas normally occupied by personnel. Differential pressures between zones within the building are used to confine the contaminants so that flow of air is from zones of lesser to zones of greater contamination potential under all conditions. Within the same confinement zones, air will also flow from areas of lesser to areas of greater contamination potential.

2.11.2 SYSTEMS PROVIDED

The major portion of the building is served by two multiunit, once-through, cascading airflow systems. In addition to the two main systems, several independent HVAC systems, as well as several outside air intakes and exhausts, are used for heating, cooling, and/or ventilating of miscellaneous Zone 4 areas and lag storage vaults. Additional standby systems are also provided for the R&H Building control room and the UPS rooms. The standby units will operate only during loss of normal power or malfunction of the main supply air system.

2.11.2.A. Main Once-Through System

Two identical multiunit, once-through, cascading airflow systems are used to provide heating, cooling, and ventilating for the major portion of the building.

Flow, control, and equipment layout of these systems are shown on Drawings H-3-56832 through H-3-56839. Each once-through system consists of the following subsystems:

(1) Supply system
(2) Exhaust system
(3) Between zones and filtration system
(4) Exhaust stack

1. Supply System. The supply system is composed of five outside air supply subsystems connected in parallel. Flow and control diagrams are schematically shown on Drawing H-3-56835.

Each subsystem contains the following equipment:

(1) Supply fan with inlet vane dampers.

(2) Chilled water cooling coil.

(3) Steam preheat coil.

(4) Glycol heat recovery coil.

(5) 30% ASHRAE prefilters.

(6) 85% ASHRAE final filters.

(7) Tornado damper.

(8) Isolation dampers.

(9) Backdraft damper.

(10) Supply airflow measuring station.

(11) Bypass duct system, including backdraft damper, bypass damper, and associated ducts, as shown on Drawing H-3-56835.

(12) All associated controls to ensure desired airflow and pressure to the facility.

(13) All associated ductwork as shown on the drawings and described in Section 2.11.2.K.

2. Exhaust System. The exhaust system is designed to provide hazard isolation, to collect and remove radioactive materials, and to limit the release of contaminants to the environment below the level required by applicable codes and regulations, as described in the Design Criteria.

The exhaust system includes the following subsystems:

(1) Zone 1 and 2 final exhaust
(2) Zone 3 and 4 final exhaust
(3) Miscellaneous Zone 4 exhaust fans

(1) Zone 1 and 2 Final Exhaust. As shown on Drawing H-3-56836, the Zone 1 and 2 final exhaust subsystem includes the following:

(a) Exhaust air inlet plenum.

(b) Six final filter plenums (four operating and two standby) connected in parallel.

(c) Four exhaust fans (two operating and two standby) connected in parallel.

(d) Isolation valves for each filter plenum and exhaust fan.

(e) Exhaust airflow station for each exhaust fan.

(f) Backdraft dampers.

(g) Six heat recovery coils (four operating and two standby) connected in parallel.

(h) All associated controls, dampers, plenums, and ductwork as shown on the drawings.

Each filter plenum includes a prefilter, two stages of HEPA filters, space for future installation of a carbon filter, cooling water spray chamber with spark arrestor demister, and aerosol test sections to allow the in-place testing of each stage of HEPA filters. Zone 1 and 2 final filters are of the "bag-in/bag-out" type, and are designed to have 50% redundancy of filters. Each filter plenum is manually isolatable for maintenance.

The final exhaust fan system is designed to have 100% redundancy. A flow control damper, together with a flow control station, is provided at each fan discharge duct to maintain constant exhaust airflow requirements.

As shown on Drawing H-3-56834, the Zone 1 and 2 final exhaust system is provided with a differential pressure controller to measure atmospheric pressure and the pressure at the exhaust system inlet plenum. This differential pressure controller is a master controller and resets to the control point of other submaster flow controllers in the supply air system to maintain a constant pressure differential at the final exhaust system inlet plenum.

(2) Zone 3 and 4 Final Exhaust. As shown on Drawing H-3-56837, the Zone 3 and 4 final exhaust subsystem includes the following:

(a) Exhaust air inlet plenum.

(b) Six final filter plenums (four operating and two standby) connected in parallel.

(c) Three exhaust fans (two operating, one standby) connected in parallel.

(d) Isolation valves for each filter plenum and exhaust fan.

(e) Exhaust airflow station for each exhaust fan.

(f) Backdraft dampers.

(g) Six heat recovery coils (four operating and two standby) connected in parallel.

(h) All associated controls, dampers, plenums, and ductwork as shown on the drawings.

Each filter plenum includes a prefilter, one stage of HEPA filters, cooling water spray chamber with spark arrestor demister, and aerosol test sections to allow the in-place testing of HEPA filters. Zone 3 and 4 final filters are of the "bag-in/bag-out" type, and are designed to have 50% redundancy of filters. Each filter plenum is manually isolatable for maintenance.

The final exhaust fan system is designed to have 50% redundancy. A flow control damper, together with flow control station, is provided at each fan discharge duct to maintain constant exhaust airflow requirements.

(3) Miscellaneous Zone 4 Exhaust Fans. As shown on Drawing H-3-56833, Sheets 1 through 14, two exhaust fans are provided for the exhaust of miscellaneous Zone 4 areas. In addition, exhaust fans are also provided for the exhaust of the exit tunnels (2), chiller room, electrical equipment rooms (2), battery rooms (2), diesel fume exhaust at receipt and inspection room (2), toilets, and chemical storage areas. These fans exhaust the air directly to the outside without passing through any HEPA filters or the exhaust stack.

3. Between-Zone Filtration. In addition to the HEPA filters in the final exhaust system, the following filters are also provided for filtration of transfer air between ventilation zones:

(1) A single-stage, testable, bag-in/bag-out HEPA filter in the airstream of all transfer ducts and openings between Ventilation Zones 1 and 2.

(2) A single-stage, testable, bag-in/bag-out HEPA filter in the airstream of all ducts and openings between Ventilation Zones 2 and 3.

(3) A single-stage, testable, bag-in/bag-out HEPA filter in the exhaust airstream between the analytical laboratory and Zone 3 and 4 final exhaust system.

(4) A two-stage (first stage acting as a prefilter), remote-handled, nontestable HEPA filter at the air exit from selected Zone 1 areas, such as the shielded process cells, remote handled equipment maintenance room, and the high-activity radwaste areas. Prefilter will not be provided.

(5) A single-stage, remote-handled, testable HEPA filter inside the exhaust duct between the selected Zone 1 areas mentioned above (item 4) and the final exhaust system. Prefilter will not be provided.

(6) A two-stage (first stage acting as a prefilter). remote-handled, nontestable HEPA filter at the air exit from the shielded canyon cells. Prefilter will not be provided.

(7) A single-stage, testable, bag-in/bag-out type HEPA filter at the air exit from the other Zone 1 areas, such as glove boxes, isotope cubicles, and filter process areas.

Prefilters will be provided for all HEPA filters, except where indicated otherwise. The prefilter will consist of a 2-in.-thick filter with fiberglass media.

4. Exhaust Stack. A single stack is provided for exhausting the major portion of the air from the R&H Building. The only air that is not exhausted through the stack is from the miscellaneous Zone 4 areas described in Section 2.11.2.A.3.

The stack will be designed to meet earthquake and tornado requirements; therefore, an alternate relief will not be provided. The stack discharge will have a minimum of 4,000-fpm velocity.

Radiation monitoring stations are provided at three main exhaust ducts leading to the stack (final exhaust north, final exhaust south, and canistered lag storage exhaust). Tornado dampers are provided at each main exhaust duct as they enter the stack.

2.11.2.B. Standby HVAC Systems

Standby systems are provided for the R&H Building control room, the two UPS rooms, and their surrounding areas. Under normal conditions, these areas are served from the once-through systems; however, because of the criticality of these areas, standby units connected to standby power will also be provided as shown on Drawing H-3-56842 (for control room) and H-3-56848 (for UPS rooms). Each system includes the following major equipment:

(1) Air-handling units, draw-through type, including supply fan, direct-expansion cooling coil, 30% AHSRAE efficiency prefilters, and 85% efficiency final filters.

(2) Indoor-type, air-cooled condensing units, including refrigerant piping and controls.

(3) Room thermostats.

(4) All ductwork, including supply, return, and outside-air intake and exhaust, as shown on the drawings.

(5) Tornado dampers located at the outside air intake and exhaust openings.

(6) Backdraft dampers located in the discharge duct of each air-handling unit.

(7) All associated piping and controls.

2.11.2.C. Canistered Lag Storage Vault Cooling System

A multiunit, once-through, 100% outside air, constant-volume ventilating system is used to maintain the lag storage vaults at a maximum of 60°F above outside ambient temperature. Flow, control, and layout of this system are shown on Drawing H-3-56840, Sheets 1 through 7. The system consists of the following major components:

(1) Four air-handling units, (three operating and one standby) connected in parallel. Each unit includes a supply fan, 30% ASHRAE efficiency prefilter, and 85% ASHRAE efficiency final filters.

(2) Six filter plenums (four operating and two standby) connected in parallel. Each plenum includes a prefilter, one stage of bag-in/bag-out type HEPA filters, and aerosol test section to allow the in-place testing of the HEPA filters.

(3) Four exhaust fans (two operating and two standby) connected in parallel.

(4) Exhaust airflow measuring station for each exhaust fan.

(5) Exhaust airflow measuring station for each vault.

(6) Backdraft and manual balancing dampers, as shown on Drawing H-3-56840, Sheet 1.

(7) Tornado dampers.

(8) Isolation dampers for each air-handling unit, filter plenum, exhaust fan, and each vault.

(9) All associated controls, dampers, plenums, and ductwork, as shown on the drawings.

The canistered lag storage vault cooling system is designed to have 33% redundancy of supply air-handling units, 50% redundancy of HEPA filtration, and 100% redundancy of exhaust fans.

2.11.2.D. Receiving and Inspection Area HVAC System

Two identical recirculating systems are used to provide heating, cooling, and ventilating for the receiving and inspection area, including the entry and exit vestibules. A typical air flow and control diagram for this system is shown on Drawing H-3-56839. Each system consists of the following major components:

(1) Two identical air-handling units connected in parallel (each operating on a continuous basis). Each air-handling unit contains 30% ASHRAE efficiency prefilter and 85% ASHRAE efficiency final filters, a chilled water cooling coil, a hot water heating coil, and a supply fan.

(2) Two identical return-air fans.

(3) Economy cycle control, including all associated dampers and controls.

(4) Two diesel fume exhaust fans (see Section 2.11.2.H).

(5) Two oil-fired door heaters, located one each in the entry and exit vestibules.

(6) Airflow stations inside ductwork to and from the receiving, inspection, and shipping area.

(7) All associated thermostats, control dampers, balancing dampers, ductwork, backdraft dampers, and controls, as shown on the drawings.

2.11.2.E. Supply Fan Room Cooling Unit

Two identical air-handling units are used in each supply fan room (north and south) to provide required cooling for the area. Equipment layout of the system is shown on Drawing H-3-56841. Each air-handling unit consists of 30% ASHRAE filters, chilled water cooling coil, a supply fan, and all associated dampers, controls, and ductwork.

2.11.2.F. Chiller Room Cooling Unit

An air-handling unit, similar to those for the supply fan rooms, is used to provide required cooling for the room. An exhaust fan is used to exhaust the air directly to the outside. Layout of the units and associated controls and ductwork is shown on Drawing H-3-56842. The air-handling unit consists of a supply fan, 30% ASHRAE filters, and a chilled water coil.

2.11.2.G. Dryer Exhaust System

A special exhaust system is provided in the laundry area to provide filtration and exhaust for the dryer. Layout and flow diagrams for the system are shown on Drawings H-3-56847 and H-3-56833, Sheet 7 of 14, respectively. Major components of the system include:

(1) A roll-type lint filter with associated plenums, controls, and ductwork.

(2) A HEPA filter plenum, including prefilters, single-stage bag-in/bag-out type HEPA filters, and aerosol test sections to allow in-place testing of the HEPA filters.

(3) Exhaust/booster fan.

(4) Bypass duct system with associated dampers to allow bypassing of the system when dryer is not operating.

(5) All associated controls, dampers, and ductwork, as shown on the drawings.

2.11.2.H. Diesel Fume Exhaust System

Diesel fume exhaust fans with ductwork extending to near the floor are provided at the receiving and inspection areas (see Drawing H-3-56839). The fume exhaust system will be manually turned on only as required.

2.11.2.I. Heat Recovery System

The runaround heat recovery system, shown on Drawing H-3-56849, is designed to recapture the heat from the exhaust of the two once-through, electrical equipment rooms, and chiller room systems, and transfer it to the heat-recovery coils located in each outside air-handling unit of the once-through systems. The heat recovery system consists of the following equipment:

(1) One bank of heat-recovery coils inside the exhaust duct between each final Zone 1 and 2 and Zone 3 and 4 exhaust filter and fan.

(2) One bank of heat-recovery coils inside each electrical equipment room exhaust duct (two systems).

(3) One bank of heat-recovery coils inside the chiller room exhaust duct.

(4) Ten banks of heat-recovery coils in the outside air intake duct, one bank in each supply subsystem.

(5) Three glycol circulating pumps (two operating and one standby).

(6) Expansion tank.

(7) All associated piping and controls.

2.11.2.J. Heating System

The main component of the heating system for the R&H Building is the local steam boiler (for description, refer to Section 2.7). Steam from the boiler is delivered to the steam preheat coils (located in each outside air supply subsystem of each once-through system) and to a steam-to-hot-water converter, which provides hot water as the heating medium to the reheat coils located in the branch temperature zone mains.

The hot water converter system includes the following:

(1) Two steam-to-water heat exchangers.
(2) Three hot water circulating pumps (one standby, two operating).
(3) Water treatment equipment.
(4) All associated piping and controls.

In addition to the steam and hot water coils, heating is also provided by two oil-fired door heaters (in the vehicle entry and exit vestibules).

2.11.2.K. Cooling System

The major portion of the R&H Building is served by a local chilled water system consisting of the following major components:

(1) Six water chillers.
(2) Seven chilled water circulating pumps (six operating, one standby).
(3) Cooling towers (for description, refer to Section 2.7).
(4) Condenser water pumps and piping (refer to Section 2.7 for description).
(5) Chilled water piping, including all associated valves and controls.

The chilled water system provides all of the cooling requirements for the once-through, cascading systems, as well as the cooling required for the supply fan room (Section 2.11.2.E), chiller room (Section 2.11.2.F), and receiving and inspection area (Section 2.11.2.D) cooling systems.

In addition to the chilled water system, three separate, small, direct-expansion systems are provided for the control room and the UPS room standby systems (as described in Section 2.11.2.B).

2.11.2.L. Ductwork

The ductwork is designed to properly convey air for ventilation and contamination control. Air intakes for the Category I portion of the R&H Building will meet Category I construction requirements. Backdraft dampers are provided inside ductwork, as shown on the drawings, to prevent backflow of air from areas of higher contamination potential to those of lower contamination potential. Duct insulation, where required, will be semirigid fiberglass with aluminum jacket. Tornado valves are provided inside all inlet and exhaust ductwork leading to and from the portion of the R&H Building designed for Category I construction. Bypass ducts and dampers are provided as required to exhaust each area directly to the outside (through final HEPA filters) in case of fire.

Ductwork material will be as follows:

(1) Galvanized steel, designed in accordance with SMACNA standards, will be used for all miscellaneous Zone 4 exhaust ductwork, as well as for the ductwork of all independent and standby systems.

(2) Continuously welded, airtight, carbon-steel ducts will be used for all main air supply, Zone 3 exhaust, all exhaust ductwork downstream of the final exhaust filters, and all transfer ducts between Zones 4 and 3. Carbon steel will also be used for all ductwork required for the canistered lag storage cooling system.

(3) All exhausts from Zones 1 and 2, as well as all transfer ducts between Zones 2 and 1 and 3 and 2, will be of stainless steel construction.

2.11.3 DESIGN FEATURES

Design features and special considerations that emphasize system reliability and simplicity for both operation and maintenance are outlined below. These features underline the design philosophy and rationale.

(1) Any HVAC equipment or component housed in a Category I structure, which has as its function to limit the potential release of radiological substances or to maintain nuclear safety, will remain operational during and after a seismic or tornado occurrence.

(2) The airflow distribution is based on the internal heat load and/or reasonable air change for each area. Operating sequence and airflow balance between the exhaust and supply air systems are such that supply air systems follow the command from exhaust systems. The prime objective is to maintain proper pressure-differential requirements among various ventilation zones.

(3) Differential pressure controllers have control reference to outside atmosphere, wherever practicable, for uniformity.

(4) In order to minimize the consequences of local spills or major accidents, portions of the ventilation system will be automatically isolatable. In addition, final filtration and exhaust systems for Zones 1 and 2 will be separated (installed in separate rooms) from those for Zones 3 and 4.

(5) All automatic controllers have local manual override.

(6) The in-cell HEPA filters (two-in-series) within each shielded process cell are basically for shielding requirements. No credit is given in the filtering efficiency because it is not verifiable.

(7) The first-stage testable HEPA filters from each shielded process cell are isolated within a remote filtration cell equipped with radiation area monitors.

(8) Each HEPA filter train of the final filtration systems (from Zones 1 and 2 and Zones 3 and 4) is protected from fire or excessive high temperature by a water-spray system. A water reservoir is provided for this purpose. The water reservoir is a hydro-pneumatic tank,

maintained at 100 psig by the plant air system. The water reservoir has been used as it will provide a more reliable water source than a conventional firewater pump, which is dependent upon emergency power.

(9) All final exhaust, testable HEPA filter units are designed to have multibank arrangements and are equipped with leakproof isolation dampers for filter changeout.

(10) Final exhaust ducting is manifolded and arranged so that any exhaust fan in the system can operate with any filter bank of the same system. The purpose of this is to reduce the dependency of system components on one another and thereby increase the flexibility of system operation.

(11) All HEPA units are of standard design for nuclear application, using the bag-in/bag-out technique of filter replacement. Exceptions are the in-cell HEPA and first-stage testable HEPA filters that are remotely replaced.

(12) Only factory-packaged equipment is used in layouts to determine equipment room space requirements. The rationale is that the equipment can be factory-tested as a package and that a single source of responsibility can be readily defined.

(13) For systems requiring multiple units, identical units are used in order to simplify spare part requirements.

(14) Independent standby cooling systems are provided for the R&H Building control room and the two UPS rooms. These are critical areas and must remain functional during commercial power failure.

(15) The following components are provided with dual power sources (commercial and standby diesel power):

- Zone 1 and 2 final exhaust fans
- Zone 3 and 4 final exhaust fans
- Control room standby cooling system
- UPS room standby cooling system
- Canistered lag storage vault cooling system

(16) Exhaust ducting from each shielded process cell to the first-stage testable filters is provided with permanent fittings as required for attachment to decontamination spray equipment.

(17) To minimize personnel exposure, all ducting to and from each shielded process cell is so arranged as to avoid a direct line of sight.

(18) Each duct penetration through a Category I structure, as well as the connections to the exhaust stack, is provided with a tornado damper.

(19) The tornado dampers are actuated by a set of pressure-differential switches. Locations of these switches are site peculiar. Reaction of these pressure switches is instantaneous. The timing of the closing and reopening of these dampers is independently adjustable from 0.5 to 15 seconds.

(20) Both the building air supply and the exhaust systems are designed to operate during the 9-second tornado transient period. It is the design intent that the final exhaust systems be operating at all times. Whether the supply fans are shut down momentarily or not is inconsequential.

(21) Equipment layouts provide for adequate space for maintenance and access, as well as space and provisions for routine removal of equipment or major components.

(22) All valves, dampers, and gauges are located for easy access. Large valves and dampers are provided with chain and/or pneumatic operators.

(23) For systems not requiring redundant units, multiple units are used to maintain reduced operation during equipment failure or maintenance.

(24) All equipment or components critical to safety will have automatic monitoring and alarms.

2.11.4 SYSTEM OPERATION UNDER NORMAL CONDITIONS

2.11.4.A. Main Once-Through Systems

During normal operation, all five supply fans of each system are operating to bring 100% filtered outside air into the facility and distribute it to the first stages of the cascading system. From there, the air travels through a series of control dampers, backdraft dampers, pre- and HEPA filters, while cascading through the different areas of the facility. The air finally passes through either the Zone 1 and 2 or Zone 3 and 4 final filter and exhaust system before being exhausted through a single stack to the outside without any portion of the air being recirculated. A simplifed composite flow diagram is shown on Drawing H-3-56832.

Interlocks are provided to ensure the following starting sequence when the system is energized:

(1) Zone 1 and 2 final exhaust fans start first.

(2) Zone 3 and 4 final exhaust fans start second.

(3) Outside air supply fans start next.

(4) Independent systems and exhaust fans start last.

The above sequence will be the automatic startup to ensure establishment of negative pressure.

With low outside air temperature, the filtered air is first warmed by passing through the heat recovery coil, then brought up to a desired temperature by the steam preheat coil. After passing through the supply fan, the air is ducted into the main supply air manifold from which the air is supplied to the various zones through branch temperature zone mains. Each branch main contains a hot water heating coil, controlled by a temperature zone thermostat to provide additional heating, as required, for each zone.

With rising outside air temperatures, the steam flow to the preheat coil is first interrupted, followed by the glycol flow to the heat recovery coil, and finally the chilled water cooling coil is activated to maintain supply air temperature at 55°F. The zone hot water heating coil may reheat zone supply air if supply temperatures higher than 55°F are required to maintain design room temperature for the individual zones.

Outside air flow rate monitors and controllers, as shown on Drawings H-3-56834 and H-3-56835, sense and control the flow rate through each outside supply fan by modulating the inlet vane dampers on each fan as required to maintain the desired flow rate. The inlet vanes will maintain the flow relatively constant, even though the filters are loading with dust.

Flow monitors, flow controllers, and differential pressure controllers are used to provide air balance and differential pressure control throughout the building. As shown on Drawings H-3-54834, H-3-54835, H-3-54836, and H-3-54837, flow monitors are provided on the inlet air supply and also on the exhausts. Air exhaust rates from the facility are maintained constant, whereas outside air flow into the building are synchronized to a lower rate than the exhaust, thereby maintaining the desired negative pressure. Should sudden increases in pressure occur, the pressure controllers will override the flow controllers and cause the supply air dampers to throttle, thereby reducing air supply to the building.

Airflow and differential pressure controllers are also used to maintain the required exhaust airflow rate and pressure differentials between ventilation zones within the building. As schematically shown on Drawing H-3-56838, internal pressures for Zone 1 areas will be set with reference to outside atmospheric pressure. For subsequent zones, the differential-pressure control system will monitor the pressure differential between a certain area (or room) and the preceding area (or room) in the cascading airflow system, and adjust an automatic damper to maintain the required pressure differential between the two zones.

Under normal operating conditions, the independent exhaust fans will operate on a continuous basis.

The final exhaust system airflow rate monitors and controllers, as shown on Drawings H-3-56836 (for Zones 1 and 2) and H-3-56837 (for Zones 3 and 4), will sense and maintain a constant flow rate through each exhaust fan by modulating the fan discharge dampers. In addition, differential-pressure controllers will also monitor the pressure drop of each final exhaust filter plenum system and modulate an automatic damper (located downstream of each filter plenum) to maintain a constant flow rate while the exhaust filters are loading with dust.

2.11.4.B. Standby HVAC Systems

Under normal operating conditions, the standby systems for the R&H Building control room and the UPS rooms will not be operating, as these areas are being served by the two main once-through systems.

2.11.4.C. Canistered Lag Storage Vault Cooling System

During normal operation, three air-handling units are operating to bring 100% filtered outside air into the six lag storage vaults. The air leaving the vaults will flow through a series of control and backdraft dampers, HEPA filters, the exhaust fans, and then will be exhausted to the outside through the building stack. A simplified flow diagram is shown on Drawing H-3-56840, Sheet 1.

The lag storage vault cooling system is designed to provide unheated, uncooled ventilation air year around. Airflow monitors, airflow controllers, and differential pressure controllers are used to provide air balance and differential pressure control between each vault and its respective shielded canyon. As shown on Drawing H-3-56840, Sheet 1, flow controllers are provided on the exhaust ducts to maintain constant exhaust flow rate of the system, as well as constant exhaust flow rate from each vault. Differential pressure within each vault is controlled on the supply side by a differential pressure controller. In addition, differential pressure controllers will also monitor the pressure drop across the filter system and modulate an automatic damper to maintain a constant flow rate while the filters are loading with dust.

2.11.4.D. Receiving and Inspection Area HVAC System

During normal operation, the air-handling units and return fans are energized and the economizer controls modulate outside and return air dampers to provide a mixed air temperature at a preset point. During favorable outside conditions, up to 100% outside air may be used. However, during low or high outside air temperature conditions, minimum outside air is admitted into the system in order to conserve both heating and cooling energy. A heating/cooling room thermostat located in the receiving area will activate chilled water or hot water flow to provide required cooling or heating. Simultaneous heating and cooling will not occur in this system. Airflow monitors, airflow controllers, and differential pressure controllers are used to provide constant air flow and maintain required pressure differentials within the receiving and inspection area.

The oil-fired door heaters, located in the entry and exit vestibules, are interlocked with the doors and are thermostatically controlled to provide heating when doors are open during cold weather conditions.

2.11.4.E. Supply Fan Room Cooling Units

The air-handling units inside the supply fan rooms are designed to provide "booster" cooling and air circulation for the fan rooms year around. Outside air from the main once-through system is mixed with indoor air, filtered, and cooled before being delivered back to the fan room. A local room thermostat will modulate a chilled water control valve, as required. If cooling is not required for the area, chilled water flow through the cooling coil is bypassed; however, air circulation is maintained.

2.11.4.F. Chiller Room Cooling Unit

The air-handling unit is designed to provide "booster" cooling and air circulation for the chiller room year around. Transfer air (from surrounding areas) is filtered, cooled, and then discharged into the room. A local room thermostat will modulate a chilled water control valve, as required. If cooling is not required, chilled water flow through the cooling coil is bypassed; however, air circulation is maintained. The air will be discharged directly to the outside by the exhaust fan.

2.11.4.G. Dryer Exhaust System

The exhaust fan is interlocked with the dryer to activate when the dryer is operating. Controls of the system are designed to maintain a constant air flow through the roll and HEPA filters, even while the filters are loaded with dust. During periods when the dryer is not in operation, the fan is deactivated and the bypass duct system is activated.

2.11.4.H. Diesel Fume Exhaust System

The diesel fume exhaust fans are independent of the room ventilation system. Operation of the fume exhaust fans will be entirely manual on an as-needed basis.

2.11.4.I. Heat Recovery System

The runaround heat recovery system shown on Drawing H-3-56849 operates when outside air temperature is below 55°F or a minimum of 10°F higher than exhaust air temperature. A series of heat-recovery coils (located inside each exhaust duct between the final filters and exhaust fans, as well as inside the chiller room and the two electrical equipment room exhaust ducts) recover heat from the exhaust air, and transfer it to the runaround glycol system. The glycol is then pumped to the heat-recovery heating coils located in each outside air supply system. If heating of outside air is not required for any of the outside air supply systems, or if outside air temperature is less than 10°F higher than exhaust air temperature, the glycol pumps are deactivated.

2.11.4.J. Heating System

Under normal operating conditions, steam, hot water, and fuel oil are available as required for heating of each zone or area.

All heating coils, door heaters, etc., have local controls that activate and deactivate the individual heating equipment as required. If heating is not required, the circulating pumps and any other power-consuming equipment are deactivated to conserve energy.

2.11.4.K. Cooling System

As with the heating system described above, chilled water is available under normal operating conditions. The operating capacity of each chiller is matched directly with the need for cooling. Preselected chilled water temperature leaving each chiller is maintained by means of variable guide vanes at the compressor inlet. Load modulation will be from 100 to 10% full load without the use of hot gas bypass. The capacity control is fully automatic, using microprocessor logic and a preprogrammed matrix for control of machine capacity and compressor sequencing under all load conditions to minimize energy usage.

2.11.5 SYSTEM OPERATION DURING FIRE

2.11.5.A. Main Once-Through Systems

In case of a fire, the fire-detection system initiates an alarm, discharges the extinguishing agent, and causes the supply air damper to the affected area to close. The option to open this damper for smoke removal will be exercised by Fire Department personnel to permit maximum exhaust of smoke by the final exhaust fans.

In areas protected by a Halon 1301 system, both supply and exhaust air dampers are closed in order to isolate affected areas. The area will remain isolated until Fire Department personnel actuate the manual exhaust duct damper to purge the smoke and Halon from the room.

In case of major fires (fires covering more than just one isolated area), the capability for smoke removal can be enhanced by deenergizing the supply fans. This decision will be left to the operator, and will be based on the magnitude of pressure buildup in the area of concern. If high temperature is detected in the inlet to the final exhaust filter plenum, the dedicated firewater spray in that plenum is activated to protect the filter media from heat damage. A moisture separator (demister) will protect the HEPA filters from water damage.

2.11.5.B. Standby HVAC Systems

If a fire occurs during normal operation of the HVAC system, the R&H Building control room and the UPS rooms are handled the same way as any other area served by the once-through systems. However, if the standby HVAC unit is operating at the time, which would indicate a loss of air flow from the normal source, the unit will be deenergized.

2.11.5.C. Canistered Lag Storage Vault Cooling System

The probability of a fire inside the lag storage vault is practically non-existent. The vault cooling system operation is not affected by a fire, therefore, unless a fire in the equipment room housing the equipment serving the lag storage vault causes some components of the system to be inoperable.

2.11.5.D. Receiving and Inspection Area HVAC System

If there is a fire in the receiving and inspection area, the fire detection system initiates an alarm, discharges the extinguishing agent, and deactivates the entire HVAC system. After the fire has been extinguished, Fire Department personnel will activate return air fans to purge the smoke from the area.

2.11.5.E. Supply Fan Room Cooling Units

If there is a fire in the supply fan room, the fire detection system initiates an alarm, discharges the extinguishing agent, deactivates the "booster" cooling system, and closes the dampers inside ducts leading to and from the main once-through system. After the fire has been extinguished, Fire Department personnel will actuate a manual exhaust damper to purge the smoke from the area.

2.11.5.F. Chiller Room Cooling Unit

If there is a fire in the chiller room, the fire detection system initiates an alarm, discharges the extinguishing agent, deactivates the air-handling unit and exhaust fan, and closes the damper inside the transfer air duct. After the fire has been extinguished, Fire Department personnel will activate the exhaust fan to remove smoke from the area.

2.11.5.G. Dryer Exhaust System

If there is a fire in the dryer exhaust system, the dryer exhaust fan is deactivated and the entire system is isolated to protect the filter system from fire and smoke. After the fire has been extinguished, Fire Department personnel will actuate the bypass damper to purge smoke from the area.

2.11.5.H. Diesel Fume Exhaust System

The diesel fume exhaust system is manually operated or dictated by local conditions. It may be used to purge local smoke, if necessary.

2.11.5.I. Heat Recovery System

Heat recovery system operation is not affected by a fire unless the fire causes some components of the system to be inoperable.

2.11.5.J. Heating System

Heating system operation will not be affected by a fire unless the fire causes some components of the system to be inoperable.

2.11.5.K. Cooling System

The cooling system will remain operational during a fire unless the fire causes some components of the system to be inoperable.

2.11.5.L. Ductwork

The ductwork inside the R&H Building is noncombustible.

2.11.6 SYSTEM OPERATION DURING EARTHQUAKE

2.11.6.A. Main Once-Through Systems

During and following the occurrence of a design basis earthquake (DBE), the HVAC system will maintain building confinement and the directed air flow from zones of lower contamination potential to zones of greater potential. Accordingly, the final exhaust system will continue to operate even if power is lost at the normal operation bus; however, the supply fans, and miscellaneous Zone 4 exhaust fans will stop upon loss of normal power. Should instrument air or control power be lost following a DBE occurrence, all control dampers will fail open, permitting outside air to be drawn into the building through the supply air bypass ducts and through succeeding confinement zones. If normal power is lost, neither heating nor cooling is available.

All areas housing critical HVAC equipment (such as exhaust fans and HEPA filters), as well as the discharge stack, are designed to withstand a DBE occurrence.

The entire HVAC system will retain its integrity and will remain in normal operation during and after an operating basis earthquake (OBE).

2.11.6.B. Standby HVAC Systems

The standby HVAC units provided for the control and UPS rooms will remain operational during and after a DBE or OBE occurrence. The system is on standby power.

2.11.6.C. Canistered Lag Storage Vault Cooling System

The entire lag storage vault cooling system will remain operational during and after a DBE or OBE occurrence. In case of normal power failure, air supply and exhaust fans will be served with standby power from the building standby power system. In addition, all lag storage supply and exhaust fans are also connected to a dedicated diesel-powered standby generator, located in the R&H Building, which is activated in case of failure of the building standby power system.

2.11.6.D. Receiving and Inspection Area HVAC System

This system is not served with standby power; therefore, it will become inoperable in case of normal power loss during a DBE. In addition, most components of the system are not designed to withstand a DBE occurrence.

2.11.6.E. Supply Fan Room Cooling Units

The air-handling units providing "booster" cooling and air circulation for the supply fan rooms are not connected to the standby power supply nor are they designed to withstand a DBE occurrence. Therefore, they may become inoperable during and following an earthquake.

2.11.6.F. Chiller Room Cooling Unit

The "booster" air-handling unit and exhaust fan are not connected to the standby power supply, and are not designed to withstand a DBE occurrence; therefore, they may become inoperable during and following a DBE.

2.11.6.G. Dryer Exhaust System

The dryer exhaust fan is not connected to the standby power supply, nor is it designed to withstand a DBE occurrence; therefore, it may become inoperable during and following a DBE occurrence.

2.11.6.H. Diesel Fume Exhaust System

This system is not connected to the standby power supply, nor is it designed to withstand a DBE occurrence; therefore, it may become inoperable during and following a DBE occurrence.

2.11.6.I. Heat Recovery System

The system is not served with standby power; therefore, glycol circulation will not be maintained in case of a normal power failure following a DBE.

2.11.6.J. Heating System

The heating system is not served with standby power; therefore, it will become inoperable in case of power loss during a DBE. In addition, some components of the heating system (such as the boilers) are not designed to withstand a DBE occurrence.

2.11.6.K. Cooling System

The cooling system (like the heating system described above) will become inoperable because of possible loss of power following a DBE. In addition, some components of the cooling system (such as the cooling towers) are not designed to withstand a DBE occurrence.

2.11.6.L. Ductwork

The ductwork system inside the Category I portion of the facility will be designed and supported to withstand a DBE or OBE occurrence. The ductwork in Non-Category I structures may be damaged during a DBE occurrence.

2.11.7 SYSTEM OPERATION DURING TORNADO

2.11.7.A. Main Once-Through Systems

The HVAC systems are designed to withstand the effects of design basis tornado (DBT) missiles and air-pressure transients. All air intakes and exhausts to and from the Category I portion of the R&H Building are protected by missile barriers incorporated into the building structure and by pressure-sensing tornado valves located inside the supply and exhaust ducts.

The tornado dampers are actuated by a differential pressure switch having an adjustable range of 0 to 100 in. H_2O (0 to 3.6 psig). A drop of ambient pressure to a preset point permits control air to close the tornado dampers. The reaction of the pressure switch is instantaneous; however, the timing of the closing and reopening of the tornado damper is independently adjustable from 0.5 to 15 seconds. At present, the timing is for a 1-second closing time and 4-second reopening time. No damage to either fan or system components from pressure surge is anticipated.

If normal power should be lost, only the exhaust system will remain operational, as described in Section 2.11.8.A.

2.11.7.B. Standby HVAC Systems

The standby HVAC systems provided for the R&H Building control and UPS rooms will remain operational during a DBT occurrence because the systems do not have any direct outside air intakes or exhausts (they simply circulate and cool inside air). These systems are also served by standby power in case of normal power loss following a DBT.

2.11.7.C. Canistered Lag Storage Vault Cooling System

The lag storage vault cooling system is designed to withstand the effects of DBT missiles and air-pressure transients. Air intakes and exhausts are protected by missile barriers and pressure-sensing tornado valves located inside the supply and exhaust ducts. Tornado valve operation is the same as that described in Section 2.11.7.A.

Should normal power be lost following a DBT, building standby power and a dedicated diesel generator, located in the R&H Building, are available to provide power to the entire system.

2.11.7.D. Receiving and Inspection Area HVAC System

The receiving and inspection area HVAC system is not protected against a DBT occurrence nor served with standby power in case of normal power failure following a DBT. Therefore, the system may become inoperable during or after a tornado.

2.11.7.E. Supply Fan Room Cooling Units

The supply fan room cooling units are protected against physical damage caused by a DBT; however, if normal power loss occurs as a result of a DBT, the system would become inoperable.

2.11.7.F. Chiller Room Cooling Unit

As with the supply fan room cooling units described above (Section 2.11.6.E), the "booster" unit serving the chiller room will be physically protected against a DBT, but it is not connected to the standby power supply. The exhaust fan is not protected against a DBT occurrence, nor is it served by standby power.

2.11.7.G. Dryer Exhaust System

The dryer exhaust system will be protected against physical damage caused by a DBT occurrence; however, should loss of normal power occur, the exhaust fan will stop and room ventilation air only will be drawn through the bypass system.

2.11.7.H. Diesel Fume Exhaust System

The diesel fume exhaust system is not protected against a DBT occurrence nor is it served with standby power. Therefore, the system may become inoperable during or after a tornado.

2.11.7.I. Heat Recovery System

The heat recovery system is protected from physical damage caused by a DBT occurrence. If power loss occurred as a result of the DBT, the system would become inoperative, as the circulating pumps are not connected to standby power.

2.11.7.J. Heating System

Several components of the heating system (such as boilers) are not protected against a DBT occurrence. In addition, the heating system is not connected to standby power; therefore, it may become inoperable during and after a DBT occurrence.

2.11.7.K. Cooling System

Like the heating system described above, some components of the system (cooling towers, condenser pumps, etc.) are not protected against a DBT and the system is not on standby power; therefore, it may become inoperable during and after a DBT.

2.11.7.L. Ductwork

The ductwork system inside the Category I portion of the facility and within the inlet and exhaust tornado valves will not be affected by a DBT occurrence.

2.11.8 SYSTEM OPERATION DURING POWER FAILURE

2.11.8.A. Main Once-Through Systems

Sufficient ventilation must be provided during an outage of normal electrical power to ensure that final confinement and directed air flow from zones of lesser contamination potential to zones of greater potential will occur. If power is lost during normal operation, all supply fans and miscellaneous Zone 4 exhaust fans stop, as they are connected only to the normal power. All solenoid valves and instrument air supplying pneumatically operated dampers will remain operational, as they are also served with standby power. However, if an interruption of control power also occurs, all control dampers will fail open, permitting outside air to be drawn into the building through the intake filters, through the supply air bypass duct, and through succeeding confinement zones. This operation will continue until normal and/or control power is restored.

2.11.8.B. Standby HVAC Systems

The standby HVAC systems for the R&H Building control and UPS rooms will remain operational during normal power outage, as they are connected to the standby power supply.

2.11.8.C. Canistered Lag Storage Vault Cooling System

The canistered fuel cladding temperature inside the vaults must be maintained below 375°C at all times. Therefore, the entire cooling system is provided with three different sources of electrical power. In addition to normal and standby power, the system is also served by an independent dedicated diesel generator, located in the R&H Building, which is activated in case of normal and standby power loss. If standby power is lost, all control power and pneumatic air supply will be interrupted, causing all control dampers to fail in the open position, permitting ventilation cooling to continue at an even higher airflow rate than under normal conditions.

2.11.8.D. Receiving and Inspection Area HVAC System

The HVAC system is not on the standby power supply; therefore, the system will not operate during loss of normal power.

2.11.8.E. Supply Fan Room Cooling Units

The "booster" system for the supply fan rooms will become inoperable during loss of normal power.

2.11.8.F. Chiller Room Cooling Unit

Both the air-handling unit and the exhaust fan will become inoperable in case of normal power loss.

2.11.8.G. Dryer Exhaust System

The dryer exhaust fan will cease to operate in case of a normal power loss; however, the dryer operation is also interrupted, eliminating the requirement for the exhaust system.

2.11.8.H. Diesel Fume Exhaust System

The diesel fume exhaust system will cease to operate during normal power failure.

2.11.8.I. Heat Recovery System

The glycol circulating pumps are not connected to the standby power supply; therefore, glycol circulation will be interrupted during normal power failure.

2.11.8.J. Heating System

The heating system will not be operational during loss of normal power.

2.11.8.K. Cooling System

The cooling system operation will be interrupted in case of normal power loss.

2.11.9 SYSTEM OPERATION DURING COMPONENT FAILURE OR MAINTENANCE

2.11.9.A. Main Once-Through Systems

The once-through HVAC systems are designed so that a single equipment failure will not jeopardize the safe operation of the system. All major components of the system are isolatable and all control valves and dampers will fail in a safe position during malfunction and/or loss of instrument air or power. Several critical components of the systems have their operating conditions displayed locally and at the central control room console. The following conditions will be displayed at the central control room:

(1) On-off operating status of each supply and final exhaust fan.

(2) Loss of air flow at each operating supply and final exhaust fan.

(3) High bearing temperature of each final exhaust fan.

(4) Excessive vibration of each final exhaust fan.

(5) High and low pressure drop across each HEPA filter in the final exhaust filter plenums.

(6) Flow rate decrease through major confinement zones.

(7) Decrease in pressure differentials across major confinement zones.

(8) System temperatures.

The final exhaust filter plenums have a 50% redundancy and, in case of excessively high or low pressure drop across the filters, an alarm condition is indicated at the control console in the R&H Building and the Site Services Building control rooms. The operator can manually close plenum isolation valves and activate a standby plenum. The final exhaust fans are also designed with 50% redundancy for Zone 3 and 4 exhaust and 100% redundancy for Zone 1 and 2 exhaust. Upon detection of airflow loss at any operating fan, the DCS automatically energizes one of the standby units and produces an alarm signal. Upon occurrence of excessive vibration or high bearing temperature in a final exhaust fan, the fan is automatically shut down, a standby unit is energized, and an alarm condition is indicated. Miscellaneous Zone 4 exhaust fans do not have any redundancy or automatic monitoring, as their operation is not critical to the maintenance of confinement zones or contamination control.

In case of supply fan malfunction, the loss of air flow is automatically detected and an alarm condition is indicated locally and remotely. The supply air to the R&H Building will decrease slightly, and the operator has the option of opening the supply air bypass damper. If all supply fans stop (in case of power outage), all bypass dampers are automatically opened.

Upon out-of-tolerance conditions of the remaining functions, no automatic correction occurs, but an alarm condition is indicated at the computer console. Local investigation and operator-initiated corrective action of the malfunction will be required.

Local, manual bypass, and/or shutdown of any portion of the systems are provided to allow the operator to perform required repairs and maintenance without interruption of system operation.

2.11.9.B. Standby HVAC Systems

As mentioned above, the R&H Building control and UPS rooms are normally served from the once-through systems. The standby units operate only during an upset condition. It is assumed that the standby systems will be maintained to ensure operation when needed.

2.11.9.C. Canistered Lag Storage Vault Cooling System

The lag storage vault cooling system is designed so that a single equipment failure will not jeopardize the safe operation of the system. All major components of the system are isolatable and all control valves and dampers will fail in a safe position during malfunction and/or loss of control air or power. Several critical components of the system have their operating conditions displayed locally and at the control room console. The following conditions will be displayed at the R&H Building and Site Services Building control rooms:

(1) On-off operating status of each supply and exhaust fan.

(2) Loss of air flow at each operating exhaust fan.

(3) High bearing temperature of each exhaust fan.

(4) Excessive vibration of each exhaust fan.

(5) High pressure drop across each HEPA filter.

(6) Flow rates through each vault.

(7) Vault discharge air temperatures.

The HEPA filter plenums have a 50% redundancy and, in case of excessively high pressure drop across the filters, an alarm condition is indicated at the control consoles in the R&H Building and Site Services Building control rooms. The operator can manually close plenum isolation valves and activate a standby plenum. The supply fans (air-handling units) have a 33% redundancy and the exhaust fans have a 100% redundancy. Upon detection of airflow loss at any operating fan, the central control computer automatically energizes one of the standby units and produces an alarm signal. Upon occurrence of excessive vibration or high bearing temperature in an exhaust fan, the fan is automatically shut down, a standby unit is energized, and an alarm condition is indicated.

2.11.9.D. Receiving and Inspection Area HVAC System

None of the components of the receiving and inspection area HVAC is designed to have redundancy in case of equipment failure or maintenance. However, multiple units (two air-handling units and two return fans) are used in order to maintain some air circulation and cooling/heating in case of failure of a supply and/or return fan. In case of failure of any other component of the system, the amount of air circulation, cooling, and/or heating will be reduced or interrupted altogether. All controls and indicators have local readouts only; however, all dampers and valves will fail in a safe position in case of malfunction or loss of control air or power.

2.11.9.E. Supply Fan Room Cooling Units

As with the receiving and inspection area HVAC, multiple fans are provided to maintain a reduced amount of air circulation and cooling in case of equipment failure or during maintenance; however, redundancy is not provided. All controls and indicators are local only, but all dampers and valves will fail in a safe position.

2.11.9.F. Chiller Room Cooling Unit

In case of equipment failure or during maintenance, the chiller room "booster" unit and exhaust fan will cease to operate, as only a single unit is used to serve this area. Local or remote alarm is not provided.

2.11.9.G. Dryer Exhaust System

As with the chiller room cooling unit described above (Section 2.11.9.F), a single exhaust fan is used; therefore, during maintenance, or in case of equipment failure, the system will become inoperable and ventilation air only will be drawn through the bypass by the main once-through system.

2.11.9.H. Diesel Fume Exhaust System

No redundancy is provided in case of equipment failure or maintenance. However, because of the large room size and the mobility of diesel-operated vehicles, multiple units (two exhaust fans) with independent manual operation are provided. In case of maintenance or failure to one fan, exhaust capability is not completely lost. If necessary, vehicle activity can be curtailed.

2.11.9.I. Heat Recovery System

In case of failure of an operating glycol circulating pump, the standby pump is automatically activated, and local and remote alarms are indicated. If any other component of the system fails, the amount of recovered heat will be reduced or interrupted altogether.

2.11.9.J. Heating System

The only components of the heating system that have a redundant unit are the hot water circulating pumps. In case of failure of any operating pump, the standby pump is automatically energized, and alarms are activated. In case of failure of any other component of the system, the amount of available heating will be reduced or interrupted altogether. Low-temperature indicators will provide local and remote alarms.

2.11.9.K. Cooling System

The chilled water circulating system is designed with a standby pump, which is automatically energized in case of failure of an operating pump. Should any other component of the cooling system fail, the capacity is reduced or (in some cases) interrupted. High-temperature indicators will provide local and remote alarms.

2.11.10 HVAC SYSTEM DESIGN CONSIDERATIONS

Several alternative airflow systems were considered before the multi-unit, once-through, cascading system was selected to serve the major portion of the R&H Building. Two examples of other systems considered are a once-through, noncascading system, and a cascading system with filtered and treated air recirculated.

The noncascading system is the least attractive of any systems considered, as it requires extremely large air flows, very large fans, large cooling and heating loads, and a tremendous amount of ductwork. It was felt that the noncascading system is not feasible for the R&H Building.

The cascading system with filtered and treated air recirculation is similar to the once-through system, except that exhaust air is recirculated after passing through the final stages of HEPA filtration. The major advantages of the recirculating system are that minimum outside air, with less outside air heating and cooling, is required, and there are fewer and/or smaller exterior wall penetrations, resulting in better tornado protection. The major disadvantages of the recirculated system include a control system that is more complex than that of the once-through system and the presence of the potential for recirculating contaminated air.

By using a heat-recovery system in conjunction with the once-through system, the requirements for outside air heating can be considerably reduced, making the once-through system the most economical and safest system for this application.

2.11.11 STEAM GENERATOR BUILDING

In addition to the HVAC systems for the R&H Building, a separate independent system, using steam-heating coils at building intakes and roof exhaust fans, will provide ventilation and combustion air requirements for the Steam Generator Building.

2.12 FIRE PROTECTION

2.12.1 FIRE SUPPRESSION

Automatic fire-suppression systems are supplied throughout the nonprocess areas of the R&H Building. Nonprocess areas are protected by ordinary, automatic wet-pipe sprinkler systems; critical areas, such as the R&H Building control room and electrical equipment room, are provided with Halon 1301 systems. Areas protected by a dry chemical system will be determined during final design of the fire protection system. Fire-suppression systems are not required in the process areas (shielded process cells or canyon cells), as described in the Basis for Design.

Firehose cabinets and manual extinguishers are provided throughout the building.

The fire protection systems are designed to serve the following functions:

(1) Provide indication of fires (water flow).

(2) Automatically actuate valves, dampers, and motors to control and extinguish fires.

For fire detection and alarm signaling systems, see Section 2.10.5.A.

2.12.1.A. Wet-Pipe Sprinkler System

The automatic sprinkler system is an integrated system of overhead piping designed in accordance with fire protection engineering standards.

A yard fire service water loop is supplied from the pumphouse, which houses two 2,500-gpm FM/UL fire pumps, as described in Section 20.2.1. The yard fire main feeds the R&H Building. A network of specially sized piping is installed in a building, generally overhead, to which sprinklers are connected in a systematic pattern. The system includes a controlling valve and a device for actuating an alarm when the system is in operation. The system is activated by heat from a fire, and discharges water over the fire area.

Operation of the wet-pipe sprinkler system is as follows: When a sprinkler is activated by high temperature and opens in a wet-pipe systems, water discharging from the system lifts the clapper from its seat in the main alarm valve, and opens an auxiliary valve. Water flows through the auxiliary valve to the retard chamber, closing the pressure switch, which activates the electric alarm. Flow through a water-flow indicator located on each floor also activates the electric alarm. During surges or pressure fluctuations, the clapper in the main alarm valve opens momentarily, trapping excess pressure in the system, allowing small amounts of water into the auxiliary valve and retard chamber, and prevents false alarms from water-pressure surges.

Sprinklers for the R&H Building are of the quartzoid bulb type, with a temperature rating of 212°F. In operation, the design allows the bulb to burst, immediately opening the waterway. All sprinklers have deflectors that distribute the water in a uniform, umbrella-type pattern downward for fire control.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions.

Fire Department connections are provided as a secondary water supply to the installed sprinkler system.

2.12.1.B. Halon 1301

An automatic, total-flooding Halon 1301 fire-suppression system is provided in the electrical equipment room, I/O rooms, and R&H Building control and computer rooms. Automatic, total-flooding Halon 1301 fire-suppression systems combine highly effective detection devices with specially designed components for high-speed agent discharge. The system is electrically actuated, and has an extinguishing agent discharge time of less than 10 seconds, as required by NFPA 12A. Agent storage containers are strategically located adjacent to or within the area to be protected. The resultant high-speed suppression of a fire reduces property damage and thermal products of decomposition to the lowest possible level. The Halon 1301 fire-suppression system is designed for total flooding at a concentration of 6%, with a full capacity reserve agent supply for the protected areas in accordance with NFPA 12A.

The system consists of fixed piping, manifolded racks complete with check valves, pressure switches, cylinders, gauges, manual-release device, detectors, circuit alarms, and controls for a complete fire-suppression system, designed to provide detection, alarm, and extinguishment of a fire.

Detectors are cross-zoned, ionization-type smoke detectors and/or photo-electric detectors, and are operated on 24 volts. Their location is based on system design; each cross-zoned pair of detectors serves a floor area of 1,000 sq ft maximum. Beneath raised floors, the maximum coverage for a pair of cross-zoned detectors is 600 sq ft. Each detector is equipped with a lamp that lights when it is alarmed, and remains on until the circuit is reset at the fire alarm control panels located in the MRS Fire Station, Security Building, and Protected Area Gatehouse. Detectors are installed on separate cross-zoned circuits, and normal automatic system operation requires the combination of any two detectors on different circuits to alarm "fire" before agent discharge; an adjustable, 0- to 60-second time delay is built in. After the time-delay timer has timed out, the extinguishing agent discharges into the protected area.

2.12.1.C. Dry Chemical System

The dry chemical system is a manually operated hoseline application of either dry chemical for Class A fires (ordinary combustible materials), Class B (flammable liquids), Class C (electrical equipment), or dry powder for Class D (combustible metals). The system is actuated by operating hand switches to the discharge agent. The systems are capable of either discharging one agent or both agents through a dual nozzle and hose arrangement. Full reserve capacity discharge is available by hand-switch actuation.

2.12.1.D. Wet Standpipes, Hose Cabinets, and Portable Fire Extinguishers

Wet standpipes with hose cabinets and portable fire extinguishers are provided throughout the R&H Building for first-aid firefighting capability.

The hoses are located in accordance with NFPA 14. Portable fire extinguishers are provided in accordance with NFPA 10. All extinguishers are UL-listed and/or FM-approved for general use; a combination of ABC, dry chemical, and Halon 1211 is used.

2.12.1.E. Special Water Spray System

Heavy smoke accumulations can cause plugging and subsequent rupture of the HEPA filters, with possible release of contamination to the atmosphere. Therefore, special firewater protection is provided for the HEPA filters in the final exhaust filter plenum.

Cooling is provided by spray nozzles within the filter plenum upstream of the demisters. The spray nozzles have a fine droplet size distribution for maximum cooling. Cooling water protection is provided by two dedicated, 2,900-gal demineralized (DI) water tanks (one each for the north and south systems), located on the third level in the exhaust fan room. Each dedicated water storage tank is pressurized with plant air at 105 psig. The system is connected to the spray nozzles within the plenum by a series of valves and controls.

When the temperature of the air flow through the plenum exceeds a predetermined range, a temperature switch located inside the plenum activates the system, pressurizes the storage tank with plant air, and provides water to the spray nozzles within the plenum at a maximum pressure of 105 psig.

When the water level in the water storage tank reaches a predetermined low level, an alarm is sounded. The tank is automatically filled from the DI water line, thus expelling plant air in the tank through the tank pressure vent valve to atmosphere.

When the temperature in the plenum is sufficiently reduced, the temperature switch opens, thereby deactivating the solenoid valve to the closed position and stopping the flow of water to the spray nozzles in the plenum.

2.12.2 FIRE ALARM AND DETECTION SYSTEM

See Section 2.10.5.A.

SECTION 3

SF, HLW, AND HAW/RHTRU STORAGE FACILITIES

3.1 INTRODUCTION

The SF, HLW, and HAW/RHTRU Storage Facilities are designed to store radioactive waste processed through the R&H Building. Two alternative storage concepts were designed: (1) a primary concept using an array of sealed storage casks (concrete casks) containing the waste canisters stored in an open field above ground, and (2) an alternate concept using an array of in-ground drywells containing sealed containers. In the sealed storage cask concept, the concrete and steel liner are designed for radiation shielding and to remove the heat by convection and thermal radiation. The drywell concept is designed to use the surrounding soil to attenuate nuclear radiation and to dissipate the heat from the waste while in storage.

Both storage concepts are designed to store 15,000 MTU of spent fuel and 100 MTU equivalent of HLW. Since the receipt rate of the transportable metal (dual purpose) casks is unknown, additional space is provided for them in both storage concepts.

3.2 CIVIL AND SITE DEVELOPMENT

Refer to Section 1.

3.3 STRUCTURAL

3.3.1 INTRODUCTION

The SF, HLW, and RHTRU Storage Facilities systems (sealed storage casks or drywells) are used for the safe storage of canistered spent fuel and other waste forms. For the sealed storage cask concept, waste materials are confined within a sealed steel canister (designed to withstand an accidental drop), and placed in a sealed concrete cask with a sealed steel liner. Because of the shielding and accidental drop design parameters, the resulting cask configuration is capable of maintaining a safe canister geometry and surviving all natural phenomena events. It is recognized that concrete spalling from tornado-generated missiles could result in a localized loss of shielding, however, this event would not cause an undue risk to the public. Therefore, the sealed storage casks have been designated Non-Category I, but will require a natural phenomena analysis. Based on the design life and retrievability requirements, QA Level I was assigned to the liner.

For the drywell concept, waste materials are confined within a sealed steel canister (designed to withstand accidental drop) and the canister placed in a sealed, in-ground drywell. Because of the in-ground placement and top shielding requirements, it is capable of surviving all natural phenomena events except tornado-generated missiles. Tornado-generated missiles could damage the surface concrete, resulting in a localized loss of shielding by exposing the liner, but would not cause an undue risk to the public. Therefore, the drywells have been designated Non-Category I, QA Level I, with 100% testing of all liner and cover welds.

3.3.2 SEALED STORAGE CASKS

The sealed storage casks are cylindrical, reinforced concrete structures with a stepped, carbon-steel-lined cavity for storing waste containers. A cylindrical concrete shield plug fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask.

The casks are 22 ft in height and 12 ft in diameter. The upper 36 in. of the cask exterior is 152 in. in diameter. A 15-deg, inclined, circumferential handling surface is provided at the bottom of this larger diameter, which interfaces with the cask handling fixture. The cask concrete wall thicknesses vary from 21 to 42 in., depending on the contained waste form (see Table 3-1). The shield plug concrete thicknesses vary from 26 to 42.5 in. The steel cover plates range from 1.0 to 2.0 in. thick which will provide protection from tornado missile penetration. All of the casks contain an embedded structural rebar cage, which is attached to the cask liner. The cage con- sists of vertical, radial, and hoops of rebar, which are 3 in. below the surface of the cask to protect the rebar from the environment. The rebar cage has been designed to withstand all loads imposed on the cask (handling, natural pheonomena, and accidents).

Pads for the sealed storage casks are of 18-in.-thick reinforced concrete mat, designed to support the weight of the casks and the loads from Design Basis Earthquake and Operating Basis Earthquake.

3.3.3 TRANSPORTABLE STORAGE CASKS

The transportable storage casks are designed to withstand both transportation and storage loads. The casks are constructed of lead and steel, with thick walls, bottoms, and covers that protect the contained waste forms.

The casks are stored horizontally on specially designed reinforced concrete cradles, which are supported by reinforced concrete footings.

3.3.4 OPEN FIELD DRYWELLS

The drywell storage units consist of a carbon-steel liner, a shield plug, and a seal-welded cover plate. The liner is installed vertically in a hole bored into the ground and is grouted in place. A 5-ft-dia by 18-in.-deep, reinforced concrete pad surrounds the top of the liner at the ground

Table 3-1 - Sealed Storage Cask Contents

Waste Type	Container Type and Number	Liner OD (in.)
Spent fuel	Twelve 12.75-in. canisters	72.0
Nonfuel-bearing components	Three 28.5-in. storage cages, each with five 55-gal drums	60.0
RHTRU (50 to 1,000 R/hr)	Seven 24.00-in. canisters	84.0
RHTRU (50 R/hr)	Nine 24.00-in. canisters	102.0
HLW	Nine 12.75-in. by 10-ft canisters	60.0
	Eight 12.75-in. by 15-ft canisters	60.0
	One 30.00-in. canister	60.0
West Valley HLW	Five 24.00-in. canisters	78.0

surface. The thickness of the cover plate was chosen to sustain the externally imposed loads from a wheel of the transfer shield transport vehicle and provides protection from tornado-generated missiles. The liner and seal-welded cover plate are designed to protect the stored wastes in the drywells.

3.4 ARCHITECTURAL

Not applicable to these facilities.

3.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

3.5.1 INTRODUCTION

This section describes the designs, construction, handling, storage, and associated equipment operations for the sealed storage casks, the transportable metal (dual-purpose) storage casks, and the open field drywells. The results of the thermal and radiation analyses performed in support of the cask and drywell designs are also included.

The storage units for the MRS Facility (sealed storage casks, transportable metal [dual-purpose] storage casks, and drywells) have been designed as containment barriers to prevent release of radioactive materials during the 100-yr design storage lifetime. The storage units are designed to contain spent fuel, high-level waste, and remote handled transuranic waste (RHTRU).

Containment barriers are provided for each type of waste. For the spent fuel, two containment barriers are provided. The storage canister provides the primary containment barrier and the storage unit liner and welded cover provide the secondary containment barrier. Two barriers are provided because the spent fuel contains both gaseous and solid radioactive materials. For high-level waste (HLW), a single containment barrier is provided by the storage unit liner and welded cover. No credit is taken for the steel canister around the HLW. Because the radioactive waste is immobilized in the solidified glass matrix in the canister, one containment barrier is considered sufficient.

For RHTRU and for the onsite-generated waste from consolidation of spent fuel (nonfuel-bearing components), a single containment barrier is provided by the storage unit liner and welded cover. The RHTRU received from offsite is contained in sealed canisters or drums, and the nonfuel-bearing components generated onsite are installed and sealed in drums. These containers are considered to provide containment of the radioactive materials from a contamination-spread standpoint and, although they are sealed, no credit is taken for them to prevent release of the radioactive materials when in storage. The materials contained in the RHTRU waste and nonfuel-bearing components are all solids; therefore, a single containment barrier is considered sufficient.

The storage units are designed to protect the spent fuel from natural and man-induced events (except war). The units are designed to take the defined Category I loads. The thick concrete walls and shield plug of the concrete casks, the metal walls and shield cover of the transportable cask, the soil surrounding the liner, the steel shield plug in the drywells, and the metal covers for all three provide protection for the stored wastes.

The storage unit containment barriers are designed to allow integrity monitoring throughout their design life. Gas sampling ports are provided on each cask and drywell to allow taking of internal atmosphere samples and checking of internal pressures. Analysis of gas samples verifies spent-fuel canister integrity, and pressure decay checks of the cask and drywell verify their leaktightness. Visual examination of the liner/cover welds is possible to ensure that integrity of the weld is maintained.

The storage units are designed to ensure that spent-fuel cladding temperatures and HLW canister temperatures do not exceed the 375°C temperature limits for each. Temperature monitoring is provided for a fixed number of the spent-fuel and HLW casks or drywells to ensure the thermal performance of the storage units. Temperatures measured on the cask or drywell liner can be compared to predictions to assess thermal performance. Liner temperature readings below established limits ensure that spent-fuel cladding and HLW canister temperatures remain below these limits.

The number of sealed storage casks and drywells required per year to store spent fuel, RHTRU, and HLW canisters is shown in Tables 3-2 and 3-3.

3.5.2 SEALED STORAGE CASKS

The sealed storage casks provide a sealed, self-shielded, dry storage container for intact spent-fuel assembly canisters, consolidated fuel rod canisters, drums of nonfuel-bearing components, HLW canisters, West Valley HLW canisters, and drums and canisters of RHTRU. The sealed storage casks are cylindrical, reinforced concrete structures with a stepped, carbon-steel-lined cavity for storing waste containers. A cylindrical concrete shield plug fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask. Sealed storage casks provide a passive method of safely storing spent fuel and nuclear waste products, using steel and concrete to provide radiation shielding. The heat from radioactive decay is conducted through the steel and concrete, and removed by atmospheric convection and thermal radiation. The cask and the enclosed storage canisters provide double containment to withstand credible natural and man-induced events.

3.5.2.A. Handling and Operations

1. Cask Construction. Sealed storage cask liners, covers, and shield plug shells are fabricated offsite and are delivered to the Cask Manufacturing Facility. Reinforcing rods (rebar) are preformed offsite, and are also delivered for cask construction.

Table 3-2 - Number of Sealed Storage Casks Required for Base Case Facility

Waste Type	Yearly Quantity (for 3,600 MTU/yr)	Total (for 15,000-MTU Facility)
Spent fuel:		
PWR (consolidated)	117	487
PWR (intact)	39	163
BWR (consolidated)	83	346
BWR (intact)	33	135
Subtotal	272	1,131
Nonfuel-bearing components:		
PWR	29	117
BWR	78	323
Subtotal	107	440
West Valley high-level waste	12	60
Onsite-generated waste	33	129*
Total	424	1,760

*All of the waste generated onsite by the processing of 15,000 MTU is stored in the storage area.

Table 3-3 - Number of Drywells Required for Base Case Facility

Waste Type	Yearly Quantity (for 3,600 MTU/yr)	Total (for 15,000-MTU Facility)
Spent fuel:		
PWR (consolidated)	1,404	5,845
PWR (intact)	468	1,949
BWR (consolidated)	996	4,148
BWR (intact)	388	1,613
Subtotal	3,256	13,555
Nonfuel-bearing components:		
PWR	85	351
BWR	232	968
Subtotal	317	1,319
West Valley high-level waste	60	300
Onsite-generated waste	295	1,154*
Total	3,868	16,328

*All of the waste generated onsite by the processing of 15,000 MTU is stored in the storage area.

Construction activities for the casks consist of welding of the gas sampling system tube to the cask liner, assembling the rebar cage around the liner, welding of the cage to the liner, and attaching thermocouple tubes (as required). The assembled cage and liner assembly is placed in a cask form for concrete pouring. A temporary cover is placed on the cask liner during concrete pouring and curing to maintain liner interior cleanliness. Following concrete pouring and a short curing period, the cask is removed from the form and placed in a curing area. After curing, the temporary cover is removed, the cask interior is inspected for cleanliness, the shield plug and temporary cover are installed, and two security seals are affixed between the temporary cover and the cask concrete.

Shield plug construction operations include filling the plug shell with concrete through an access hole provided in the top of the plug and welding a cover plate over the hole.

2. Empty Cask Handling. The empty cask is handled in the Cask Manufacturing Facility, using the specially designed cask handling/lifting fixture. The completed empty casks are loaded onto the cask transporter by means of this handling/lifting fixture and the facility crane. The empty cask is moved to the R&H Building by the transporter to await loading. When the cask is received at the protected area gate, the security seals are inspected to ensure that no tampering has occurred. The empty cask is then moved into the transfer/discharge corridor opposite one of the loadout/decon rooms for loading preparation.

3. Cask Loading, Sealing, and Inspection. Before loading, the cask security seals are removed and the cask temporary cover is removed, using the monorail crane in the corridor. The temporary cover is returned to the Cask Manufacturing Facility for reuse. Three lifting eyes are installed in the shield plug for remote plug handling.

The cask is then moved into the loadout/decon room. The contamination barrier between cask and hot cell port is installed, the shadow shield is rotated into place, and the door is closed behind the transporter.

The hot cell port plug and the cask shield plug are removed, using the hot cell powermast; both are placed inside the hot cell on the floor. Waste containers are individually loaded into the cask, using the hot cell crane, until it is full. The cask shield plug and hot cell port plug are replaced, the contamination barrier is removed, the shadow shield is rotated, and the loadout/decon room door is opened. The door is again closed behind the transporter when it has moved into the transfer/discharge corridor. A contamination survey of the cask top is performed and, if necessary, it is decontaminated by a vacuum system. The shield plug lifting eyes are manually removed in preparation for cask sealing.

The cask cover, suspended from the seal-welding machine by its three attachment eyes, is lowered into position on the cask by the monorail crane. The welder torch head is positioned to make the weld, using controls on the welder control console. The automatic welding sequence is initiated, and the welder torch head travels around the periphery of the cover. The welding operation requires three weld passes, a root pass and two cover passes, to develop a fillet weld with a 0.375-in. throat thickness between the cask cover and the cask liner.

For accountability and security purposes, a security seal is included in the second weld cover pass. Following weld completion, the welding machine is removed from the cover and placed on the work platform in the transfer/ discharge corridor.

The cask liner/cover weld integrity is inspected in two ways: the weld surface is nondestructively examined by the magnetic particle method; in addition, the cask is tested for leak-tightness. The gas sampling port is used to perform a pressure-decay check by either pressurizing or partially evacuating the cask interior and measuring pressure change versus time. If both tests yield acceptable results, the weld surface and heat-affected zone are cleaned and painted with varnish to prevent corrosion.

4. Cask Transport and Emplacement. Following cask sealing and inspection, the transporter moves the cask out of the R&H Building to the proper storage location in the storage facility. The cask handling crane and attached cask handling/lifting fixture are moved into position before transporter arrival.

The crane is used to position the lifting fixture on the cask and lower it into place. The lifting fixture is engaged from the crane cab; the cask is lifted from the transporter, and emplaced on a storage pad. The lifting fixture is then disengaged and removed, and the crane and fixture are moved to the next storage pad location. After final placement of the cask, thermocouple instrumentation connections are completed.

5. Monitoring Operations. Monitoring of the sealed storage cask liner and cover integrity is performed on a periodic basis. Sampling of a cask internal atmosphere is performed by removing the access cover bolted to the gas sampling port housing. An evacuated bottle with a valve is attached to the quick-disconnect fitting on the end of the assembly of compression fittings located inside the port housing. Gas samples are collected for analysis to determine the presence of any gaseous fission products or canister tag gas in the cask interior. Gas analysis results obtained from cask samples indicate whether canisters or canisters and fuel rods have lost their integrity. Cask liner/cover integrity is tested by using the pressure-decay check described previously.

Monitoring will also include temperature surveillance for a fixed number of casks. Temperature measurement is accomplished by using thermocouples installed in tubes, extending from the cask exterior to the liners of spent fuel and commercial high-level waste casks. Temperature readings are automatically recorded. The thermocouple/tube design allows for replacement operations in the storage facility if failure occurs.

6. Accountability Operations. Storage cask accountability operations are performed yearly to ensure that the radioactive materials in storage are

present. The activities associated with accountability include the numbering of all storage casks and the recording of the specific contents of each cask. The contents are recorded during loading operations. The security seals placed in the cask liner/cover weld are visually inspected each year, using a mobile cherry-picker to reach the cask cover. In addition to the security seals, the cask liner/cover weld can be inspected during this operation. The presence of the enclosed radioactive materials can be checked by using portable radiation sensors. Readings can be recorded at specific points around the circumference of each cask following initial loading and at yearly intervals. Comparison of radiation level readings will verify the presence of the contents.

7. Retrieval and Unloading. Retrieval and unloading operations are, for the most part, the reverse of the storage and loading operations. Some of the activities that are unique to retrieval and unloading are described below.

Before the storage cask is lifted, the cask concrete lifting surface is examined for degradation. Should any spalling or other degradation have occurred, the situation is assessed relative to the need for repair before lifting. Repair should be limited to cleaning of any spalled or broken surfaces and addition of enhanced bonding mortar to the affected area to return the surface to its original configuration.

Before the cask is transported to the R&H Building, a gas sample of the cask interior is taken for analysis to determine the presence of radioactive gaseous fission products. If no fission products are found, the cask can be unsealed without taking any precautions to protect workers. If gaseous fission products are found, the cask interior could be evacuated through the gas sampling port, and the workers required to wear respirators and anti-contamination clothing during cask unsealing.

With the cask in the transfer/discharge corridor, the cask weld is removed, using the welding machine (as a cutting torch) or a rotary cutting tool. Once the weld is cut, the cover is removed, the shield plug lifting eyes are installed, and the cask is moved into the loadout/decon room for remote unloading.

8. Operating Personnel. An estimate has been made of the personnel required to perform the cask handling, storage, monitoring, and accountability operations. These do not include any cask or shield plug construction activities at the Cask Manufacturing Facility or any remote encapsulation or waste package-handling activities elsewhere in the facility.

A storage area crew would consist of a crew chief, a transporter operator, a crane operator, and two technicians (one for cask handling and one for instrumentation hookup). The crew required inside the R&H Building would consist of two technicians (one for cask cover handling and welding, the other for cask pressure checking) and an inspector. Since sealed storage cask sealing and storage operations require less than one shift to perform, some of the personnel can be used for other operations in the R&H Building or the two technicians noted could do the operations both in the building and in the storage facility.

Monitoring would be performed by as many technicians as required to complete gas sampling and/or pressure check operations for all casks within the chosen time period (i.e., once per month, once per quarter), and within the ALARA exposure criteria. Accountability operations would require an inspector to examine the security seals and cask covers, and a technician to take radiation-measurement readings and to move the inspector among the casks.

3.5.2.B. Cask Descriptions

1. General Cask Description. The sealed storage casks are cylindrical, reinforced concrete structures with a stepped, carbon-steel-lined cavity for storing waste containers. A cylindrical concrete shield plug fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask. For purposes of the conceptual design, all casks have been designed with the same height and exterior configuration to enable them all to be fabricated using the same forms and handled by the same lifting fixture. The casks are 22 ft in height and 12 ft in diameter. The upper 36 in. of the cask exterior is 152 in. in diameter. A 15-deg, inclined, circumferential handling surface is provided at the bottom of this larger diameter, which interfaces with the cask handling fixture.

The cask height and diameter selection was based on an assessment of the waste container lengths, the shielding needed above and below the containers, a reasonable arrangement of containers within a circular liner, and the shielding needed around the containers. Once the height and diameter were selected, these two dimensions were fixed (for purposes of the conceptual design) so that the R&H Building interfaces (door opening sizes, hot cell floor heights, etc.) would not change. The diameter of the cask was limited to about 12 ft so that the cask weight could be limited to about 200 tons. If the cask were much larger, the additional weight would require much larger and more expensive handling equipment (see Section 3.5.2.C.5 for further discussion of cask crane size and costs).

Each waste type to be stored in the MRS Facility is placed in a cask designed to provide adequate radiation shielding and heat transfer capability. The number of each type of container in any cask was determined by a combination of space efficiency, radiation source strength, and waste decay heat level. The different cask designs and their contents are defined in Table 3-1.

The sealed storage cask handling surface created by a step in the cask outside diameter (15 deg from the horizontal) has been considered to provide the only reliable handling configuration for the sealed storage casks. This design relies on the embedded rebar and concrete surrounding it for lifting load transmission. The rebar is protected from the environment by 3 in. of concrete. The concrete handling surface is accessible, inspectable, and repairable should any of the concrete spall away. This surface also provides several times the needed load bearing area for lifting, so that any spalling in local areas on the cask may not need to be repaired. This design is predicated on the premise that any metal lifting devices embedded through the cask top surface or sides provide no means of integrity inspection or load capability verification. Corrosion of embedded lifting devices that penetrate through the cask exterior is probable over a 100-yr lifetime because rainwater has a path from the surface of the cask along the embedded steel.

All of the casks contain an embedded structural rebar cage, which is attached to the cask liner. The cage consists of vertical, radial, and hoops of rebar, which are 3 in. below the surface of the cask. The cages (see Drawings H-3-55001 and H-3-55003) have vertical and hoop rebar on approximately 6-in. centers from cask top to bottom, with radial rebar extending across the top and bottom of the cask. The radial rebar is bent down or up, and welded to either headed studs welded to the liners or to rebar hoops welded to fins on the liners. Rebar hoops and radial rebar are extended to the center of the bottom of the cask to support the concrete below the liner. The sealed storage casks for the spent fuel and HLW include vertical rebar and hoops at approximately 6-in. centers, at the perimeter of fins on the liner, to conduct decay heat to the cask exterior. In addition, radial rebar from the inner hoops to the outer hoops is provided for these two types of casks (also for heat removal). The additional rebar for these casks is discussed further in the Design Studies Volume.

Each sealed storage cask is provided with a means for taking samples of the interior atmosphere. This gas sampling port (see Drawing H-3-55008) consists of a stainless steel tube, welded to the bottom of the liner, which extends to a sealed box embedded in the surface of the cask. Inside this box, the tube is welded to an assembly of compression fittings, a valve, and a quick disconnect provided to allow gas bottle or pressure check equipment connection. Access to the fittings and valve is provided through a lid bolted to the embedded box. The gas sampling port is attached to the liner bottom to allow for drainage of any fluid from the cask interior. This could include any decon or cleaning solution that may be used on the cask interior or any water that may have accidentally entered the cask during cask fabrication or transport to the R&H Building (before loading and sealing). The gas sample port location (approximately 18 in. above the bottom of the cask) was chosen to provide operator access. The gas sample line configuration was chosen so as not to affect the shielding capability of the cask. Because the port line has to go through the rebar, the line has to be attached during cask construction.

The inclusion of a single gas sampling line was investigated to be sure that gases drawn into a vacuum bottle from this line would provide representative samples of the internal atmosphere. The results of this assessment (see Design Study Volume) indicate that releases from a ruptured canister and/or fuel rod would diffuse throughout the cask interior within about 6 days. The taking of gas samples on a monthly basis (or longer) should provide reasonable assurance that fuel rod or canister rupture can be detected from the analysis of cask gas samples.

The reinforced sealed storage cask design was assessed to determine what measures should be taken to protect the cask rebar from corrosion and to minimize the degradation of cask concrete caused by internal heating. The cask design uses the concrete as shielding as well as for some structural capabilities. The rebar cage around the perimeter, on the top, and on the bottom of the cask provides most of the cask structural capabilities for handling and for absorbing external loads (missiles, drops, etc.). To provide protection for the rebar and for the concrete needed for structural capabilities, assuming the cask concrete will be a normal portland cement (Type II or Type V), the following measures should be considered:

(1) Ensure that the specified water/cement ratio is as low as possible, consistent with good practice in other respects, to limit the amount of free water in the as-cured cement and thereby minimize its permeability.

(2) Ensure good cement mixing and consolidation, using vibratory techniques to prevent inhomogeneities, segregation of constituents, and voids.

(3) Maintain adequate cover (6 cm of concrete) over the rebars to ensure that the diffusion distance through which chloride ions or oxygen must migrate is large.

(4) Include siliceous materials that can combine with free lime, such as fine silica in the mix, to increase resistance to saline environmental effects.

(5) Use a low-alkali cement (limit Na_2O and K_2O to less than about 0.6%) to help limit intrinsic chloride content.

(6) Limit the permeability of all constituents by use of a dense, nonpermeable aggregate.

The above measures are recommended for consideration during detailed design to the extent that they are consistent with other aspects of design, are practicable, and are cost-effective.

2. <u>Cask Component Descriptions</u>. The sealed storage casks consist of concrete, rebar, a gas sampling port (all three previously described), a liner, a shield plug, and a cover plate. In addition, a temporary cover is provided to close the liner top opening before waste container loading; thermocouple tubes, junction boxes, conduit, and thermocouple connection heads are installed on the spent fuel and HLW casks. These components are described below.

(1) <u>Liners</u>

A carbon-steel liner (see Drawings H-3-54994, H-3-54995, H-3-54996, H-3-54997, and H-3-54998) forms the inside cavity of the concrete cask. All liners have a flange as an upper surface, which is welded to a pipe section. This pipe section interfaces with the shield plug. A steel ring is welded to the bottom of the pipe section and forms a ledge on which the shield plug sits. This ring is welded to the lower liner section in which are stored the waste containers. A flanged head is welded to the bottom of the liner. This provides a continuous steel containment barrier.

The flange at the top of the casks is 0.75 in. thick and 3.5 in. wide. The upper liner pipe section is 0.5 in. thick and is sized to provide a 0.5-in. radial clearance between shield plug and liner pipe. The liner pipe length (terminating at the shield plug ledge) is determined by the shield plug height (needed for vertical shielding). The ledge is a 1.0-in.-thick ring, sized to provide the needed offset between the lower liner section and the shield plug/upper liner gap. This gap has an impact on shield plug handling and on radiation streaming to the top surface of the cask. For shield plug handling, the gap should be as large as possible. A 0.25-in. diametral gap was chosen as a starting point from which radiation analyses would be done and from which handling interfaces could be evaluated. Increases in gap size for handling clearance will result in higher dose rates at the cask top. This can be compensated for by increasing the size of the step in the liner. For the conceptual design, the gap size was set at 0.50 in. and the step size was increased (from that for the 0.25-in. gap) to limit the increase in the scattered radiation portion of the dose rate to about a factor of 3. Further evaluations of this gap configuration are needed as part of the detailed design effort. The ledge is situated axially on the liner to maintain the top of the shield plug 0.75 in. below the top of the liner flange.

The lower liner section diameter and thickness were designed to accommodate the different waste containers to be stored. For the casks containing spent fuel and HLW, a 2-in.-thick liner with 16 external fins has been provided for heat transfer purposes. The number of canisters contained in each cask was determined based on the thermal analysis results presented in the next section. These numbers (12 for spent fuel and 9 for HLW) and the required shielding needed around each resulted in different liner diameters. The fins provided on each liner were extended from the liner to a 79-in. diameter to use a uniform rebar cage design for both. For the nonfuel-bearing components, the RHTRU canisters or drums, and the West Valley HLW, the lower liner is 0.5 in. thick. The diameters of these liners were determined based on internal arrangements of three, five, seven, or nine drums or 24-in.-dia canisters and on the required concrete shielding needed around the liner. For the nonfuel-bearing component cask liner, the 0.5- in.-thick liner (containment boundary) is surrounded by 1.5 in. of steel (needed for shielding). The steel is in the form of thin, rolled sheet that is wrapped around the fabricated liner. This concept was used on the FFTF Cask design for disposable solid waste, and represents a much less expensive design than fabricating the entire liner out of 2-in.-thick steel.

The design of liner interior components is also dependent on the waste containers. For the spent fuel and HLW casks, eight radial fins are provided to enhance heat transfer from the canisters to the liner wall. The fins are made of extruded aluminum and have a flat section, which is bolted to the interior of the liner. Other internal fin materials were investigated, and are discussed in the Design Study Volume. Above and below the internal fins are steel canister support plates. These plates have clearance holes for the number of canisters to be contained (see Table 3-1). The plates are welded to the inside of the liners, and provide lateral support as well as positioning for all of the canisters. No internal container restraints are included in the other cask designs.

The bottom portion of each liner is a commercially available, 0.5-in.-thick flanged head. The diameter of the head is sized to match either the inside or outside diameter of the lower liner. For the two 2-in.-thick liner designs, the liner wall has a transition from 2 to 0.5 in. for welding. Steel plates are welded to the bottom of the flanged heads for the HLW casks to provide additional shielding. A 1.5-in.-thick, circular steel plate is provided below the HLW cask head; a 0.5-in.-thick, circular steel plate is provided below the West Valley HLW cask head.

The liner flange, the upper and lower liner sections, the shield plug ledge ring, and the flanged head are assembled by using full-penetration welds. To inspect the welds, magnetic particle methods are used for the root pass and final pass, as a minimum, or radiography may be used. Fillet welds on the liner fins or for the internal support plates are visually examined only. Welding of head studs to the exterior of the unfinned liners and welding of rebar to these studs or the liner fins is made and inspected to the appropriate specifications.

The rolled-steel sheet shield around the 0.5-in.-thick, nonfuel-bearing component (NFBC) cask liner (containment barrier) provides several advantages over the 2-in.-thick liners needed for the spent fuel and HLW casks. First, there is very little heat load in the NFBC cask, and a continuous liner thickness is considered unnecessary. Since the thermal contact resistances between wrapped sheets would result in significantly higher cask interior temperatures, the wrapped liner would not perform acceptably for the spent-fuel or HLW cask.

Second, the fabrication and inspection costs for the thinner, wrapped liner will be less than those for a solid liner of comparable thickness. The rolling process to turn a 2-in.-thick plate into a cylinder the diameter of the NFBC liner will probably require that two half cylinders be rolled and then seam welded together along the entire length. For a 0.5-in.-thick liner of the same diameter, a single rolling operation with only one seam weld is required. Since the liner wall (and any welds) forms the containment barrier portion of the cask, full-penetration welds with volumetric examination will be required. The time to make two 2-in.-thick, full-penetration welds along the liner length is estimated to be 4 to 8 times longer than one 0.5-in.-thick weld would take. The two welds will also require additional time for the nondestructive examination required (radiography or dye penetrant). The welds used to attach the steel sheet to the thinner liner can be intermittent fillet welds (simply to hold the rolled sheets to the liner), which would require little more than visual inspection. The rolling operation of the sheeting on the liner and the fillet welding should take much less time than the difference in welding and inspection operation times for the full-penetration welds. Further evaluation of the costs involved and optimization of the cask liner designs are part of the detail design phase.

(2) Shield Plugs

A cylindrical, concrete-filled shield plug (see Drawing H-3-54992) is provided for each concrete cask. The shield plug is designed (in conjunction with the cask cover) to attenuate radiation to the top of the cask to about 10 mRem/hr. The shield plug is encased in steel to maintain its configuration during its lifetime and for ease of decontamination after that. Three internally threaded steel embedments are welded to the top of the plug for transmitting lifting loads to lifting eyes, which are installed for handling. The removable lifting eye design for handling the shield plugs provides the same remote handling interface for the hot cell crane as the discharge port plugs. From a shielding and fabrication standpoint, this configuration is better than one in which the lifting eyes are recessed into the shield plug or one in which the top surface of the shield plug is lowered to allow clearance for the lifting eyes.

Determination of the diameter of the shield plugs was based on the lower liner section inside diameter, the shield plug/upper liner section gap, and an offset between the two. The offsets are different for the different casks because of the locations and strengths of the radioactive wastes in the cask. The shield plug thickness was based on the concrete and steel shielding below the liner, the length of the waste container, and the fixed height of the cask. The shield plugs have steel plates of various thicknesses (top or bottom) to provide added shielding within the limited height envelope for the plug. The top plate of the plug has an access hole for pouring concrete into the plug. A plate is welded over this hole after the concrete has cured. A small hole is included in this plate to allow any water vapors generated during cask and plug heating to escape.

(3) Covers

A circular, carbon-steel cover is provided for each concrete cask (see Drawing H-3-54991). The cover is sized to fit on the liner flange (diameter is 2 in. less than flange outside diameter) and to be seal-welded to it. Three lifting eyes are welded to the cover for handling and to interface with the cover welding machine. The cover thickness provides (1) additional radiation dose attenuation at the top of the cask (in addition to that provided by the shield plug), (2) protection against penetration of the secondary containment barrier by tornado missiles, and (3) containment for internal pressure from canister and fuel rod rupture.

A temporary cover plate is provided for each cask configuration (see Drawing H-3-54993). These reusable covers consist of a 1.0-in.-thick, circular plate, with a thin ring welded to the perimeter of the plate. The ring is slightly larger than the outside diameter of the liner flange, and serves to position the temporary cover and to keep debris, water, etc., out of the cask before it is loaded and sealed. A neoprene gasket is glued to the underside of this cover to interface with the liner flange and prevent damage to the flange.

(4) Instrumentation

Provisions have been made for temperature monitoring of the spent-fuel and HLW casks. Instrumentation tubes (see Drawing H-3-55008) are attached to the outside surface of these cask liners by spot-welded metal clips, and are routed to a thermocouple connection head mounted on the surface of the cask. Conduits are connected to these connection heads that terminate in a sealed junction box mounted about 5 ft above the bottom of the cask. Thermocouples are routed through the tubes to the liner, where temperatures can be recorded and compared with predictions to ensure that the cask and its contents are performing as anticipated.

3. Thermal Analysis Results. Analyses have been performed to predict thermal performance of sealed storage casks containing spent fuel and HLW. The analyses varied such cask parameters as liner thickness, internal fin configurations, fin materials, radial rebar content, number of canisters, and waste-form heat generation. Acceptable performance of the casks is measured in terms of maintaining spent fuel rod clad temperatures and HLW canister temperatures below 375°C. The Design Studies Volume presents details of the methods, assumptions, and results of the cask thermal analyses. The results are summarized below.

(1) Spent Fuel

Twelve canisters of consolidated 33,000-MWD/MTU burnup, 10-yr-old PWR spent fuel can be stored in a sealed storage cask without exceeding the fuel rod clad temperature limit. To achieve this, aluminum fins are needed inside the liner and radial rebar (4% of the volume) is needed between the inner and outer rebar cages. The temperatures predicted for the cask components and the cask surface temperatures are shown in Figure 3-1. Figure 3-2 shows the temperature isotherms throughout the cask concrete. Calculations for consolidated 33,000-MWD/MTU burnup, 5-yr-old fuel and consolidated 55,000-MWD/MTU burnup, 10-yr-old fuel were also made. The results showed that fuel rod temperature predictions exceeded the 375°C limit for as few as eight canisters in the cask. For this, only intact fuel at the higher burnup and shorter life can be stored in the sealed storage casks.

(2) High-Level Waste

Nine canisters of the reference HLW can be stored in a concrete cask with aluminum fins and radial rebar. Figure 3-3 shows the temperature isotherms calculated for the cask concrete. The other two HLW canisters were analyzed in a sealed storage cask. For the 1-ft-dia by 15-ft-long canister, eight canisters can be stored without exceeding the canister temperature limit. For the 30-in.-dia by 15-ft-long canister, one canister can be stored in a sealed storage cask; however, its heat load must be limited to 14,325 W (about 80% of the reference heat load).

4. Radiation Analysis Results. Radiation analyses have been performed for the six sealed storage cask configurations. Details of the radiation analyses are presented in the Design Studies Volume. The results are briefly presented herein.

The sealed storage cask configurations were designed to limit surface dose rates to 10 mRem/hr on the top of the cask, 20 mRem/hr on the sides of the cask, and 200 mRem/hr on the bottom of the cask. Initially, hand calculations were performed to establish the thicknesses of concrete required to achieve these dose limits. Configuration refinements and computer-code calculations were performed to better predict cask dose rates. The results of the calculations are summarized in Table 3-4.

3.5.2.C. Equipment Descriptions

1. Introduction. This section describes the major pieces of equipment used for storage cask operations. Additional details of the standard features for this equipment are provided in the outline specification for each.

2. Cover Welding Equipment. The cask cover welding equipment consists of a handling fixture, a welder torch assembly, and a power supply and control unit.

The handling fixture is designed to be compatible with the transfer/discharge corridor monorail crane and with each of the cask covers. The handling fixture is attached to the cask cover by using the three lifting eyes welded to the cover. These eyes provide positioning between the

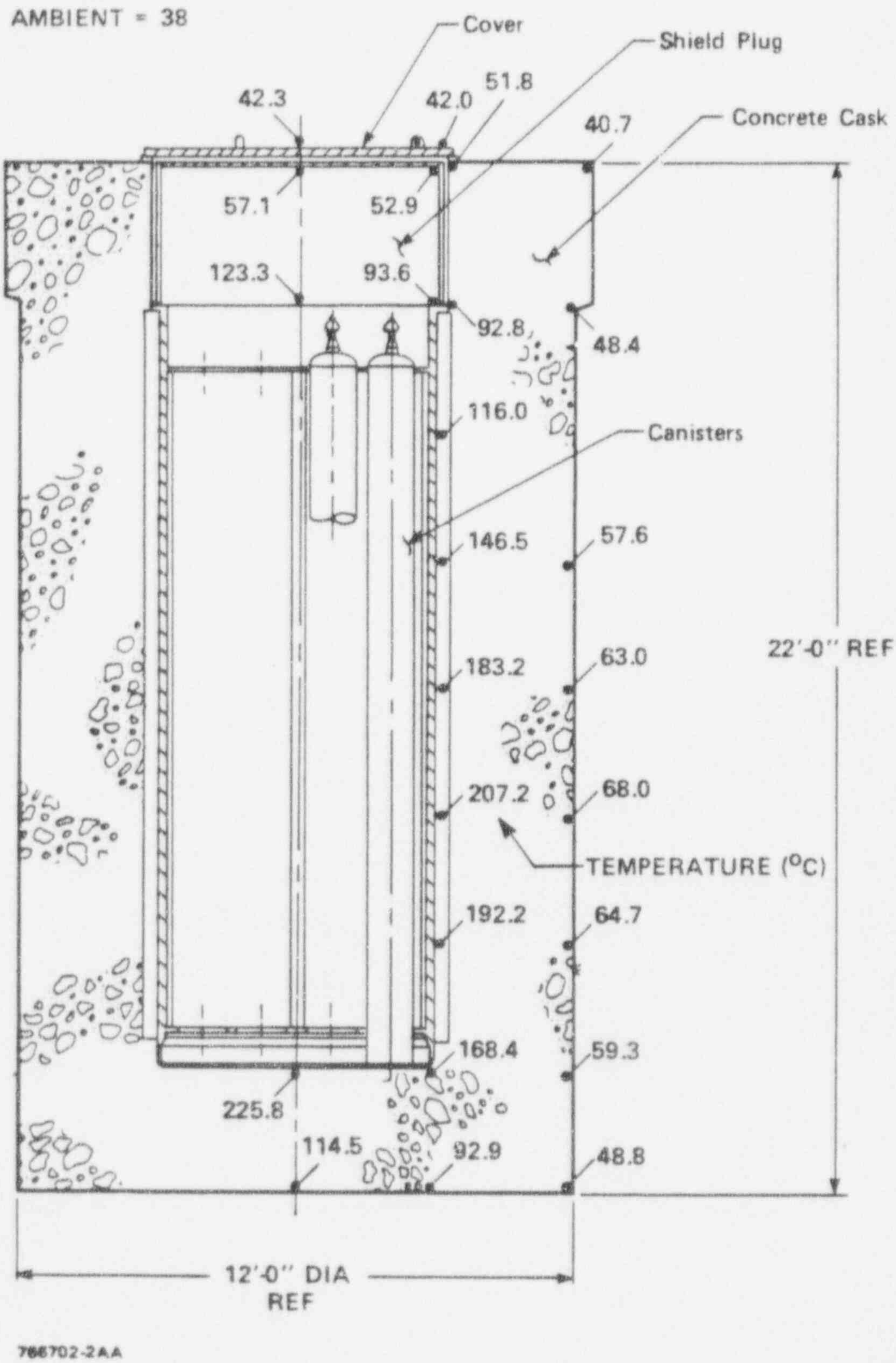


Figure 3-1 - Spent-Fuel Cask Component and Surface Temperatures

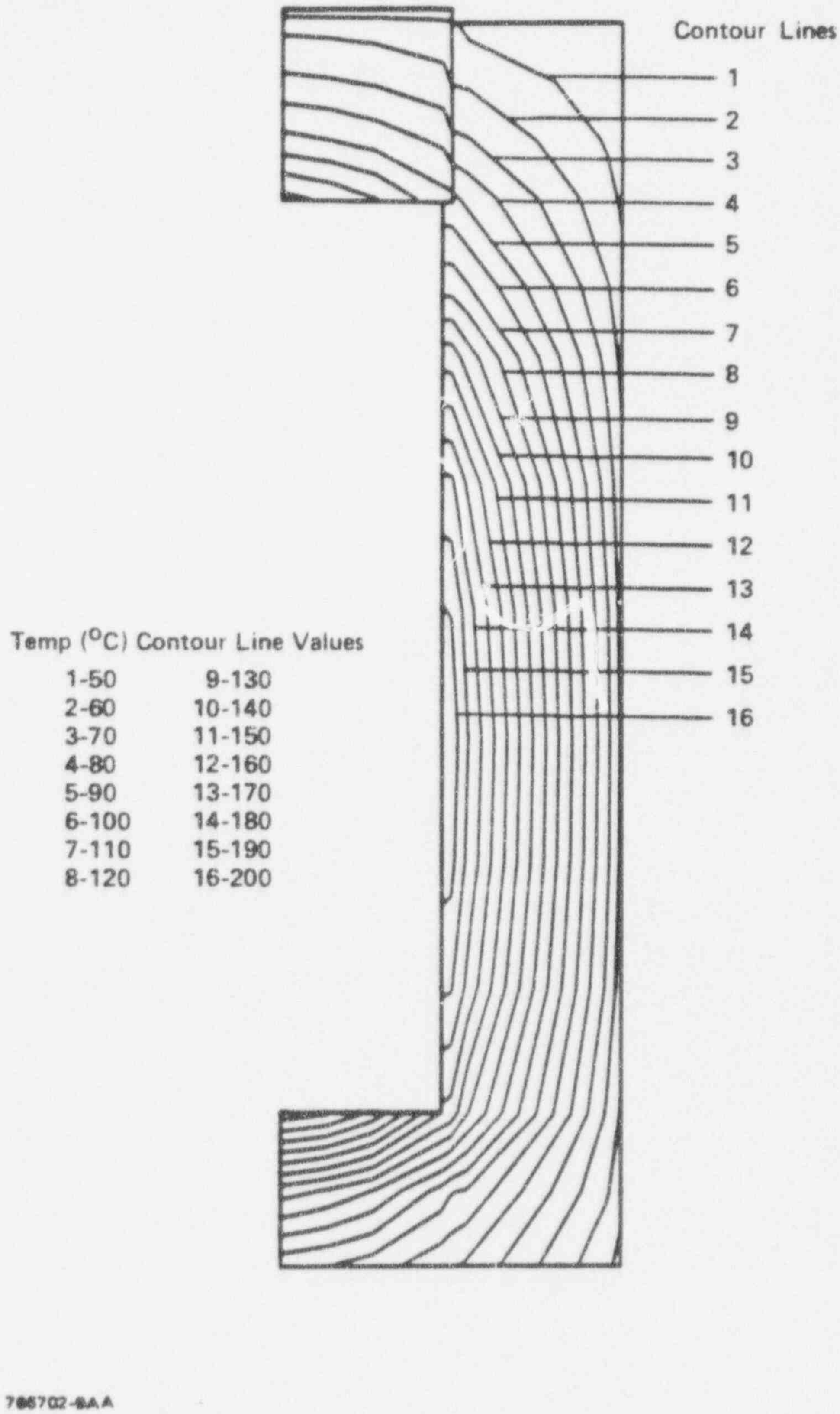
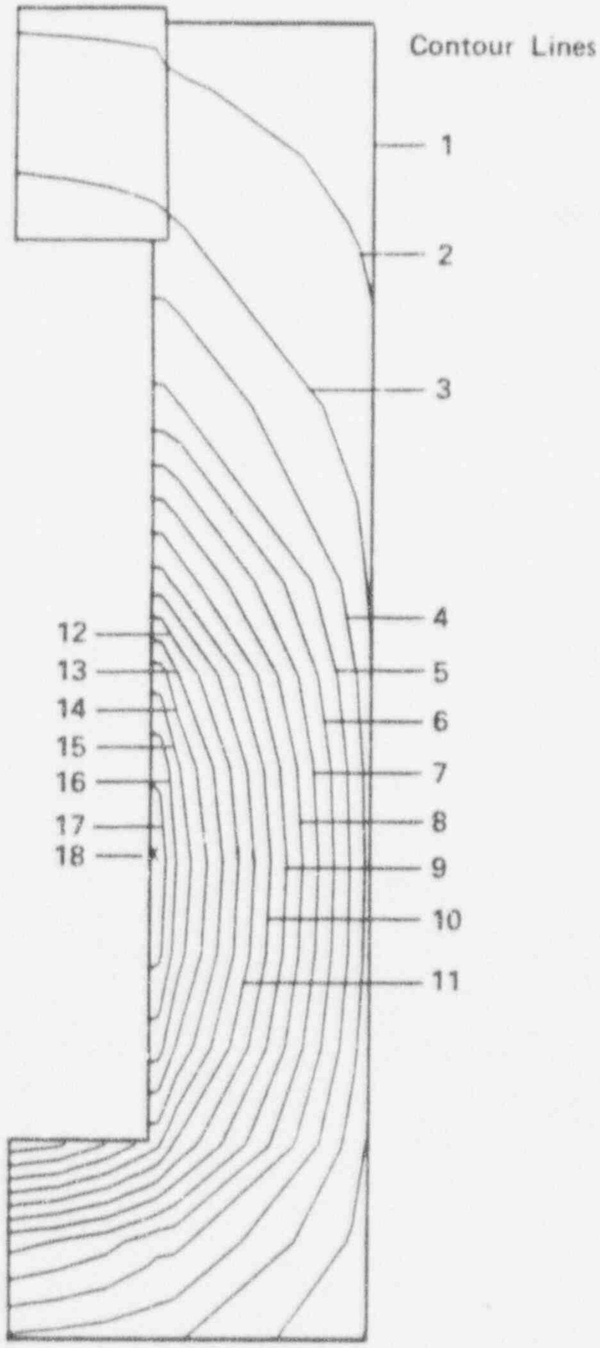


Figure 3-2 - Spent-Fuel Concrete Cask Isotherms
(10-yr-old, 33,000-MWD/MTU Fuel; 2-in. Liner, 4% Radial Rebar)



Temp (°C) Contour Line Values

1 – 38	10 – 165
2 – 45	11 – 180
3 – 60	12 – 195
4 – 75	13 – 210
5 – 90	14 – 225
6 – 105	15 – 240
7 – 120	16 – 255
8 – 135	17 – 270
9 – 150	18 – 285

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Figure 3-3 - HLW Concrete Cask Isotherms
(Reference HLW Waste Form, 2-in. Liner, 4% Radial Rebar)

Table 3-4 - Summary of Total Dose Rate Results for Casks (mRem/hr)

	Side	Bottom	Top-Center of Cask		Top-Over Gap	
			Below Cover	Above Cover	Below Cover	Above Cover
Spent fuel cask						
Consolidated (33-10)	6.12	62.6	10.04	1.33	4.57	1.69
Intact (33-5)	14.35	137.27	24.45	3.29	9.87	2.45
Intact (55-10)	12.32	91.81	15.80	2.06	12.08	6.16
HLW cask						
HLW	1.94	18.98	2.98	0.52	21.1	16.2
Nonfuel-bearing components cask						
Skeletons (33-10)	10.7	143.0	32.0	4.1	18.4	4.0
50-R/hr RHTRU cask						
50 R/hr RHTRU	21.1	6.17	4.28	1.55	1.42	0.72
1,000-R/hr RHTRU cask						
1,000 R/hr RHTRU	21.5	123.4	12.22	4.42	3.90	1.34
WV HLW cask						
WV HLW	2.17	2.60	0.15	0.056	0.066	0.034
2,500 R/hr RHTRU	19.2	23.5	3.06	1.10	0.95	0.491

portion of the handling fixture, that interfaces with the welder torch assembly and the cover perimeter. A circular track is provided around the outside of the handling fixture, which allows the welder torch assembly to accurately track around the cover plate.

The welder torch assembly consists of a standard welding torch and the necessary motors and controls to allow the torch to be moved around the perimeter of the handling fixture, and to move the torch up, down, and radially relative to the handling fixture. Attached to the torch assembly are the necessary gas, cooling, electrical, and control cables needed to allow operation and control from the power supply and control unit.

The power supply and control unit is a commercially available unit, with the necessary parameter controls and functions to allow welding operation and parameter recording. The power supply and control unit is located on the transfer/discharge corridor work platform in an area away from the cask, so that worker exposure during the welding operation is minimized. Power cables and gas lines from the power supply and control unit are made of radiation-hardened materials to increase their lifetimes.

3. Cask Transporter. The cask transporter is used to move the sealed storage casks from the R&H Building to the storage facility. It is a self-propelled, crawler-type vehicle. Each crawler tread is driven by a heavy-duty diesel engine with an automatic transmission. This provides very precise maneuverability, and a tight turning radius, as each tread is independently driven.

The cask transporter (shown in Drawing H-3-54985) is a modified version of a standard 600-ton crawler. The cask transporter has a slightly shorter overall width and a longer length to be more compatible with the R&H Building. The crawler treads have been reduced in width and increased in length to provide the required load spreading. The crawler has a thick metal plate, with a retaining ring around the perimeter, to interface with the cask. The maximum speed of the crawler transporter is 3 mph. This speed limitation and the weight of the casks should prevent casks from falling off the transporter.

4. Cask Handling/Lifting Fixture. The sealed storage cask handling/lifting fixture (see Drawing H-3-54987) is a specially designed fixture for handling and lifting the concrete storage casks at the MRS Facility. The handling/lifting fixture is a cylinder with an internal flange at its lower, open end. A segmented, circular shear block arrangement inside this cylinder is used to lift the cask. The upper end is closed by a conical transition to a crane attachment. The conical section cylinder, flange, and shear blocks are designed to transmit the cask weight loads to the crane hook. The present design shows the crane attachment as a twin (sister) hook. Within the cylind- rical section of the fixture are the mechanisms that support the shear blocks and that actuate the mechanism.

The cask handling/lifting fixture is designed for semiremote operation and to be fail-safe. The attachments to the crane hook and the mechanisms for engaging the shear blocks are electrically actuated. Electric power is supplied from the crane; the controls and sensor readouts are located in the crane cab. Cables between the fixture and crane cab are provided. The path of load transmission through the segmented shear blocks to the cylindrical section flange, along with the shear block motion restraint by the design configuration, provide fail-safe operation. The fixture cannot be removed from the cask without removing the load (cask) from the fixture.

The cask handling/lifting fixture is operated as described below. As the fixture is lowered over a cask, a plate near the upper end of the cylindrical section comes to rest on top of the cask. Further lowering of the fixture causes the shear blocks to be lifted off the internal flange. When the fixture is fully lowered over a cask, the shear blocks are suspended between the internal flange of the fixture and the shoulder of the cask. At this point, a fixture/cask proximity sensor indicates that the shear block actuator can be energized.

When the actuator is energized, the actuator plate rotates several degrees, lifting the actuator cables. The cables, in turn, pull upward on the abutting ends of the shear blocks; the lifting force is reacted by compressing springs located between the blocks, and the shear blocks move inward to a smaller radius. The weight of the shear blocks is significantly greater than the force necessary to compress the springs; thus, the blocks are not lifted, but caused to move inward. The fixture is then lifted to engage the blocks between the cask lifting surface and the flange at the bottom of the fixture.

5. Storage Area Crane. The storage area crane is a commercially available, 600-ton rated, mobile crane that is used to lift sealed storage casks off the transporter and place them in a prescribed position on the storage pads in the storage area. The crane is mounted on a crawler to provide mobility and to spread the lifting loads to meet soil-bearing pressure limitations. The crane lifting capacity and boom length (100 ft) have been chosen to allow the heaviest loaded cask to be lifted and rotated at the swing radius dictated by the sizes of the crawler transporter and the crane and the storage ,-- arrangement. A specially designed boom or positive boom stop, features that preclude extending the swing radius beyond the safe limits for handling the load, may be considered in the detailed design.

The load rating and cost of the mobile crane were considered in the choice of the 600-ton-capacity crane. The size and rating of the crane are based on the operating radius at which a certain load is to be handled. For the MRS casks, the range of operating radii (the distance between crane axis of rotation and the center of the cask) is estimated to be between 40 and 50 ft. Data from Manitowoc Engineering Co. on its available crawler cranes with the shortest boom length and greatest lift capacity are as follows:

Crane No.	Rating (tons)	Lift Capacity (tons) at Radius 20 ft	40 ft	45 ft	50 ft
6000W-2	600	600	304	254	217
6000W	500	500	253	212	181
4600S-4	350	350	110	93	80
4600S-3	240	210	73	63	55
4100S-2	230	174	72	61	53

The 6000W-2 crane with a 600-ton capacity was chosen for the MRS to ensure lifting capacity for all of the sealed storage cask configurations and to allow some flexibility in the operating radius. The next larger size of crawler crane has a 1,000-ton rating with a capability of lifting 275 tons at a 75-ft radius.

The budgetary estimate for the 600-ton crane is $2.5 million and for the 1,000-ton crane is $6.5 million.

3.5.3 TRANSPORTABLE STORAGE CASKS

Transportable metal (dual-purpose) storage casks provide a sealed, self-shielded, dry storage container for intact spent fuel assemblies or for consolidated fuel rods. For the MRS Facility, the transportable casks will be employed as both the shipping and storage containers. The casks are loaded in the reactor spent fuel pool, the water removed, and the casks sealed before shipment by rail to the MRS Facility. The casks are transported onsite horizontally, and are stored horizontally on reinforced concrete cradles.

For the MRS conceptual design, the REA-2023 cask has been assumed to be the only transportable cask that will be received, handled, and stored. The handling equipment and storage arrangement have been designed specifically for this cask, using the configurations recommended by the vendor. The designs of equipment, the handling and storage configurations, and the operations described in this section are considered representative of those required for other transportable casks.

3.5.3.A. Handling and Operations

1. Cask Handling. Upon arrival at the MRS Facility, the casks are inspected and cleaned before being removed from the railcar. Since the casks are shipped horizontally and are also stored in the same orientation, the handling operations are performed with the cask remaining horizontal. However, suspect casks would be upended and handled as other rail casks for inspection and/or unloading. The 150-ton bridge crane in the R&H Building receiving and inspec- tion area and a lifting yoke, specifically designed for the particular cask being handled, are used to handle the cask.

The cask lifting yoke is attached to the transportable cask lifting trunnions. This involves engaging the yoke hooks with the cask center trunnions and attaching two counterbalance arms to the trunnions at the top of the cask. The bridge crane is then used to transfer the cask horizontally to a specially designed skid on the cask transfer trailer. Steel tiedown bands are fastened around the cask to secure it to the trailer, and the yoke is lowered onto the trailer with the counterbalance arms still attached to the cask trunnions. The yoke is carried out to the storage facility with the cask for use there. An onsite tractor is used to haul the cask and transfer trailer to the storage facility.

The lifting yoke can also be used to upend the cask and handle it vertically. First, the counterbalance arms must be removed. The yoke hooks are then engaged with two of the cask upper trunnions. The cask can then be upended and carried vertically.

2. Cask Storage Operations. At the storage facility, the transportable casks are moved to a predetermined storage location. The tiedown devices used to restrain the cask during transit are removed. Using the storage facility mobile crane, the yoke is lifted to engage the hooks on the cask center trunnions; the cask is lifted from the transfer trailer, and set in place on two concrete cradles. The yoke counterbalance arms are released from the cask trunnions, and the yoke is set onto the yoke stand on the trailer. The six lifting trunnions are removed from the cask and stored for future use. The transfer trailer and yoke are returned to the R&H Building.

3. Monitoring Operations. Monitoring of the transportable casks consists of cask internal pressure monitoring and collecting samples of the interior atmosphere. This ensures that the integrity of the cask cover seals is maintained. A voltage readout, calibrated to read pressure directly from a pressure transducer installed on the cask, may be used to monitor the cask internal pressure. Interior gas collection is done with a vacuum-sampling bottle connected to the cask vent tube. It may also be necessary to visually inspect the outside surface of the cask and cover for signs of corrosion. In addition, for transportable casks that use a water jacket for neutron shielding, a periodic check of the water level is necessary to ensure adequate radiation protection for storage facility workers.

With the casks in a horizontal storage orientation, inspection and monitoring operations are simplified. Regarding ALARA considerations, time spent in the cask vicinity for these activities is reduced by simplifying and minimizing operations. Because the cask covers are facing the roadway, they can be easily checked to make sure the seal is still functioning properly. Also, monitoring ports are readily accessible because they are near the cover of the cask.

4. Accountability Operations. The accountability operations for the transportable casks and their contents start with numbering (unique identifying) of the casks and recording of their contents. Reactor operators may be required to number the casks before shipment as part of the waste receipt criteria. Each cask will also have a written record of its contents supplied by the reactor operator. Radiation measurement readings on each cask

(performed at the MRS Facility) will be included as part of the accountability records for comparison with readings taken during storage. For security purposes, security seals may be added to the cask between the cover and cask body.

The yearly accountability operations at the storage facility will include checking of all casks for security seals (or cover closure integrity), recording of cask numbers, and recording of radiation measurements for each cask. Comparison of these yearly records with those taken upon cask receipt will verify the presence of the radioactive materials. For transportable casks, these operations require no special vehicles because the cask cover and sides are accessible from ground level.

5. Retrieval Operations. Retrieval operations for cask offsite shipping are the reverse of the handling and storage operations previously described.

6. Operating Personnel. It is expected that the personnel performing the handling, storage, monitoring, accountability, and retrieval operations would be those already defined for other R&H Building and storage facility activities. This is because the specialized operators, technicians, and inspectors are already part of the MRS Facility staff, and storing of spent fuel in transportable casks is the most time-efficient (hours per MTU of fuel).

3.5.3.B. Equipment Descriptions

This section describes the major pieces of equipment used for transportable metal (dual-purpose) storage cask operations. Additional details on the standard features for this equipment are provided in the outline specification for each.

1. Transportable Cask. The reference storage cask chosen for the MRS Facility conceptual design is the REA-2023 transportable storage cask. It is designed to accommodate 24 PWR or 52 BWR spent fuel assemblies at present, but can be specially designed to contain consolidated fuel rods. The cask is cylindrical, with a diameter slightly less than 8 ft and a length of approximately 15.5 ft. Empty, the cask weighs 88 tons and, when loaded with consoli- dated fuel, weighs a maximum of 125 tons. It is constructed of lead and stainless steel for gamma shielding and is surrounded by a tank of ethylene-glycol solution for neutron absorption. Specially reinforced sections of the neutron shield tank are provided that allow the cask to be stored horizontally. The cask provides a passive means of dissipating spent fuel decay heat to the environment by natural convection from the outer surface; that minimizes the requirements for maintenance and surveillance during storage. Also, provisions are made to allow interior gas sampling and recording of pressure. Because the cask closure uses a double-containment design, with a welded final closure of the secondary cover, it is not intended to be opened after leaving the reactor spent fuel pool. For handling purposes, the cask is fitted with six removable lifting trunnions.

The REA-2023 cask can accommodate 24 intact PWR spent fuel assemblies, with enrichments up to 3.5%, burnups to 33,000 MWD/MTU, decayed at least 5 yr after irradiation, and generating not more than 1.0 kW of heat per assembly. The internal containment vessel of the storage cask can be backfilled with a positive pressure of helium following cask loading. The use of helium as the internal atmosphere enhances heat transfer within the cask, and allows for containment vessel gas pressure monitoring and sampling to ensure that the integrity of the cask seals is maintained. The maximum dose rate at the surface of the cask from the above fuel is 20 mRem/hr.

2. Lifting Yoke. The lifting yoke (see Drawing H-3-54938) is used for all transportable cask lifts. Its design has been tailored after other rail cask lifting yokes. For specific use at the MRS Facility with the REA cask, the yoke is designed primarily to make horizontal lifts, and is adaptable to upend the cask and carry it vertically.

The main yoke structure is composed of two large parallel plates to which are connected two hook arms. Extending from each arm is a hook sized to engage with the 8-in.-dia trunnion near the center of the REA cask. These are the major loading bearing members. Additionally, a removable counterbalance arm is connected to each hook arm to maintain the cask in a horizontal position. These smaller members are attached to the other trunnions at the top of the casks. A single lifting bail is provided to interface with either the 150-ton crane at the R&H Building or the mobile 600-ton crane at the storage facility. The yoke was designed to the criteria for lifting devices for nuclear material shipping containers. Weld configurations were designed to allow periodic nondestructive examination.

3. Transportation Equipment. The cask transportation equipment consists of a transfer trailer, a cask transfer skid, and a yoke stand. The transfer trailer is a commercially available, flatbed trailer. For this application, a trailer with articulated front and rear axles has been chosen to minimize the required turning radius in the storage facility. The trailer has a 10-ft-wide by 20-ft- long, flat steel bed. The load capacity is 300,000 lb, and the trailer has 32 tires to spread the load.

The cask transfer skid (see Drawing H-3-54990) is a specially designed steel frame that bolts to the transfer trailer bed. The transfer skid has two U-shaped supports for the cask, which are sized and positioned the same as the concrete storage cradles. The two supports consist of welded flat plates, which transfer the cask weight to the trailer. Two channels are welded between the supports to provide stability. A steel tiedown band, with adjustable turn- buckles, is bolted to each support to allow the cask to be secured to the support and trailer.

The yoke stand (see Drawing H-3-54990) is bolted to the trailer behind the transfer stand. The stand, which consists of welded steel plates and channels, provides a raised surface on which the lifting yoke can be placed for its return to the R&H Building. The stand permits the yoke bail to be positioned so that the crane hook can be inserted or removed by the crane operator without need for added handling operations.

4. Storage Cradles. The transportable casks are stored horizontally on two reinforced concrete cradles, one at each end of the cask (see Drawings H-3-54988 and H-3-54989). The function of the cradles is to keep the casks stationary and to elevate them above ground level to enhance heat dissipation. The cradles are U-shaped, reinforced concrete structures supported by a reinforced concrete footer, which extends to a depth at least 1 ft below the frost line. Each cradle has an integral, stainless steel facing on the round surface on which the cask rests. The cradles are positioned so as not to interfere with any of the cask ports that need to be accessed and to support the cask in the areas where the neutron tank is specially reinforced. The cradles are fabricated in place on an as-needed basis. The rebar and stainless steel facing are preassembled and installed in forms; the concrete is poured and vibrated in place.

3.5.4 OPEN FIELD DRYWELLS

Drywells provide a passive method of safely storing spent fuel assemblies, drums of compacted nonfuel-bearing components, HLW canisters, West Valley HLW canisters, and drums and canisters of RHTRU. This concept uses the surrounding geologic medium to attenuate radiation and to dissipate decay heat generated by the waste while it is sealed in the drywell. Four drywell sizes have been designed to accommodate the variations in waste container configurations. Each drywell holds a single canister of waste. Each different waste type is stored in a unique array of drywells, sized according to the containers they must hold, and spaced according to the amount of waste heat that must be dissipated and the thermal conductivity of the soil at the reference sites. Sufficient heat must be passively transferred from the drywell interior to maintain fuel cladding and canister temperatures below specified limits.

3.5.4.A. Handling and Operations

1. Drywell Installation. Fabricated drywell liners, covers, and shield plugs are received at the MRS Facility by either truck or rail shipments. After unloading, they are stored until needed. Drywell liner installation consists of first pouring an annular concrete bearing pad, its exposed face being flush with the soil surface. Its outside diameter is 5 ft, with an inner diameter chosen according to the diameter of the drywell liner to allow access for grout installation tubes between the liner and pad. Because the spacing of the 30- and 36-in.-dia drywells is closer than the others, one continuous, 6-ft- wide pad is poured instead of individual circular pads. All pads have a depth that extends 6 in. below the site frost line to prevent axial movement from freeze/thaw cycling. For the reference warm-wet site, all pads are 18 in. deep. The pad provides drywell stability and protection from surface erosion, furnishes an interface for the transfer shield during canister emplacement operations, and also provides a reference surface for liner installation. Next, a hole is drilled into the soil, its diameter and depth being determined by the diameter and length of the drywell liner (including grout tube clearance). Concrete pad and hole sizes are tabulated below.

Drywell OD (in.)	Pad ID (in.)	Hole Diameter (in.)	Hole Depth (in.)
16.0	29.0	26.0	252.0
18.0	31.0	28.0	240.0 or 186.0
30.0	46.0	42.0	252.0
36.0	52.0	48.0	252.0

The drilling of the emplacement hole and subsequent liner and grout installation should be done within a reasonable time span so that emplacement hole cleanout is not required. This period may vary for soils at different sites; it should be determined, based on trial site data before liners are installed. Cleanout of the hole can be done by the same equipment used to dig the hole. Because the grout layer on the outside of the liner and below the liner provides some corrosion protection, but more importantly ensures good thermal coupling to the soil and structural support for the liner, cleanout can include making the hole deeper. If some of the material on the side of the hole has collapsed into the bottom, it can be removed, and the added space between the liner and the area that collapsed can be filled with grout. The thickness and depth of the grout layer are not critical for drywell performance.

The newly bored hole is now ready for drywell liner installation. A drywell handling fixture is clamped to the liner flange. The fixture and liner are raised, using the eyebolts attached to the fixture, and both are moved from storage to a predetermined location, and lowered into the drywell hole. The liner is positioned so that the underside of the liner flange is 0.5 in. above the concrete pad and the liner is approximately centered in the pad hole. Leveling bolts on the fixture are used to level the top of the fixture, which subsequently results in the drywell liner centerline being vertical within the required tolerance.

Filling of the annulus around the liner with grout is completed in two pours. The first pour fills the annular space part way up the liner. This is done so that the bouyancy effect of the grout will not push the liner up out of the hole. After the grout has hardened and the liner is fixed in position, the handling fixture is removed, a temporary cover is installed, and the grout is poured to fill the remaining length of annulus. The grout is poured up to the underside of the liner flange, and is sloped downward to the concrete pad. This is intended to direct rainwater away from the liner flange and cover.

For spent fuel and HLW drywell liners, the thermocouple tube must be attached to the outside of the liners before installation into the drywell hole. The tube is routed along the liner exterior from the bottom of the liner to the top, and is held in place by small steel clamps, which are spot-welded to the liner. Attachment would be done with the liners horizontal and, with the handling fixture attached, the liners would be carefully upended. During upending and installation of the liner into the emplacement hole, some means of protection for the tube could be provided; e.g., a heavy-wall pipe ove the tube, which could be tied to the handling fixture. When the liner is completely lowered into the hole, the thermocouple tube is bent to horizontal, and is routed along a radial channel preformed in the concrete pad, and into a junction box containing a thermocouple junction. The junction box is designed to be mounted in a floor where vehicles can drive over it. This box will be installed in a concrete-lined hole adjacent to the concrete pads. To limit the potential for transporter loads on this box, the boxes are positioned along the drywell row centerline in the direction of transporter travel. These liners are grouted in the same manner as the other drywells, except that the trough in the concrete must also be filled with grout to embed the thermocouple tube.

2. Canister Loading and Transport. Waste container emplacement in drywells requires the loading of the canister into the transfer shield and transporting the canisters to the storage facility. Before a waste canister is loaded into the transfer shield, the drywell shield plug is loaded. In this operation, the lower gate of the transfer shield is opened, and the winch lowers the grapple onto a shield plug pintle. The grapple engages with the pintle, and the shield plug is hoisted into the lower part of the transfer shield. The shield plug support drawer is then moved inward under the plug, and the winch lowers the plug onto the drawer. The grapple is detached from the shield plug pintle and raised, and the drawer is moved outward so that the shield plug will clear the waste canister path. The transfer shield lower gate is then closed. The transfer shield is then ready for waste canister loading.

The transfer shield is moved into the R&H Building loadout/decon room, and is positioned under the discharge port. The transfer shield is raised to mate with the discharge port. The port is fitted with a contamination barrier and is within a shadow-shield ring, which is part of the ceiling of the loadout/decon room. The transfer shield upper gate, containing the winch, is opened, and the room door is closed. Using the hot cell crane, the discharge port plug is removed, and the waste canister is lowered into the transfer shield until it is seated on its lower gate. The grapple is released, the hot cell crane is withdrawn, and the discharge port plug is replaced. The room door is opened to allow operator access to the transfer shield controls. To prepare for transport to the storage facility, the transfer shield upper gate is closed. The winch lowers the grapple, which is then engaged with the canister pintle, and the canister is lifted slightly, ensuring that the grapple has secured the canister. The canister is seated on the lower gate, without grapple disengagement. The transfer shield is lowered to clear the shadow shield, using the forklift mast of the transporter. The transfer shield is moved into the transfer/discharge corridor for inspection before release for transport to the storage facility. Following release, the vehicle transports the transfer shield containing the waste canister to the drywell storage area.

3. Drywell Loading, Sealing, and Inspection. The drywell is prepared for receipt of the canister by removing the temporary cover, examining the interior to ensure that no water or extraneous debris is present, and cleaning the liner flange in preparation for welding. The transfer shield is

aligned with the empty drywell and lowered onto the concrete pad. After the canister is raised off the lower gate, the gate is opened, and the canister is lowered into the drywell. If the winch travel and load indicators show that the canister is seated in the drywell, the grapple is disengaged and withdrawn. The shield plug drawer is extended, the grapple is lowered, and the shield plug is grappled. The drawer is withdrawn, and the shield plug is lowered into the drywell. When the grapple is withdrawn into the transfer shield, the transfer shield is raised to clear the drywell, and the transporter can return to the R&H Building to repeat the canister/shield plug installation sequence. Once the transfer shield is removed from the top of the drywell, final visual accountability checks are performed before drywell cover welding.

The drywell cover crane and transport vehicle (a pickup truck with rear-mounted jib crane) are used to bring drywell covers from their storage area to the drywell storage facility, and move them into position at a drywell. Drywell cover-sealing and inspection operations are similar to those for the sealed storage casks described in Section 3.5.2.A.3. Once the drywell cover with the welding machine attached has been positioned on the drywell liner flange, the welding torch head is positioned, and the welding sequence is started from a power supply and welding process controller mounted on the vehicle. The welding apparatus guides itself around the periphery of the cover, making three weld passes (a root pass and two cover passes) to develop the desired 0.375-in., fillet-weld throat thickness between the cover and the upper flange of the drywell liner. As with the cask cover/liner welds, a security seal is included in the second weld cover pass. Once the seal weld has been inspected by nondestructive and leak-check methods and accepted, the weld and heat-affected zone are cleaned, and a corrosion barrier of clear varnish is applied.

4. Monitoring Operations. Monitoring of the drywell liner and cover integrity is performed on a periodic basis. Sampling of drywell internal atmosphere is performed by removing the gas sampling port access lid bolted to the drywell cover plate. An evacuated bottle with a valve is attached to the quick-disconnect fitting on the end of the assembly of compression fittings located underneath the lid. Gas samples are collected, and can then be analyzed for the presence of gaseous fission products or canister tag gas in the drywell atmosphere. Gas analysis results obtained from drywell samples indicate whether canisters or canister and fuel rods have lost their integ- rity. Drywell liner/cover integrity is tested by using the pressure decay check previously described for sealed storage casks, and by visual inspections of drywell covers, welds, and liner flanges.

Monitoring also includes temperature surveillance for a fixed number of drywells. Temperature measurement is accomplished via thermocouples on the exterior of spent fuel or commercial high-level waste drywell liners.

5. Accountability Operations. Drywell accountability operations are done on a yearly basis to ensure that the radioactive materials in storage are present. The activities associated with accountability include identifying each drywell and recording of the specific contents of each. The contents

are recorded during drywell loading operations. The security seals placed in the drywell liner/cover weld are visually inspected each year. The presence of the enclosed radioactive materials can be checked by using portable radiation sensors. Readings can be recorded following initial drywell loading and at yearly intervals. Comparison of radiation-level readings will verify the presence of the contents.

6. Retrieval and Unloading. Retrieval and unloading operations are, for the most part, the reverse of the storage and loading operations. Some of the activities that are unique to retrieval and unloading are described below.

Before the enclosed canister is transported to the R&H Building, a gas sample of the drywell interior is taken for analysis for the presence of radioactive gaseous fission products. If no fission products are found, the drywell can be unsealed without taking any precautionary actions to protect workers. If gaseous fission products are found, the interior could be evacuated through the gas sampling port, and the workers could be required to wear respirators and anticontamination clothing during drywell unsealing.

The drywell cover weld is removed by using the welding machine (as a cutting torch) or a rotary cutting tool. Once the weld is cut and the cover is removed, the shield plug and canister can be removed into the transfer shield, and the transfer shield can be moved into the loadout/decon room for remote unloading.

7. Operating Personnel. An estimate has been made of the personnel required to perform drywell storage, monitoring, and accountability operations. A total of eight crews would be needed to perform drywell storage operations. It is estimated that 490 drywells can be loaded by each crew, working 250 days/yr. Each storage crew would consist of a crew chief, a transporter operator, a transfer shield operator, an inspector, and two technicians for cover handling, welding, and pressure checking.

Monitoring would be performed by as many technicians as required to complete gas sampling and/or pressure check operations within the chosen time period and within the ALARA exposure recommendations. Accountability operations would require an inspector to examine security seals and drywell covers.

3.5.4.B. Drywell Descriptions

1. Drywell Components. A completed drywell consists of a carbon-steel liner oriented vertically in a hole bored into the ground, a shield plug, and a seal-welded cover plate. It also includes instrumentation, grout filling the annulus around the liner, and the concrete pad at the ground surface. In addition, a temporary cover and a handling fixture have been included in the drywell design.

(1) Liner

The drywell liner (see Drawings H-3-55038 and H-3-55039) is a welded, carbon-steel assembly consisting of two lengths of different-diameter pipe connected by a concentric reducer and closed at the bottom by a forged end-fitting. The drywell liner dimensions and contents are defined in Table 3-5. Depending on the size of the drywell, the upper section of the liner is either a lap-joint stub end or a straight length of pipe having a ring welded to its top, which serves as the flange. For 16- and 18-in. drywells, the stub end is a standard 1-ft length; for the 30- and 36-in. drywells, however, an 18-in.-long pipe section is used. The length of the lower pipe section is such that the total depth from the ground level to the bottom of the liner is 246 in., except for the HLW drywells, which use 234- and 180-in. pipe lengths. These lengths were determined to place the top of the waste package at the proper depth for radiation attenuation. For the bottom end closure, the two larger-diameter drywells have a flanged head pipe fitting; the smaller drywells are fitted with an elliptical end cap. The concentric reducer serves two functions: (1) it provides a seating surface for the shield plug, and (2) it provides an enlarged opening at the mouth of the drywell, which reduces the accuracy necessary for alignment of the transfer shield during canister installation.

Drywells designed for either spent fuel canister or HLW canister storage are equipped with a surface-mounted thermocouple tube. The tube is stainless steel and is held to the liner by three clips, which are spot-welded to the liner. The tube extends from near the bottom of the liner, and is routed to a thermocouple connection.

(2) Shield Plug

A metal shield plug is part of the drywell design (see Drawings H-3-55042 and H-3-55043). It is provided to attenuate radiation to the ground surface to 10 mRem/hr. The lower end of the plug is tapered to match the contour of the pipe reducer. The upper portion has vertical sides, which fit into the larger-diameter portion of the drywell liner. Four vertical slots have been machined into the tapered portion of the shield plug to allow gas circulation between the annulus (between the canister and liner) and the space between the shield plug and cover. Clearances between the plug and liner and the step created by the reducer attenuate radiation streaming. Atop the shield plug is a threaded lifting pintle, whose configuration matches that of the container inside the drywell. The threaded connection allows different pintles to be installed on the shield plug. The shield plug and container pintles are matched so that the grapple in the transfer shield can be used for both without requiring grapple changeout.

The shield plug materials vary for the different wastes contained in the drywell. For the spent fuel and HLW, the shield plugs are of cast iron. The cast iron provides attenuation for both gammas and neutrons. For the nonfuel-bearing components, West Valley HLW, and RHTRU, the shield plugs are of carbon steel because the radiation is predominantly gamma.

Table 3-5 - Drywell Dimensions and Contents

Liner Diameter (in.)	Liner Length (in.)	Contents	Container OD (in.)	Container Length (in.)
16.0	247.0	Spent-fuel canister	12.75	192.0
18.0	235.88	HLW canister	12.75	180.0
	181.88	HLW canister	12.75	120.0
30.0	247.	Nonfuel-bearing components		
		Drum or RHTRU drum (five per package)	28.50	186.5
		West Valley HLW canister	24.00	120.0
		RHTRU canister	24.00	180.0
36.0	247.0	HLW canister	30.00	
		Overpacked 55-gal drum (five per package)	31.50	202.5

The metal shield plug was chosen instead of a concrete shield plug for its cost effectiveness. The reasons for its choice are:

(a) Plugs can be cast into the desired configuration (steel or cast iron) with the appropriate taper.

(b) No additional fabrication (machining, welding, etc.) is needed beyond drilling and tapping the hole for the pintle.

(c) A concrete plug requires at least 34 in. of concrete (longer liner is needed) for comparable radiation attenuation.

(d) A fabricated steel shell (machined, welded, and inspected) is needed for the outside of any concrete shield plug.

(3) Covers

Seal-welded to the liner top flange is a circular steel cover plate (see Drawings H-3-55044 and H-3-55052). The cover-plate thickness was chosen to sustain the load imposed by a wheel of the transfer shield transport vehicle. A 6-in. length of 6-in.-dia pipe is welded to the underside of the cover, and closed at the bottom by a circular plate. Inside this pipe is an assembly of compression fittings, which are used to collect samples of drywell interior gas into a vacuum bottle. Access to this sampling port is through a smaller lid that is bolted to the upper side of the cover plate.

A temporary cover (see Drawing H-3-55047) is provided to keep debris from collecting on the liner flange and falling inside the drywell; it is designed to remain in place until a waste canister is installed in the drywell. The temporary cover is a circular plate, with the same thickness as the cover plate to withstand transporter tire loads. Welded to the circumference of the plate is a thin steel strip, which forms a lip and serves to position the cover properly. A neoprene gasket is glued to the underside to prevent damage to the liner flange.

(4) Liner Handling Fixture

One additional piece of equipment associated with the drywell is the liner handling fixture. The fixture (see Drawing H-3-55051) is a cover that clamps to the liner flange. Attached lifting eyes provide a means for handling the drywell liner. Once the drywell is lowered into the hole, leveling bolts on the handling fixture, which bear against the concrete pad, are used to plumb the drywell. This device is replaced by the temporary cover once the grout has hardened and the position of the drywell is fixed.

2. Storage Site and Corrosion Considerations. Site selection for a drywell storage facility can have an effect on drywell and storage facility design. The geology and hydrology of the site must be factored into the design of

the drywell because its performance is dependent on the soil properties for both decay heat dissipation and radiation shielding. Inherent flexibilities in the drywell design can be used to adapt the concept to a wide variety of properties. Drywell liner design and evaluations have to address the potential corrosive effects of the soil material and moisture on the drywell liner. Therefore, characterization of the soil material is necessary for the drywell system to determine such properties as thermal conductivity, density, and any corrosive effects on the liner material. The maximum fuel cladding temperatures or temperatures of various waste forms or canisters for the drywell storage system can be adjusted by varying th pacing between drywells. The relative spacing is dependent on the therm conductivity of the soil and the waste-form decay heat levels. This modification to drywell spacing affects the size of the storage facility by increasing total land usage, but has little impact on the individual drywell design.

A conceptual assessment of the impact of drywell radiation and heat on soils and grout has been completed, and is presented in the Design Studies Volume. The assessment defines some of the changes that could be expected for certain types of soils. In addition, some of the soil characteristics that would have to be examined at a potential drywell storage facility site are defined. The specific impacts of drywell radiation and heat on MRS Facility soils would have to be developed for a specific site, and factored into the drywell design.

Methods of corrosion protection for the drywell liners have been assessed and are presented in the Design Studies Volume. For the MRS Facility conceptual design, corrosion protection for the drywells includes a zinc-based primer applied to the exterior surfaces of the drywell liner, the grout layer around the liner, and a cathodic-protection system. Without specific soil constituents and characteristics of the MRS Facility site soil, no information can be generated on the needed liner thickness to serve as a corrosion barrier. A cathodic-protection system, using an impressed current rather than a sacrificial anode, is recommended for the drywell liners to meet the 100-yr design life specified. Further information on this type of cathodic-protection system is presented in the Design Studies Volume.

3. <u>Thermal Analysis Results</u>. Analyses have been performed to predict drywell thermal performance considering spent fuel and HLW. The analysis considered key variables (drywell spacing, soil thermal conductivity, and waste-form heat generation) for the purpose of identifying values of those parameters that would result in satisfactory drywell performance. Thermally, the performance of a drywell is measured in terms of its ability to maintain key waste package temperatures at values below specified limits. Details of the thermal analyses are described in the Design Studies Volume.

The drywell spacings for spent fuel and for HLW, defined in Table 3-6, were based on maintaining peak fuel rod temperatures (for spent fuel) and peak HLW canister temperature below 375°C. Studies were performed to determine the effect of the one soil thermal-conductivity value of 1.2 w/m^{o}K for the preferred site on drywell spacing and the emplaced decay heat loads. The results are summarized below.

Table 3-6 - Drywell Spacing

Drywell Size (in. dia)	Waste Type	Drywell Spacing (ft-in.)
16.0	Spent-fuel canisters	16-0 x 16-0
18.0	HLW canisters	20-0 x 20-0
30.0	Nonfuel-bearing component drums, West Valley HLW canisters, RHTRU canisters or drums	10-0 x 5-6
36.0	Overpacked drums	10-0 x 5-6
36.0	HLW canisters	40-0 x 40-0

(1) Spent Fuel

Consolidated 33,000-MWD/MTU burnup, 10-yr-old PWR spent fuel can be stored in drywells spaced 16 ft apart at the preferred site. For the higher-burnup or shorter-decay-period PWR spent fuel, only intact spent-fuel storage is possible. Calculations were made for consolidated 33,000-MWD/MTU burnup, 5-yr-old fuel and consolidated 55,000-MWD/MTU burnup, 10-yr-old fuel in drywells spaced 35 ft apart (thermally isolated from each other); in this case, spent-fuel rod cladding temperature exceeded the 375°C limit.

(2) High-Level Waste

For the preferred storage site soil thermal conductivity, drywell thermal analysis results for the three HLW canister designs were used to define the minimum drywell spacings and either the reference or maximum decay heat loadings, which were found to meet the 375°C canister surface temperature limit. The results are presented in Table 3-7. For the reference, 1-ft-dia by 10-ft-long HLW canister to meet the 375°C canister temperature limit, the canister was raised as close as possible to the ground surface (consistent with shielding needs) and the liner wall thickness was increased from 0.5 to 1.156 in., both to enhance axial heat transfer through the liner.

4. Radiation Analysis Results. Radiation analyses have been performed for the drywells and transfer shield designs for the different waste containers. Details of the methods and input data are described in the Design Studies Volume. The results are briefly presented in this section. The radiation analysis dose-rate calculations for the top of the drywell cover are summarized in Table 3-8. The dose rates presented do not represent the maximum ground surface doses calculated. The maximum doses calculated are less than 10 mRem/hr at any point on the ground surface. The shield plug thickness, its depth, and the depth of the waste canister all have an effect on the dose rates at different points on the ground surface. For the conceptual design, it was determined that the calculations performed were sufficient to verify the concept and to provide sufficient shielding.

Hand calculations were performed to size the gamma and neutron layer thicknesses for the transfer shield configurations already described. In addition, calculations were made to determine the radiation levels around the drywell during canister emplacement. These calculations show that radiation levels at 6 ft from the drywell are less than 50 mRem/hr during canister emplacement.

3.5.4.C. Equipment Descriptions

1. Introduction. This section describes the major pieces of equipment used for drywell operations. Additional details of the standard features for this equipment are provided in the outline specification for each.

Table 3-7 - Results of HLW Drywell Thermal Analyses

Canister (dia x length, ft)	Total Decay Heat (W)	Heat Generation Rate (W/cm^3)	Minimum Drywell Spacing (ft)
1 x 10	2,200[a]	0.01055[a]	20
1 x 15	3,300[a]	0.01055[a]	40[b]
2.5 x 15	5,348	0.00295	40[b]

[a]Represents the reference decay heat values identified in the Functional Design Criteria.

[b]A 40-ft spacing represents a field of essentially thermally isolated drywells; i.e., increases in spacing will not result in any increase in total acceptable decay heat.

Table 3-8 - Drywell Cover Dose Rate Calculations

Drywell Size (in.)	Contents	Dose at Top of Cover (mRem/hr)
16	Consolidated spent fuel (33-10)	3.4
	Intact spent fuel (33-5)	6.3
	Intact spent fuel (55-10)	7.3
18	HLW	5.1
30	Nonfuel-bearing components	3.0

2. <u>Canister Transfer System Equipment</u>. The transfer system employed to transport the radioactive waste containers from the R&H Building to the storage facility drywells consists of a top-loading/bottom-unloading transfer shield mounted on a transport vehicle.

(1) <u>Transfer Shields</u>

The transfer shield (see Drawing H-3-55037) consists of a cylindrical shield with upper and lower shield door assemblies, grapple, hoist mechanism, shield plug drawer, and control system. There are four versions of the transfer shield, each designed to accommodate a different waste container.

The drywell transfer shield is a long cylinder with composite walls consisting of several concentric layers of shielding and structural materials. The inside diameter of transfer shield is sized to accommodate the waste packages to be handled. For the spent fuel and HLW, the shield inside diameter is 15.50 in. For the 24-in.-dia drums, canisters, and overpacks for these packages, and for the 30-in.-dia HLW, the shield inside diameter is 36 in. Surrounding this inner liner is a layer of lead for gamma radiation attenuation. The thickness of this layer varies from 7 in. for the spent fuel to 8.6 in. for the drums of nonfuel-bearing components. Surrounding the lead is the shield structural pipe section (1 in. thick), which is designed to maintain shield integrity and to transmit all loads from the hoist. The transfer shields for spent fuel and HLW have an additional layer of neutron-absorbing material (Bisco NS-3). This layer is surrounded by a thin steel shell. The thicknesses of the four transfer shield designs were based on limiting the transfer shield surface dose rate to 50 mRem/hr.

The upper end of the transfer shield is designed to interface with the discharge port of the R&H Building hot cell so that the waste canister may be loaded from the hot cell into the transfer shield. The lower end of the transfer shield is configured to mate with the mouth of the storage drywell so that the waste canister can be transferred from the transfer shield into the drywell. The transfer shield is equipped with two gates and a shield-plug installation drawer. The two gates are designed to provide shielding during transport of the canisters and during canister loading and unloading. The upper gate is fitted with a winch, sheaves, and the waste canister grapple. The lower gate supports the canister during transport. The space between the gates is sufficient to accommodate the longest waste canister to be transported. Located below the lower gate is the shield-plug installation drawer, where the plug is carried before its installation into the drywell. Shielding is provided around the shield-plug installation drawer by a cast-iron block with sufficient thickness to provide radiation attenuation comparable to that of the cylindrical section of the shield.

The two shield gates and the shield plug drawer are moved in and out by electric-motor-driven ball-screws. The winch and grapple are also electrically operated. All five of these items have mechanical override capabilities so that, in case of loss of electric power, the shield can be operated into a "safe" configuration. The two gates and the drawer have position-indication devices to indicate when they have reached their full-in and full-out positions. The hoist has a load readout indicator and a cable runout indicator to show whether the waste package load is supported by the grapple and the location of the grapple. The grapple has indicators for the following conditions: latched, unlatched, and contact with the canister or shield plug pintle. The electric and drive components and the position/load sensors mounted on the shield are enclosed in weatherproof enclosures. The grapple, cable, and winch are designed with operation interlocks for fail-safe operation and to criteria for lifting nuclear containers. The control system, with the aforementioned readout indicators, is included in a single panel, mounted in the cab of the transport vehicles.

(2) Transport Vehicle

The transport vehicle (see Drawing H-3-55036) for the transfer shields is a specially designed version of a commercially available, side-mounted, forklift truck. The transfer shield is bolted to the forks and to the upper portion of the mast. The mast provides a 30-in. vertical travel and a lateral tilt capability. The transporter and transfer shield loads are shared by six tires with footprint sizes sufficient to spread the load to the roadways. The transporter has a 27-ft turning radius and a maximum speed of 10 mph.

For ALARA considerations, shielding has been added to the top surface of the cab and to the backside of the cab to limit operator doses to 2 mRem/hr. The shield consists of a layer of lead and Bisco NS-3, with carbon-steel plates surrounding and between these materials.

3. Cover Welding Equipment. The cover welding equipment consists of a handling fixture, a welder torch assembly, and a power supply and control unit.

The handling fixture is designed to be compatible with each of the drywell covers. The handling fixture is attached to the drywell cover, using the three lifting eyes welded to the cover. These eyes provide positioning between the portion of the handling fixture that interfaces with the welder torch assembly and the cover perimeter. A circular track is provided around the outside of the handling fixture, which allows the welder torch assembly to accurately track around the cover plate.

The welder torch assembly consists of a standard welding torch and the necessary motors and controls to allow the torch to be moved around the perimeter of the handling fixture, and to move the torch up, down, and radially relative to the handling fixture. Attached to the torch assembly are the necessary gas, cooling, electrical, and control cables needed to allow operation and control from the power supply and control unit.

The power supply and control unit is a commercially available unit, with the necessary parameter controls and functions to allow welding operation and parameter recording. The power supply and control unit would be located on the drywell cover handling vehicle.

3.6 PROCESS (RADWASTE TREATMENT)

Not applicable to these facilities.

3.7 MECHANICAL PROCESS

Not applicable to these facilities.

3.8 INSTRUMENTATION AND CONTROL

3.8.1 INTRODUCTION

The storage casks in the SF, HLW, and RHTRU Storage Facilities are monitored for temperature. Gas grab samples are obtained routinely and analyzed for canister integrity verification. A selected number of radiation detectors are installed to protect working personnel. Air samplers are installed in the alarm zone around the perimeter of the storage facilities to detect potential radioactivity in the airborne particulates. A CCTV system is provided for surveillance of the storage facility alarm zone.

3.8.2 CASK TEMPERATURE MONITORING

The storage casks in the SF, HLW, and RHTRU Storage Facilities are continuously and remotely monitored for temperature. Low-level voltage signals from K-type dual thermocouples installed in the low, intermediate, and upper levels of casks are hardwired to multiplexers centrally located to serve a group of 165 casks (3 inputs/cask). The multiplexers are housed in pedestal-mounted, weatherproof enclosures. They are designed to accept 500 low-voltage inputs, which are: multiplexed, converted to digital serial codes, and transmitted by shielded cables to the DCS. The cask temperature data in the DCS are logged and stored for trending.

3.8.3 GAS GRAB SAMPLING

Gas grab samples are obtained routinely from recessed, quick-disconnect sample ports in the lower portion of the casks, and are analyzed in the R&H Building analyzer room for helium, krypton 85, and other noble gases. The presence of any of these gases is an indication of loss of canister integrity.

3.8.4 RADIATION MONITORING

The first 60 casks placed on the support pad are monitored by a group of 20 temporarily installed, gamma-radiation detectors that are centrally located among each group of three casks. The signals from these detectors are transmitted via centrally located data-acquisition modules to redundant radiation monitoring system terminals located in the R&H Building and Site Services Building control rooms, respectively. These data are converted into engineering units and stored in the radiation monitoring system terminal memory. Historical records, trending plots, and alarms are derived from the stored data. The information generated and stored in the terminal may be retransmitted to the DCS or to peripheral equipment upon interrogation by the DCS or an operator, respectively. Local alarm units are installed near the radiation detectors to visually and audibly alert nearby personnel to high radiation excursions. The detectors are relocated as required to protect working personnel during cask emplacement.

3.8.5 ENVIRONMENT AIR MONITORING

Fixed-filter particulate air samplers are located in the alarm zone around the perimeter of the storage facility to collect samples of airborne particulates to be analyzed in the R&H Building analyzer room for radioactivity that might be released from the storage and processing areas of the MRS Facility.

3.8.6 CCTV SYSTEM

The perimeter security surveillance CCTV cameras are located in the alarm zone, and are equally spaced. The CCTV cameras are capable of remote operation and control from alarm monitoring stations located in the Protected Area Gatehouse and the Security Building. The CCTV viewing monitors are provided with selective switching capabilities to enable them to monitor the area surveyed by any CCTV camera. The CCTV viewing monitors are located in the primary and backup alarm monitoring stations.

3.8.7 SEISMIC MONITORING SYSTEM

The seismic monitoring system for the SF, RHTRU, and HLW Storage Facilities consists of a centrally located, mechanical, self-standing, peak-acceleration recorder. This device triaxially records the acceleration levels associated with seismic events without the need for electrical power, and is virtually maintenance-free. The sensitivity is $\pm 0.01g$ and the full-scale acceleration range is $\pm 2g$; however, 0 to 3g and 0 to 5g elements are available for higher acceleration measurements, if desired. Data reduction is accomplished by measuring the maximum displacement of the scratched record from the zero line. Multiplication of this value by the "acceleration sensitivity" factor for each axis yields the maximum acceleration in all three axes.

3.8.8 METEOROLOGICAL INSTRUMENTATION SYSTEM

The meteorological instrumentation system is a complete system for measuring wind speed, wind direction, ambient temperature, barometric pressure, relative humidity, and precipitation. Four complete sets of measuring instruments are located inside the alarm zone, one at each corner of the MRS Facility exclusion area. This system is designed to meet the requirements of 10 CFR 72.72(b)(3) to determine the effects of natural weather phenomena on the storage facilities and buildings. The weather-variable signals are collected by an intelligent communication module at each of the four locations, and transmitted to the microprocessor-controlled central station in the R&H Building control room by means of dedicated lines and modems. The central station collects the data from the remote sites, reformats, and sends the data on to the peripheral devices and the DCS. A dedicated printer and keyboard provide an operator interface to the central station terminal in the R&H Building control room.

3.8.9 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in these facilities are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

3.9 PIPING

Not applicable to these facilities.

3.10 ELECTRICAL

3.10.1 POWER SERVICE

Facility power is obtained from a double-ended, double-fed unit substation, with one normal 4.16 kV feeder and one standby 4.16 kV, located in a pre-fabricated powerhouse adjacent to the facility gate station. The substation transforms the 4.16-kV primary distribution voltage to a 480Y/ 277-volt, 3-phase, 4-wire system for distribution to the storage area lighting, patrol road lighting, and other power and lighting loads.

The substation is designed to operate selectively from normal power and standby power system sources. In case of failure of the normal power feeder, the normal power load is disconnected and only the security fence lighting remains connected to the standby power system. The transfer system is automatic and restores service to the HID luminaires of the security fence lighting system.

Dry-type, 480-208Y/120-volt, 3-phase transformers are provided for receptacles and instrumentation throughout the area. The transformers are located at the low-voltage load centers to minimize secondary voltage drop.

All indoor electrical equipment conforms to NEMA-1 type enclosures and all outdoor electrical equipment is of weatherproof construction.

3.10.2 LIGHTING

3.10.2.A. General

All outdoor lighting is on a 480Y/277-volt, 3-phase, 4-wire supply system and is of the high-pressure sodium type. Storage facility lighting luminaires are arranged in clusters on 50-ft poles equipped with lowering devices.

Light control is by means of photocells with manual override. Lamp ballasts are of the energy-efficient, high-power-factor type.

Selected "Quartz-Halogen" fixtures are provided at gates, corners, and at intervals for the security force lighting to provide some illumination until gas-discharge lighting is at full intensity.

3.10.2.B. Illumination Levels

Illumination levels are designed for the following values at ground levels:

Patrol road = 1 ft-c maintained
Fence lighting = 1 ft-c maintained

3.10.3 GROUNDING

The storage facilities are provided with a grounding system to limit voltages caused by lightning, line surges, and equipment malfunctions and to facilitate proper overcurrent device operation in case of ground faults.

Lightning terminals, grounding conductors, and bonding plates are provided for a complete grounding system in compliance with Article 250 of the National Electrical Code.

3.10.4 COMMUNICATIONS

Telephone station equipment is located in the area gate station and is connected to the MRS Facility EPABX main switch located at the Site Services Building.

3.10.5 INSTRUMENTATION

For instrumentation monitoring, an underground, concrete-encased, rigid conduit system is provided. Hand- and manholes are used to facilitate instrumentation installation and maintenance requirements. Electric power is provided to all multiplexer stations at 120 volts, single phase, 60 Hz.

3.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

Not applicable to these facilities.

3.12 FIRE PROTECTION

Not applicable to these facilities.

SECTION 4

CHTRU FACILITY

4.1 INTRODUCTION

The base case MRS Facility is capable of receiving, storing, and shipping onsite-generated, contact-handled transuranic wastes (CHTRU).

4.2 CIVIL AND SITE DEVELOPMENT

4.2.1. GENERAL

The CHTRU Facility is located in the protected area east of the R&H Building. The CHTRU Facility is sized to acommodate all CHTRU wastes generated onsite while processing the first 15,000 MTU of spent fuel. Additional space is allocated to the east for incremental additions to the CHTRU Facility.

4.2.2 ACCESS

Access is provided to the CHTRU Facility via the transport vehicle road that runs east from the back of the R&H Building. Both this road and the gravel surfacing around the storage area are designed for the trucks and cranes that are used in the storing of CHTRU.

4.2.3 DRAINAGE

Finish grade adjacent to the CHTRU Facility is sloped so as to direct rainwater away from the facility. Site drainage is designed to direct overland flow away from this facility.

4.2.4 LANDSCAPING

No landscaping is provided for this facility.

4.3 STRUCTURAL

The CHTRU Facility is an underground box structure containing twenty-four 8-ft-8-in. square compartments, approximately 17 ft deep, formed by 8-in., concrete block interior walls and 12-in., concrete block exterior walls. The roof consists of removable concrete plugs of sufficient weight to prevent removal during a tornado. Each compartment has one plug, sump, and drain. The foundation consists of continuous wall footings and a slab-on-grade floor. The entire facility is designed as a Category I structure.

4.4 ARCHITECTURAL

Not applicable to this facility.

4.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

The onsite-generated CHTRU waste drums are palletized, four to a pallet, in the R&H Building, and transported to the CHTRU Facility on a 2-ton, flatbed truck. Each pallet weighs approximately 4,000 lb. Pallets are unloaded from the truck, and lowered into CHTRU storage well cells by use of a crawler-mounted, 40-ton crane. After 20 pallets (80 drums) have been lowered into a cell, the cell is sealed with concrete plugs weighing 30 tons each.

4.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

4.7 MECHANICAL PROCESS

The CHTRU Facility drain system collects drainage from the storage cells. Container leakage and water seepage into the cells is collected by the gravity-drain system and conveyed to the CHTRU collection sumps. This liquid is not normally contaminated. The function of the system is to monitor the liquid level and examine the waste for possible contamination. Noncontaminated liquid is removed by vacuum truck for disposal. Contaminated waste is moved by vacuum truck to the R&H Building for treatment in the liquid radwaste system.

The amount of CHTRU drainage expected is negligible.

4.8 INSTRUMENTATION AND CONTROL

The CHTRU Facility is designed for maintaining radiation exposures of operating personnel to ALARA levels. Each compartment of the compartmented storage enclosures is individually accessible for adding or removing multi-drum pallets, and is equipped with provisions for manually sampling the air and monitoring the interior for temperature and radiation level.

The temperatures of the multidrum enclosures are measured manually by means of access ports through the tops of the enclosures. Air samples are also taken through these same ports. Portable instruments are used to measure temperature and radiation. The discrete air samples are analyzed by the analytical laboratory.

Each of the two main storage facility sumps contains a fixed beta/gamma monitor and a level meter for monitoring the sump liquid. Both of these variables are indicated, recorded, and alarmed by the DCS in the R&H Building control room.

Noncontaminated liquid is removed by a vacuum truck for disposal. Liquids containing radioactivity are moved by a vacuum truck to the R&H Building for treatment in the liquid radwaste system.

A 3-axis, strong-motion accelerograph monitors for earthquakes in the CHTRU Facility area. This unit has three independent force-balance accelerometers, which are self-contained to record accelerations up to ± 1 g. Typically, the accelerograph remains on standby until an earthquake occurs, and then actuates to full operation within 100 ms. Because magnetic-tape FM recording is used, rapid and accurate electronic digitization and conversion to computer-compatible tape are possible by using the seismic tape playback system in the R&H Building control room. A self-contained, 2-axis acceleration trigger initiates operation of the system.

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this facility are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

4.9 PIPING

4.9.1 PLUMBING

Not applicable to this facility.

4.9.2 PIPING

The piping system is designed to withstand the loads for the Category I structure.

A drain is provided in each compartment of the facility. The drain effluent is collected and piped to sumps. The drainage piping is double contained (liquid waste line inside a secondary encasing line) in compliance with the requirements of 10 CFR 72, Subpart F.

The piping system is designed to use corrosion-resistant materials and is butt-welded. Flanges are provided only at equipment as required for servicing.

The encasement line is provided with a liquid detector to monitor for a leak in the liquid radwaste pipeline.

All welding is in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code, as modified by ANSI B31.1, in compliance with 10 CFR 72, Subpart G.

The complete installation is in compliance with ANSI B31.1.

4.10 ELECTRICAL

Not applicable to this facility.

4.11 HVAC

Not applicable to this facility.

4.12 FIRE PROTECTION

Not applicable to this facility.

SECTION 5

ADMINISTRATION BUILDING

5.1 INTRODUCTION

The Administration Building is designed to accommodate such functions as accountability, plant management, plant operations, finance and administration, health and safety, quality assurance, personnel, and public relations. Other support facilities (such as lunch, conference, multipurpose and copy machine rooms, restrooms, custodial, mail, and storage facilities) are also provided. This building is constructed of noncombustible materials. All building fixtures and furniture are included.

5.2 CIVIL AND SITE DEVELOPMENT

5.2.1 PARKING

Parking for employees working in the Administration Building is provided outside the Main Gate/Badgehouse. Parking is also provided adjacent to the Administration Building for site vehicles serving the building.

5.2.2 LANDSCAPING

The area in front of the Administration Building is landscaped. This includes the area between the Administration Building and the employee parking lot, as well as the area between the Administration Building and the Main Gate/Badgehouse.

5.3 STRUCTURAL

The Administration Building is constructed of reinforced concrete block walls, a steel-framed roof with a 1-1/2-in. metal roof deck, and a slab-on-grade floor. The roof is supported by bearing walls and steel columns with continuous wall footings and spread footings.

5.4 ARCHITECTURAL

5.4.1 GENERAL

The Administration Building is a separate, single-story structure, 242 ft long, of variable width, with a floor area of approximately 19,000 sq ft. It is designed to house offices, a conference room, a computer room, a lunchroom, a multipurpose room, support facilities, and building services.

1. Office Area. The office area is designed to house operations, management, and support personnel. The personnel occupancy for a single day shift is subdivided by function, as follows:

Assignment	Number of Personnel
Finance and Administration (OA)	6
Personnel	6
Public Relations (OA)	3
Accountability	4
Plant Management (OA)	8
Plant Operations (OA)	5
Data Acquisition (computer room)	5
Quality Assurance	6
Reception	1
Health/Safety (OA)	4
Contracts (OA)	3
Security	1
Subtotal Operational Personnel	52
DOE/NRC/State Representatives (OA; Nonoperational Personnel)	26
Total	78

(1) Certain separately defined office functions have an adequately sized open office area, identified above by (OA), using furniture and furnishings to define individual work stations for clerical and support personnel.

(2) In addition, at the periphery of the building, each office function has two or more private (or semiprivate) offices for managers adjacent to their respective open office areas or adjacent to the corridor. At 10 ft x 14 ft, these offices are large enough for two people should future needs require double occupancy of these rooms.

(3) A conference room sized for 10 occupants is located within the office area and is accessible from the corridor. For larger conferences, the multipurpose room may be used.

(4) Two photocopy machine alcoves with storage facilities are located at each end of the office area, adjoining the corridor.

2. Computer Room. A 20- x 30-ft computer room with access flooring is located near the middle of the office area. Doors at each end of the room allow personnel and equipment access from the double corridor. A data acquisition office and a telephone equipment room are located adjacent to the computer room, and all required components (consoles, printers, storage cabinets, etc.) are furnished (see Instrumentation).

3. Lunchroom. A 20- x 25-ft lunchroom is designed to seat a minimum of 20 persons, with a small kitchen containing food-preparation facilities. Vending machines and self-service microwave ovens are provided. The lunchroom may also serve as an additional conference room.

4. Multipurpose Room. A 30- x 20-ft multipurpose room is designed to accommodate 40 occupants. It includes a counter with a sink, a coat closet, audio-visual equipment, and a storage room for tables, chairs, and training equipment.

5. Support Functions. The following are provided in the service area of the building:

(1) Receiving and Storage: A 33- x 24-ft room with an exterior service entrance for receiving and storing goods and supplies necessary for the operations of the office areas, building services, and lunchroom; metal storage shelves around the perimeter of the room.

(2) Storage: Two separate storage rooms in the office area for office materials and stationery, forms, office machines, and other office needs.

(3) Mail Room: A room for the receipt and storage of mail delivered to the Administration Building from the central mail facility in the Site Services Building.

6. Building Services. Space is provided for the following building services, as required for the normal operation of the building:

(1) HVAC Equipment Room: A 50- x 24-ft room to contain major air-handling equipment and ductwork. An air-cooled condenser is located in the adjacent service yard outdoors.

(2) Boiler Room: A 10- x 20-ft room for a hot water boiler, pumps, tanks, and related equipment.

(3) Telephone Equipment Room: A 10- x 14-ft room for telephone and computer terminal boards and related equipment.

(4) Plumbing Equipment: Toilet rooms, janitor's closet, kitchen, vending machines, etc., are provided with hot and cold water systems.

(5) Electrical Equipment: The transformer and switchgear are located in a fenced portion of the outdoor service yard. Electrical panels are located in electrical equipment rooms at each end of the building.

7. Circulation. Adequate space is provided for visitor and personnel circulation throughout the building. All normal entrances and exits are provided with vestibules for weather protection. A lobby is provided at the main entrance and is furnished with a reception counter, waiting area, and a display area with an adjacent storage room. The lobby entrance into the main

corridor provides access, controlled by the receptionist, to functions throughout the building, as well as to emergency exits. In the office area, the corridor is looped, providing greater flexibility and access to office functions.

5.4.2 MATERIALS OF CONSTRUCTION

The Administration Building is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story structure with reinforced masonry exterior bearing wall and steel-framed roof, composed of two main exterior elements:

- Split-face concrete block wall and insulated, tinted window elements protected by vertical sun-control fins.

- A panelized metal facia and soffit at the roof structure to provide solar control as climatic conditions require.

(2) All exterior walls, roofs, and roof-ceiling assemblies are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls, except in toilets, are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

5.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1)	UBC Occupancy Class:	B-2
(2)	Ceiling heights:	9'-4" for lobby, offices, conference, lunch, and multipurpose rooms 8'-0" for toilet rooms, storage rooms, corridors, janitors' closets, and other small rooms
(3)	Kind of traffic:	Foot traffic throughout the building, except for pallet trucks at the loading dock, Receiving and Storage Area

(4) Size of access openings:

6'-0" x 7'-0" personnel
3'-6" x 7'-0" personnel
3'-0" x 7'-0" personnel
8'-0" x 9'-4" service
14'-0" x 9'-4" service

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Lobby, offices, office corridor, conference, and multipurpose room	Carpet	Rubber cove	Gypsum board	Suspended acoustic tile
Computer room	Access flooring	Rubber cove	Acoustic tile on gypsum board	Suspended acoustic tile
Toilets	Ceramic tile	Ceramic tile	Ceramic tile	Suspended gypsum board
Lunchroom, service corridor, kitchen, and vending	Vinyl tile	Rubber cove	Vinyl-covered gypsum board	Suspended acoustic tile
Receiving and Storage, mechanical equipment	Concrete	Rubber cove	Gypsum board	Exposed structure

(6) Special equipment:

Lobby, offices, and conference room:	Desks, chairs, credenzas, bookcases, file cabinets, tables
Toilets:	Metal toilet partitions Toilet accessories Mirrors
Lunchroom:	Vending machines Microwave oven Cooktop with exhaust hood and oven Refrigerator/freezers Tables, chairs

Training room:	Audio-visual equipment Training equipment Tables, chairs
Photocopy alcoves:	Photocopy machines Storage and equipment
Receiving and Handling, storage:	Metal storage shelves Desk, chair, file cabinet

5.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this building.

5.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

5.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided from the compressor system located in the Security Building.

The hot water boiler system requires supply of fuel oil, natural gas (if available), and process water.

The fuel-oil system consists of a day tank and a supply pump supplying No. 2 diesel oil to the boiler at a winter peak rate of 7.7 gph and 30 psig. Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 1,080 scfh.

Process water is used for makeup water to the boiler and is continuously supplied at the winter peak rate of 0.7 gpm.

Potable water is used for fire protection, drinking, and restrooms.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily-sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. They are collected by gravity flow to a collection tank located near the Security Building at the drainage flow rate of 3.5 gpm.

5.8 INSTRUMENTATION AND CONTROL

5.8.1 GENERAL-PURPOSE COMPUTER

The general-purpose computer system is provided in the Administration Building computer room, and is used by staff personnel for payroll, accounting, purchasing, personnel, inventory control, maintenance control, accountability, scheduling, utilities, and other business functions, as required.

All of the computer system mainframe components, and two operator consoles, each with CRT and keyboard, two keyed send/receive (KSR) printers, and one line printer are provided in the computer room.

5.8.2 DISTRIBUTED CONTROL SYSTEM

A distributed control system (DCS) remote terminal (with CRT, keyboard, KSR line printer, video copier, and modems) is provided in the Administration Building computer room for callup and printout of accountability, process, alarm-monitoring, and utilties monitoring data stored in the DCS in the R&H Building control room (or the backup DCS in the Site Services Building).

5.8.3 UTILITY SYSTEMS

All utility systems in the Administration Building are remotely monitored, and capable of being remotely controlled.

The hot water boiler is monitored remotely and locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, along with a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler, are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel oil supply day tank (TK-503) contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning on and off the transfer pump by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel oil supply pumps are controlled from the boiler control panel. Only status light signals are transmitted to the DCS, as shown on Drawing H-3-56923, Administration Building, Hot Water Boiler.

5.8.4 SECURITY AND FIRE ALARMS

All fire alarms in the Administration Building are monitored by the fire alarm monitoring system in the Fire Station, and transmitted to the Alarm Monitoring Station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

5.8.5 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

5.9 PIPING

5.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

A floor drain is provided in the recessed floor of the computer room, and is connected to the sanitary sewer.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

The dishwasher is provided with an electric booster to obtain the required 180°F water.

Hot and cold water piping is insulated.

Plumbing fixtures meet requirements for the physically handicapped.

Piping runs are concealed in ceilings, walls, and furred spaces in the office area and are exposed in the boiler room and HVAC equipment room.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

5.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas, if applicable, are connected to the MRS Facility distribution system. Fuel-oil and fuel-gas usage for the building are metered.

Equipment and funnel drains are provided in the boiler room and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC equipment drains are provided and connected to the MRS Facility process sewer system.

Process water for heating system makeup is provided at 100 psig from the potable water supply to the building. A reduced-pressure principal backflow preventer is installed to prevent any possiblity of contaminating potable water.

Plant air and instrument air are supplied from the Security Building air systems.

Plant air utility stations for air-tool use are provided in the boiler room and HVAC equipment room.

Instrument air is provided in the boiler room and HVAC equipment room.

Piping runs are exposed in the boiler room and HVAC equipment room.

The complete installation is in compliance with ANSI B31.1.

5.10 ELECTRICAL

5.10.1 POWER SERVICE

Building power is provided by a single, dry-type, outdoor pad-mounted transformer that transforms the primary voltage to 480Y/277 volts for all power and lighting loads, including service to the Main Gate/Badgehouse. The entire distribution system is coordinated for selective fault protection. Electrical equipment and installations indoors are general-purpose types in NEMA 1 enclosures. Fixtures and installations outdoors are of weatherproof construction.

Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels are used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size.

5.10.2 LIGHTING

5.10.2.A. General

In general, 277 volts are used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent lighting fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in areas where continuous work is to be performed, such as offices, control rooms, and corridors. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps.

Fluorescent fixtures in mechanical and electrical rooms are of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID lighting fixtures are used on the exterior of the building. Ballasts with integral fuses are used with all HID light fixtures.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are on time-switch control, with a manual override capability.

Incandescent fixtures are provided in small rooms and in areas that will be used intermittently, such as janitors' closets.

5.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system automatically switches to emergency power upon loss of normal power, and consists of individual battery-operated emergency units with 120-volt ac output. Emergency power is supplied to selected lights at stairways, corridors, computer room, and other specified areas.

The batteries have a capacity for 90 minutes of continuous operation. Emergency lighting circuits are panel-switched with a handle-locking device. All wiring of the emergency lighting system is to conform to the applicable requirements of Article 700 of the NEC.

5.10.2.C. Outdoor Floodlighting and Area Lighting

General-purpose street and area lighting for ramps, parking areas, and lighting in outdoor and night operational areas are of the HID type. Lighting is photoelectric relay-controlled, with manual switch override. Outdoor floodlighting is provided for ramps and entrance areas.

5.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be needed for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5.10.2.E. Exit Lighting

The entire exit lighting system is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided for all emergency exits and passageways as required by the NFPA Life Safety Code - No. 101. The electrical power source for the exit lighting system is connected to the normal power source.

Only one switch and overcurrent device are installed in the supply circuit for exit lighting.

Exit lights and signs are combined in an internally illuminated fixture, with translucent globe or letters, as approved by Underwriters' Laboratories, Inc.

5.10.3 COMMUNICATIONS

5.10.3.A. Public Address System

A public address system is installed in the Administration Building for paging. The system is provided with two paging zones and operates as follows:

(1) Zone 1: All calls; this zone covers all areas of the Administration Building.

(2) Zone 2: This zone initiates from the Site Services Building and overrides Zone 1 for priority calls.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all large paging areas.

The public address system employs the latest solid-state devices with all speaker cables installed in a conduit. The master station is located in the main lobby.

5.10.3.B. Fire Alarm and Detection System

An electrically supervised, noncoded, building fire alarm system is provided. The system includes a fire alarm control panel, smoke detectors, fire sensors, manual fire alarm stations, annunciator panel, standby battery connections to the sprinkler system, local audible alarm, and a municipal master box to transmit building identification code to the MRS Fire Station and Security Building. The annunciator panel is located in the lobby area. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA 101 Life Safety Code.

5.10.3.C. Telephone System

A telephone terminal board (consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances) is installed in the telephone equipment room for termination of all station cables for this building. A separate, 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided in all offices, computer room, reception and receiving, and storage room.

All telephone cables are installed in a conduit.

5.11 HVAC

5.11.1 SYSTEM OPERATION

The Administration Building is provided with a double-duct, variable-volume system. This system incorporates an economizer cycle and conventional (pneumatic/electric) automatic and local manual controls.

Upon system startup, the supply and return/exhaust fans energize and the minimum outside airflow damper opens to maintain year-around ventilation requirements. Economizer controls modulate outside air and return air dampers to provide a mixed air temperature at a preset point. During favorable outside conditions, up to 100% outside air is used for free cooling. During low outside temperature or in the summer season, minimum outside air is admitted to conserve both heating and cooling energy.

Each temperature zone is provided with a zone thermostat that modulates the hot and cold air volumes of the supply air terminal box located in the zone supply air duct. In the computer room, air is supplied overhead and below the raised floor from a single thermostat and terminal box. The variable/constant-volume-type terminal box consists of two actuators responding to a single signal from the zone thermostat. One actuator controls the air volume output; the other actuator controls the proportional flow of hot and cold air. As the space cooling load decreases from the design level, less cold air is required. Cold air volume drops accordingly. The terminal box continues to modulate cold air flow down to a minimum set value if the load continues to fall. At this point, the cold air valve on the terminal box begins to close and the hot air valve opens to a point at which the higher supply air temperature handles the new load condition. When the cooling load increases, the control sequence is reversed.

On the heating cycle (or lower cooling requirements), as the variable air valves throttle the zone airflow rates, the pressure in the supply duct increases. In turn, the inlet vanes on the supply fan decrease the supply air flow to match the action of the valves. The decrease in supply air is monitored and the information is transmitted to a flow control system. This system, in turn, monitors and controls the flow through the return and exhaust fan. This provides the constant differential flow rate necessary to maintain building pressurization and provide the necessary intake of outside air to balance the air lost through the various exhaust fans.

Smoke detectors, located in the main supply and return air ducts, shut down the HVAC system if there is a fire. A capability is provided to manually place the system in a 100% exhaust mode for smoke purging.

The dual-duct, variable-air-volume system provides flexibility of zone control, air source for both heating and cooling at all times, and effective energy use because of the elimination of simultaneous heating and cooling.

Provisions to recover heat from exhaust air were not made because only a minimum of outside air is brought into the building to offset exhaust and pressurization requirements.

5.11.2 EQUIPMENT

Equipment includes the following:

(1) Air-handling unit (blow-through type), including filter box, direct-expansion cooling coil, hot water heating coil, and supply fan with variable inlet vane.

(2) Return/exhaust fan with variable inlet vane.

(3) Air-cooled condensing unit with refrigerant piping and controls.

(4) Variable/constant-volume-type terminal boxes.

(5) Economizer cycle control dampers.

(6) Hot water unit heater.

(7) Hot water boiler and associated controls.

(8) Hot water pumps.

(9) Exhaust fans and gravity relief vents.

(10) Zone room thermostats, dampers, and associated controls.

5.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Administration Building. This system is fed from the MRS Facility water-distribution grid. It is designed in accordance with NFPA 13 and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm and an electric alarm and supervisory signal to the main fire protection annunciator.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system for the Administration Building. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 6

SECURITY BUILDING

6.1 INTRODUCTION

The Security Building provides facilities for the safeguards and security functions, including the secondary alarm monitoring station (AMS), which is housed in a hardened, bullet-resistant area.

6.2. CIVIL AND SITE DEVELOPMENT

6.2.1 PARKING

Parking for employees working in the Security Building is provided outside the Main Gate/Badgehouse. In addition to the parking enclosure directly adjoining the Security Building, parking for security vehicles is provided adjacent to the Security Building. This parking lot also serves the Fire Station.

6.2.2 LANDSCAPING

Landscaping is provided around the entrance to the Security Building.

6.3 STRUCTURAL

The Security Building is a two-level structure, constructed of reinforced concrete block, concrete walls, a steel-framed roof with 1-1/2-in. metal roof deck, a slab-on-grade floor, and a structural slab floor over the basement. The hardened areas have reinforced concrete floors, roof, and walls. Roofs are supported by bearing walls. Floors over the basement are supported by bearing walls, concrete beams, and columns with continuous wall footings and spread footings. The mechanical and electrical equipment rooms are in a hardened, bullet-resistant area, enclosed by 8-in. concrete walls, 10-in. concrete roof, and floor. The weapons storage vault is also enclosed in a hardened structure. The AMS, UPS, and control equipment room are located in the hardened basement structure.

6.4 ARCHITECTURAL

6.4.1 GENERAL

The Security Building has a separate two-level (ground level and lower level) rectangular plan, 68 x 108 ft, and a total floor area of approximately 9,100 sq ft (excluding enclosed parking). It is located near the Administration Building, and serves as the security headquarters for the MRS Facility. Security surveillance is provided throughout the site, using Control Alarm and Remote Surveillance Systems, which are also found in the Protected Area Gatehouse. Security clearance and badging operations are provided in the Main Gate/Badgehouse, as described in Section 7.4.

(1) The Security Building is normally occupied by eight security personnel during the day shift and three during the other shifts. Eleven additional Security/Patrol Officers serve at various locations throughout the site during the day shift and nine during the other shifts. These personnel report to headquarters in the Security Building.

The 24-hr security force is organized into four shifts, with a fifth shift coinciding with the day shift to provide additional personnel, as needed.

Assignment	Number of Personnel by Shift: Day	2nd	3rd	4th	Total
Captain	1		-		1
Lieutenant	1	1	1	1	4
Security/Patrol Officers	(10[a])	(10[a])	(10[a])	(10[a])	-
AMS Monitoring Guards	2	2	2	2	8
Clerical	1	-	-	-	1
Extra Duty	5	-	-	-	5
Total	10	3	3	3	19

[a]These personnel are stationed at various other gatehouses or are on site patrol. They report to security headquarters in the Security Building.

The Captain, Shift Lieutenant, secretary, clerk, and Alarm Monitoring Station (AMS) guards occupy permanent stations or offices in the building; the remaining personnel occupy various work stations (such as gatehouses) throughout the site. Two Security/Patrol Officers are on moving patrol when not temporarily occupied at the Inspection Gatehouse.

(2) The Security Building has a lobby/waiting area and exercise room for personnel. Adequate restrooms, lockers, and shower facilities are provided for both men and women, who will change into duty uniforms or back into street clothes at shift changes. A multipurpose room is provided for lunches, meetings, briefings, etc.

(3) The AMS guards are assigned to a hardened AMS in the lower level, with uninterruptible power supply (UPS), a battery room, control

equipment and computer room, and HVAC and electrical equipment in a hardened area on the ground level to enable continuous operation during an emergency. A hardened weapons storage vault is also provided.

(4) Equipment within the lower-level hardened area includes the following:

- A two-way radio communication system.
- A monitoring console for CCTV cameras throughout the facility.
- Evacuation and criticality alarms.
- A security/safety console with monitoring panels that indicate alarms for fire, metal detection, intrusion detection, and other designated facility security and safety signals.
- Personnel card access-control system.
- Computer.

(5) A security patrol vehicle parking enclosure with three parking spaces is provided directly adjoining the Security Building.

6.4.2 MATERIALS OF CONSTRUCTION

The Security Building is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a two-level (ground level and lower level), reinforced masonry and reinforced concrete structure, with steel roof framing and metal panel fascias and soffits. The hardened areas have reinforced concrete floors, walls, and roof. All hardened areas are either located within the building perimeter walls or below grade (lower level) for additional protection. The design, in general, is compatible with that of the Administration Building.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) Except at hardened areas and in toilets, interior walls are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

6.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B-1

(2) Ceiling heights: 9'-4" for lobby, offices, multipurpose room, and corridors

8'-0" for toilets, lockers, showers, and storage rooms

12'-0" for mechanical and electrical equipment rooms

11'-2" for lower level battery room and UPS room

(3) Kind of traffic: Foot traffic throughout, except for pallet trucks or other lifting devices for transporting equipment to an equipment hatch in ground level mechanical equipment room; vehicular traffic in enclosed parking

(4) Size of access openings:
6'-0" x 7'-0" personnel
3'-0" x 7'-0" personnel
6'-0" x 9'-0" equipment access

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Lobby, offices, multipurpose	Vinyl tile	Rubber cove	Gypsum board; reinforced concrete at hardened areas	Suspended acoustic tile
Control alarm and remote surveillance, control equipment and computer room	Access flooring	Rubber cove	Gypsum board	Suspended acoustic tile
Toilets, lockers, and showers	Ceramic tile	Ceramic tile	Ceramic tile	Cement plaster

(6) Special equipment:

Lobby, offices:	Desks, chairs, tables, credenzas, file cabinets
Multipurpose:	Vending machines Unit kitchen Microwave oven Tables and chairs
Exercise room:	Exercise equipment
Control alarm and remote surveillance, control equipment and computer room:	Monitoring console Security/safety console
Toilets:	Metal toilet partitions Toilet accessories Mirrors Lockers - double tier Prefabricated metal shower enclosures
Photocopy alcove:	Photocopy machine
Weapons storage:	Gun racks Ammunition storage

6.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYTEMS

A crawl beam, located in the mechanical equipment room, mounting a 3-ton, hand-chain-operated hoist, is provided to move equipment located in the lower level of the building. A hatch opening in the floor of the mechanical equipment room is provided for accessing the lower level with the hoist.

6.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

6.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) is provided by a compressor system. The air system consists of a compressor, coolers, separator, filters, receiver, dryers, and associated controls and instrumentation.

The hot water boiler system requires supply of fuel oil, natural gas (if available), and process water.

The fuel-oil system consists of a day tank and a supply pump supplying No. 2 diesel oil to the boiler at a winter peak rate of 3.8 gph and 30 psig. Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 518 scfh.

Process water is used for makeup water to the boiler and is continuously supplied at the winter peak rate of 0.5 gpm.

Potable water is used for fire protection, drinking, restrooms, eyewash and safety showers.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. They are collected by gravity flow to a collection tank located near the Security Building at the drainage flow rate of 3.5 gpm.

6.8 INSTRUMENTATION AND CONTROL

6.8.1 ALARM MONITORING STATIONS

Two Alarm Monitoring Stations (AMSs) provide centralized access control, monochrome CCTV monitoring, intrusion detection, alarm monitoring, and event recording for the MRS Facility. The primary AMS is located in the Protected Area Gatehouse and the redundant AMS is located in the Security Building. With the exception of the intrusion detectors, access card readers, CCTV cameras, and other detectors, all equipment at these two locations is duplicated.

Site security is provided by a double-fenced alarm zone, 100 ft wide, around the protected and storage area perimeter. A taut-wire inner fence and buried pressure-sensitive sensors between the fences provide intrusion detection capability. Card readers and CCTV cameras, located near the R&H Building and Security Building doors, provide access control at these unmanned doors. The signals from these devices are transmitted by tamperproof and failure-indicating cables to the computerized primary and redundant (backup) AMSs.

Fixed CCTV surveillance cameras are installed nominally 328 ft (100 m) apart in the alarm zone. Redundancy is provided by installing the cameras with overlapping viewing zones. Additional pan, tilt, and zoom (PTZ) cameras are interspersed with the fixed within the alarm zone and at the protected area access gates. The PTZ cameras are used by security personnel to inspect suspicious-looking objects that were previously detected by the computerized motion-sensing system through the fixed CCTV cameras, as shown on drawing H-3-56789 (sheet 1 of 4). The monitors and switching units for the CCTV cameras are located in the AMS operating consoles. The intrusion alarms are actuated by two-out-of-three logic for reliable intrusion detection. In addition to this system, a patrol road inside the inner fence facilitates routine vehicular patrol and alarm response by security personnel. The vehicles are equipped with two-way shortwave radios for maintaining communications with the AMSs. Access to the site is controlled by manned security checkpoints at the Main Gate/Badgehouse and the Inspection Gatehouse.

6.8.2 UTILITY SYSTEMS

All utility systems in the Security Building are remotely monitored and capable of being remotely controlled.

The hot water boiler is monitored remotely as well as locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, and a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler, are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel oil supply day tank (TK-504) contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning on and off the transfer pump by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel oil supply pumps are controlled from the boiler control panel. Only status light signals are transmitted to the DCS, as shown on Drawing H-3-55156, Security Building, Hot Water Boiler.

Oil-free dried plant and instrument air is provided by a compressor backed up by a spare. The compressor is controlled locally from a vendor-furnished panel and monitored remotely for motor on-off status. The plant air is dried and the pressure is dropped to 100 psig and monitored remotely for pressure before entering the distribution header. The instrument air is dried to a dewpoint of -40°F, the pressure is reduced to 100 psig, and the air is remotely monitored for moisture content, and pressure.

6.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Security Building are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the AMS. All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

6.8.4 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

6.9 PIPING

6.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

Hot and cold water piping is insulated.

Plumbing fixtures meet requirements for the physically handicapped.

A safety shower and eyewash station, to comply with ANSI Z358.1, are provided in the battery room.

Piping runs are concealed in ceilings, walls, and furred spaces.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

6.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas, if applicable, are connected to the MRS Facility distribution system. Fuel-oil and fuel-gas usage for the building are metered.

Equipment and funnel oily drains are provided in the boiler room and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC equipment drains are provided, and are connected to the MRS Facility process sewer system.

A floor sump is provided in the battery room and is drained by using a portable pump, when necessary.

Process water for heating system makeup is provided at 100 psig from the potable water supply to the building. A reduced-pressure principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Plant air and instrument air are supplied from equipment in the Security Building.

Plant air utility stations for air-tool use are provided in the boiler room, mechanical and electrical equipment rooms, and air compressor room.

Instrument air is provided in the boiler room, mechanical and electrical equipment rooms, and mechanical equipment room.

The plant air and instrument air system provides plant and instrument air to the Administration Building and the Fire Station.

Piping runs are exposed in the boiler room, mechanical and electrical equipment rooms and air compressor room.

The complete installation is in compliance with ANSI B31.1.

6.10 ELECTRICAL

6.10.1 POWER SERVICE

Normal building power is from a single 4.16-kV primary feeder configuration system. Double-ended, dry-type, indoor, load-center-unit substations will transform the primary voltage to 480Y/277-volts for all power and lighting loads, including service to the weigh station and Fire Station. If a failure of the normal feeder occurs, power will switch to the standby feeder automatically, with minimum transfer time.

In case of a normal primary feeder failure, critical building power will be provided by a single 4.16-kV primary feeder from the standby generator system. The double-ended, dry-type, indoor load-center-unit substation will transform the primary voltage to 480Y/277 volts for critical power and lighting loads. Feeders are provided to supply the Protection Area Gatehouse and Site Services Building standby loads.

The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose types in NEMA-1 enclosures.

Dry-type, 480-208Y/120-volt, 3-phase, 4-wire transformers and circuit-breaker distribution panels are provided for convenience outlets, incandescent lighting, small loads, and motors less than 1/2 hp in size.

An uninterruptible power supply (UPS) system is provided for surveillance monitoring, fire alarms, access control computer, and essential lighting fixtures. The inverter output is 480Y/277 volts, 3 phase, connected to a UPS bus from which all UPS loads are derived. The battery bank is rated at 125 volts, with ampere-hour capacity sufficient to sustain the entire UPS load for a period of 90 minutes.

6.10.2 LIGHTING

6.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in areas where continuous work is to be performed, such as offices, control rooms, and corridors. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps.

Fluorescent fixtures in mechanical and electrical rooms are of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID lighting fixtures are used on the exterior of the building.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are of the HID type, with solar-compensated, time-switch control and manual override.

Incandescent fixtures are provided in small rooms and in areas that will be used intermittently, such as janitors' closets.

6.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during total power outage. Individual battery-operated fixtures or emergency lighting units are provided at stairways, corridors, and in the control room.

Emergency lighting circuits are panel-switched with a handle-locking device and are fed from the standby power system. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

6.10.2.C. Outdoor Floodlighting and Area Lighting

General-purpose street and area lighting for ramps and parking areas, and lighting in outdoor and night operational areas, are of the HID type. Lighting is photoelectric relay-controlled, with manual switch override.

6.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the

Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

6.10.2.E. Exit Lighting

The entire exit lighting system is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided for all emergency exits and passageways as required by the NFPA Life Safety Code - No. 101. The electrical power source for the exit lighting system is connected to the standby power supply system.

Only one switch and overcurrent device are installed in the supply circuit for exit lighting.

Exit lights and signs are combined in an internally illuminated fixture, with translucent globe or letters, as approved by Underwriters' Laboratories, Inc.

6.10.3 COMMUNICATIONS

6.10.3.A. Public Address System

A public address system is installed in the Security Building for paging. The system is provided with two paging zones, and operates as follows:

(1) Zone 1: All calls; this zone covers all areas of the Security Building.

(2) Zone 2: This zone initiates from the Site Services Building, and overrides Zone 1 for priority calls.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all large paging areas.

The public address system employs the latest solid-state devices, with all speaker cables installed in a conduit.

6.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, building fire alarm system includes a fire alarm control panel, smoke detectors, fire sensors, manual fire alarm stations, annunciator panel, connections to the sprinkler system, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station. The annunciator panel is located in the lobby area. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL listed; and is installed in accordance with the NFPA 101 Life Safety Code.

6.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in conduit.

6.10.3.D. Radio System

A fixed-base radio system is provided at the Security Building for inter-communications with security personnel and to to provide a communications link to local law-enforcement agencies.

6.10.3.E. Intrusion Alarm System

A central microprocessor is located in the Security Building to control, monitor, and scan security information relative to:

(1) Electrostatic field sensor
(2) Fence disturbance detection system
(3) Door alarms
(4) Card-key access control

All security system wiring is installed in a rigid metallic conduit system.

6.10.3.F. Intercommunications System

An intercommunications system is provided between the Security Building and card-key reader location to supplement the operation of the card access reader if it fails.

6.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Security Building is divided into two separate areas and is served by two separate systems. One system serves the nonhardened area and the other serves the hardened area.

6.11.1 NONHARDENED AREA

A single-duct, constant-volume HVAC system is provided for year-around heating and cooling requirements. The system includes the following major components:

(1) A draw-through-type air-handling unit, including filter box, direct-expansion cooling coil, hot water heating coil, and supply fan.

(2) Return/exhaust fan.

(3) Air-cooled condensing unit with refrigerant piping and controls.

(4) Hot water reheat coils

(5) Economizer cycle control dampers.

(6) Hot water unit heaters (door type).

(7) Hot water boiler and associated controls.

(8) Hot water pumps.

(9) Exhaust fans and gravity exhaust vents.

(10) Zone room thermostats, dampers, and associated controls.

Upon system startup, the supply and return/exhaust fans energize and the outside air damper opens to minimum position, which admits minimum outside air to provide year-around ventilation requirements. Economizer controls modulate outside air and return air dampers to provide a mixed air temperature at a preset point. During favorable outside conditions, up to 100% outside air is used for free cooling. When temperature is low or during the summer, minimum outside air is admitted into the system to conserve both heating and cooling energy.

During the hot season, a minimum of outside air is mixed with return air, preheated, and delivered to various rooms in the area. If additional heating is required, the zone thermostats activate the hot water valves at each reheat coil in the supply ducts in accordance with the individual requirements.

During mild ambient conditions, the economizer cycle operates for maximum possible cooling. Upon continuing rise in outside air temperature to a preset point, the outside air damper is returned to a minimum position, and the cooling system (air-cooled condensing unit) is started. During the cool season, the supply air temperature is maintained at about 55 to 60°F.

Smoke detectors, located in the main supply and return air ducts, shut down the HVAC system if there is a fire. A capability is provided to manually place the system in a 100% exhaust mode for smoke purging.

6.11.2 HARDENED AREA

A single-package, air-cooled, air-conditioning unit provides the heating and cooling requirements for this area. Major equipment includes the following:

(1) Air-conditioning unit, single package, indoor type, including supply fan, condenser fan, coil compressor, evaporator coil, hot water heating coil, and all associated piping and controls.

(2) Filter box with 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters.

(3) Exhaust fan and gravity relief vents.

(4) Room thermostat and associated controls.

A constant volume of outside air mixed with return air is filtered, heated or cooled, and delivered to the area. The entire system is located inside a hardened mechanical equipment room with the same construction integrity as the area to be served. The system is provided with standby electrical power in case of normal power failure.

The single-package, indoor-type unit was chosen to provide the HVAC system with the integrity consistant with the area to be covered. This HVAC system provides good ventilation (consistent air volume), uses simple controls, and provides effective energy use because of the elimination of simultaneous heating and cooling.

Provisions to recover heat from exhaust air or to use an economizer cycle were not made because the system is very small and the penetration through the hardened area must be kept to a minimum.

6.12 FIRE PROTECTION

Fire protection is provided throughout the Security Building. It includes an automatic wet-pipe sprinkler system, a Halon 1301 system, and portable fire extinguishers.

6.12.1 WET-PIPE SPRINKLER SYSTEM

An automatic wet-pipe sprinkler system is provided throughout the facility except in electrical equipment rooms. This system is designed in accordance with NFPA 13 and is complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls. Fire Department connections provide a secondary water supply for the installed sprinkler systems.

6.12.2 HALON 1301 SYSTEM

Areas of high value or of high program importance (e.g., computer areas/control alarm, electrical equipment rooms, and remote surveillance room) are provided with a total-flooding Halon 1301 system (with sprinklers provided as a secondary system for basic building protection). The system consists of fixed piping manifolded racks, cylinders, detectors, circuits, alarms, and controls designed to provide detection, alarm, and extinguishment of fire in accordance with NFPA 12A.

The electrical equipment rooms are protected by the Halon 1301 system only.

6.12.3 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are provided for the Security Building in accordance with NFPA 10.

SECTION 7

MAIN GATE/BADGEHOUSE

7.1 INTRODUCTION

A Main Gate/Badgenouse is provided at the main entrance to the MRS Facility. It serves as the security clearance and badging function for all visitors and employees, and as an inspection station for all nontransport vehicles, such as delivery vehicles, maintenance vehicles, and any staff or private automobiles authorized to enter the site.

7.2 CIVIL AND SITE DEVELOPMENT

7.2.1 PARKING

Parking for employees working in the Main Gate/Badgehouse is provided in the employee parking lot, which is located outside the Main Gate/Badgehouse. Two parking spaces are reserved for onsite vehicles serving the Main Gate/Badgehouse in the onsite parking lot provided for the Administration Building.

7.2.2 LANDSCAPING

Landscaping is provided on all sides of the Main Gate/Badgehouse. The area between the employee parking lot and the Main Gate/Badgehouse is also landscaped.

7.3 STRUCTURAL

The Main Gate/Badgehouse is constructed of reinforced concrete block walls, metal deck roof, slab-on-grade floor, and continuous wall footings. The guardroom is a hardened, bullet-resistant area, enclosed by 12-in. concrete block walls and 8-in. concrete roof and walls. The steel canopy over the Inspection Area is a rigid-frame structure on spread footings.

7.4 ARCHITECTURAL

7.4.1 GENERAL

The Main Gate/Badgehouse is a separate, single-story structure with a rectangular plan, 57 x 26 ft, and a floor area of approximately 1,500 sq ft. A covered Vehicle Inspection Area is located adjacent to the building.

The Main Gate/Badgehouse provides the initial observation and inspection functions for all nontransport vehicles (such as delivery and maintenance vehicles) entering the site, as well as security clearance and badge control for all visitors (escorted and unescorted) and personnel entering and leaving the site. All transporter vehicles delivering radioactive shipments are processed at the Inspection Gatehouse as described in Section 8.4.

(1) The Main Gate/Badgehouse is normally occupied by three security personnel on each of four shifts: two guards and a badge/clearance processing clerk.

(2) The Main Gate/Badgehouse contains three main rooms: a passage and waiting room, badge clearance processing room, and a hardened guardroom. Men's and women's toilets are available to both visitors and employees. There is also an electrical equipment room.

(3) Unescorted visitors and employees, whose destination is the Administration Building, are directed to a separate door and vestibule leading to an exterior fenced area. At the opposite end of this 100-ft-long fenced area is the entrance to the Administration Building lobby. Employees and escorted and unescorted visitors, whose destination is one of the other facilities on the site, pass through a vestibule and exit doors to the exterior. Most of the remaining site facilities are within walking distance and, when necessary, onsite vehicles may be used.

(4) Normally, all employee and other private vehicles park in the off-site parking lot, not being allowed onsite past the Main Gate/Badgehouse. Only transport vehicles, delivery vehicles, and other authorized vehicles are permitted on the site.

(5) The Vehicle Inspection Area is a covered area just inside the main gates, which control entrance to and exit from the MRS Facility. The roadway passes directly through the Inspection Area, and is suitable for delivery vehicles and any other vehicles authorized to enter the site. Authorized vehicles enter the inspection area from the outside through the sliding gates. Further entry from the inspection area to the security area is controlled by a lift gate (arm type). Exit from the security area is controlled similarly in a reverse manner.

7.4.2 MATERIALS OF CONSTRUCTION

The Main Gate/Badgehouse is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, reinforced masonry walled structure with steel roof framing and metal panel fascias and soffits. The Inspection Area is covered by a metal roof and fascia supported by structural steel columns and beams. The hardened guardroom has

reinforced concrete and masonry walls and bullet-resistant glass windows. The roof is of reinforced concrete.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls, except at hardened areas, are constructed of gypsum board on light-gauge framing, except in toilets.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

7.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B2

(2) Ceiling heights: 8'-8" for all rooms except 8'-0" for toilets

(3) Kind of traffic: Foot traffic in the building
Delivery vehicles and other authorized site vehicles in Inspection Area

(4) Size of access openings: 6'-0" x 7'-0" exterior personnel doors
3'-0" x 7'-0" interior and exterior personnel doors
24'-0" gate at vehicle access

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Passage and waiting room, badge/clearance processing, guardroom and vestibules	Vinyl tile	Rubber cove	Gypsum board Reinforced concrete at hardened areas	Suspended acoustic tile
Toilets	Ceramic tile	Ceramic tile	Ceramic tile	Gypsum board

(6) Special equipment:

Passage and waiting room:	Seating
Guardroom:	Table, chairs
Toilets:	Toilet accessories Mirrors

7.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this building.

7.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

7.7 MECHANICAL PROCESS

Potable water is provided for fire protection, drinking, and restrooms.

7.8 INSTRUMENTATION AND CONTROL

7.8.1 CCTV CAMERAS

CCTV cameras are provided for remote security surveillance of incoming personnel and commercial supply/service vehicles. The TV cameras are designed with the capability for remote control and operation, and to permit their removal for inspection and maintenance. The TV monitors have redundancy of viewing capability and operation, and are provided with selective switching capabilities to permit monitoring of areas surveyed by any TV camera at the Main Gate/Badgehouse.

The monitoring instrumentation is independent of all other systems and is provided with independent battery backup power supplies. All detection/alarm devices, including transmission lines to the Alarm Monitoring Stations (AMSs), are failure- and tamper-indicating.

7.8.2 UTILITY SYSTEMS

All utility systems in the Main Gate/Badgehouse are remotely or locally monitored, and capable of being remotely controlled.

7.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Main Gate/Badgehouse are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the AMS. All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

7.9 PIPING

7.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

Hot and cold water piping is insulated.

Piping runs are concealed in ceilings, walls, and furred spaces.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

7.9.2 PIPING

Not applicable to this building.

7.10 ELECTRICAL

7.10.1 POWER SERVICE

Building power is obtained from a motor control center (MCC) located at the Administration Building. The service feeder is 480Y/277 volts for distribution to all power and lighting loads. The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose types in NEMA-1 enclosures. Fixtures and installations outdoors are of weatherproof construction.

A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel are used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size.

7.10.2. LIGHTING

7.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all interior areas. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps. Fluorescent fixtures in the electrical room are of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor type, and are of the energy-efficient type.

HID luminaires are used on the exterior of the building. Ballasts with integral fuses are suitable for use with HID.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are on time-switch control, with a manual override capability.

7.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system consists of self-contained, battery-operated emergency equipment.

The batteries have a capacity for 90 minutes of continuous operation. The emergency lighting circuit will be panel-switched. All wiring of the emergency lighting system is in conformance with the applicable requirements of Article 700 of the NEC.

7.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided to allow illumination during nighttime operation.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor floodlighting is provided for the vehicle inspection area and the security fence perimeter.

7.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. Where higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

7.10.2.E. Exit Lighting

All exit lighting is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided as required by the NFPA Life Safety Code - No. 101.

Only one switch and overcurrent device are installed in the supply circuit for exit lighting.

7.10.3 COMMUNICATIONS

7.10.3.A. Public Address System

Public address system speakers are installed in the Main Gate/Badgehouse for paging. The system is provided with one paging zone, and is initiated from the Site Services Building or by telephone access from selected locations within the Main Gate/Badgehouse.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas.

The public address speaker system employs the latest solid-state devices, with all speaker cables installed in a conduit.

7.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, building fire alarm system includes a small fire alarm control panel, smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The annunciator panel is located at the guard station. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA 101 Life Safety Code.

7.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in conduit.

7.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The HVAC system for the Main Gate/Badgehouse includes the following major equipment:

(1) Single-package heat pump, including compressor, condenser, evaporator coil, supply fan, condenser fan, 30% efficiency filters, auxiliary heaters, economical, with enthalpy control and all associated piping, dampers, and controls.

(2) Exhaust fan.

(3) Room thermostat.

Because of its small size, this building was very well suited to take advantage of the low operating costs and simple controls of a heat-pump system. A constant volume of cooled or heated air is delivered to the different rooms of the building. The system is controlled by a single thermostat located in the guard station.

7.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Main Gate/Badgehouse. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and a supervisory signal to the main fire protection annunciator.

An automatic dry-pipe sprinkler system is provided for the sheltered area under the canopy.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 8

INSPECTION GATEHOUSE

8.1 INTRODUCTION

An Inspection Gatehouse is provided to inspect and clear all rail and tranport vehicles delivering radioactive shipments to the MRS Facility.

8.2 CIVIL AND SITE DEVELOPMENT

8.2.1 PARKING

Parking for onsite vehicles is provided adjacent to the Inspection Gatehouse for the inspectors who are dispatched to the Inspection Gatehouse when a shipment arrives.

8.2.2 LANDSCAPING

No landscaping is provided for this facility.

8.3 STRUCTURAL

The Inspection Gatehouse is constructed of reinforced concrete block walls, metal deck roof, slab-on-grade floor, and continuous wall footings. The guardroom is a hardened, bullet-resistant area, enclosed by 12-in. concrete block walls and 8-in. concrete roof. The steel canopy over the Inspection Area is a rigid-frame structure on spread footings. The inspection pits have 8-in. concrete block walls and slab floors. The railcar inspection pit has a gridiron of steel beams to support the railcars.

8.4 ARCHITECTURAL

8.4.1 GENERAL

The Inspection Gatehouse is a separate, single-story structure with a rectangular plan, 41 x 29 ft, and a floor area of approximately 1,200 sq ft. A covered rail and transport truck inspection area is located adjacent to the building.

The Inspection Gatehouse provides the initial observation and inspection functions for all rail and transport vehicles entering the site.

(1) The Inspection Gatehouse is occupied by three security personnel, when needed, including one guard and two inspectors on each of four shifts. When not required at the Inspection Gatehouse, these personnel perform other duties throughout the MRS Facility.

(2) The Inspection Gatehouse has a hardened guard/inspector room, a storage room, and a toilet.

(3) The Inspection Area is a covered, fenced compound with sliding gates controlling entrance to and exit from the Protected Area of the MRS Facility. The roadways in the Inspection Area are divided into two distinct areas: one for transport vehicle inspection, the other for railcar inspection.

(4) Upon arrival at the Inspection Area, the transport vehicle tractor is disengaged from the trailer and, using a turnaround area, is driven back out through the gates and offsite. An onsite tractor is brought forth for attachment to the trailer. After the inspection is complete, the shipment is transported to the Protected Area for processing as appropriate.

(5) A similar procedure is followed for handling rail shipments. An offsite locomotive is uncoupled from the rail-transport cars at the Inspection Area, and a special onsite locomotive delivers the shipment to appropriate locations in the Protected Area.

(6) Both the transport vehicle and the railcar inspection areas include pits for undercarriage inspection. All vehicles bearing unacceptable shipments because of radiation contamination or documentation irregularities are routed to an "off-normal" Shipment Storage Area, located within the Protected Area of the site.

8.4.2 MATERIALS OF CONSTRUCTION

The Inspection Gatehouse is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, reinforced masonry walled structure with structural steel roof framing and metal panel fascias and soffits. The Inspection Area is covered by a metal roof and fascia supported by structural steel columns and beams. The hardened guard/inspector room has reinforced masonry walls and bullet-resistant glass windows. The roof is of reinforced concrete.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls, except at hardened areas, are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

8.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B2

(2) Ceiling heights: 8'-8" for all rooms except 8'-0" for toilets and storage

(3) Kind of traffic: Foot traffic in the building
Railroad and transport vehicles in Inspection Area

(4) Size of access openings: 3'-0" x 7'-0" interior and exterior personnel doors

29'-0" gate at rail access

20'-0" gate at transport vehicle access

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Guard/inspector room, vestibules, storage	Vinyl tile	Rubber cove	Gypsum board Rein-forced concrete at hard-ened areas	Suspended acoustic tile
Toilet	Ceramic tile	Ceramic tile	Ceramic tile	Gypsum board

(6) Special equipment:

Toilet: Toilet accessories
Mirror

8.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this building.

8.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

8.7 MECHANICAL PROCESS

Potable water is provided for fire protection, drinking, and restrooms.

8.8 INSTRUMENTATION AND CONTROL

8.8.1 CCTV CAMERAS

CCTV cameras are provided at the Inspection Gatehouse for remote security surveillance of incoming personnel and the truck/rail cask inspection area.

8.8.2 RADIATION MONITORS

Portable, hand-held radiation monitors are provided for inspecting incoming truck and rail casks for levels (if any) of alpha, beta, and gamma emission.

8.8.3 UTILITY SYSTEMS

All utility systems in the Inspection Gatehouse are remotely or locally monitored, and capable of being remotely controlled.

8.8.4 SECURITY AND FIRE ALARMS

All fire alarms in the Inspection Gatehouse are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the Alarm Monitoring Station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

8.9 PIPING

8.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater.

Hot and cold water piping is insulated.

Piping runs are concealed in ceilings, walls, and furred spaces.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

8.9.2 PIPING

Not applicable.

8.10 ELECTRICAL

8.10.1 POWER SERVICE

Building power is obtained from an outdoor, pad-mounted transformer. It transforms the primary voltage to 480Y/277 volts for distribution to all power and lighting loads. The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose types in NEMA-1 enclosures. Fixtures and installations outdoors are of weatherproof construction.

A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel are used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size.

8.10.2 LIGHTING

8.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all interior areas except storage rooms. Fluorescent fixtures have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor type, and are of the energy-efficient type.

HID luminaires with ballasts and integral mounted fuses are used on the exterior of the building above walkways and entrances.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are on time-switch control with a manual override capability.

Incandescent fixtures are provided in storage rooms.

8.10.2.B. Emergency Lighting System

An emergency lighting system is provided for illumination during normal power outage. This system automatically switches to emergency power upon loss of normal power. It consists of self-contained, individual battery-operated emergency equipment. Emergency lighting is installed at the guard/inspection room.

Only one switch and overcurrent device are installed in the supply circuit for exit lighting.

The batteries have capacity for 90 minutes of continuous operation. The emergency lighting circuit is panel-switched. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

8.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operations in the inspection area. Lighting is photoelectric relay-controlled with a manual switch override.

8.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

8.10.3 COMMUNICATIONS

8.10.3.A. Public Address System

Public address system speakers are installed in the Inspection Gatehouse and outdoor area for paging. The system is provided with one paging zone, and is initiated from the Site Services Building and by telephone access from selected locations within the Inspection Gatehouse. The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas.

The public address speaker system employs the latest solid-state devices, with all speaker cables installed in conduit.

8.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, building fire alarm system includes smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA 101 Life Safety Code.

8.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the panel room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. A telephone station is provided. All telephone cables are installed in conduit.

8.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The HVAC system for the Inspection Gatehouse includes the following major equipment:

(1) Single-package heat pump, including compressor, condenser, evaporator coil, supply fan, condenser fan, 30% efficiency filters, auxiliary heaters, economical, with enthalpy control, and all associated piping, dampers, and controls.

(2) Exhaust fan.

(3) Room thermostat.

Because of its small size, this building is well suited to take advantage of the low operating costs and simple controls of a heat-pump system. A constant volume of cooled or heated air is delivered to the different rooms of the building. The system is controlled by a single thermostat located in the guard/inspection room.

8.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Inspection Gatehouse. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and a supervisory signal to the main fire protection annunciator.

An automatic dry-pipe sprinkler system is also provided.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 9

PROTECTED AREA GATEHOUSE

9.1 INTRODUCTION

A Protected Area Gatehouse is provided at the entrance to the MRS Facility protected area. It serves as a badge check and a detection monitoring function for all personnel entering the Protected Area, and has an inspection area for nontransport vehicles (such as delivery vehicles, maintenance vehicles, and any staff or private automobiles) authorized to enter the site. It also houses the primary Alarm Monitoring Station (AMS).

9.2 CIVIL AND SITE DEVELOPMENT

9.2.1 PARKING

Parking for the guards working in the Protected Area Gatehouse is provided outside the Main Gate/Badgehouse. Two parking spaces are provided adjacent to the Protected Area Gatehouse for onsite vehicles inside the protected area.

9.2.2 LANDSCAPING

No landscaping is provided for this facility.

9.3 STRUCTURAL

The Protected Area Gatehouse is a two-level structure, constructed of reinforced concrete block, with concrete walls, concrete roof, a steel-framed roof with a 1-1/2-in. metal roof deck, slab-on-grade floor, and structural slab floor over the basement. The monitoring room, access control, and alarm monitoring station are all hardened, bullet-resistant areas, enclosed by 8-in. concrete walls, 12-in. concrete block walls, and 8-in. concrete roof. The roof and floor are supported by concrete beams and bearing walls on continuous wall footings.

9.4 ARCHITECTURAL

9.4.1 GENERAL

The Protected Area Gatehouse is a separate, two-level (ground level and lower level) structure, which has an essentially rectangular plan, 62 x 66 ft, and a total floor area of approximately 6,500 sq ft. A vehicle inspection area is located adjacent to the building.

The Protected Area Gatehouse provides personnel monitoring and inspection for all employees entering and leaving the protected area, as well as the control alarm and remote surveillance functions and related mechanical and electrical equipment systems.

(1) The Protected Area Gatehouse is normally occupied by four security guards on each of four shifts.

(2) The Protected Area Gatehouse contains two levels: a ground level and a lower level (basement). The ground level contains a detection monitoring room, hardened electrical and mechanical equipment rooms, and a hardened access control room. The hardened access control room personnel supervise passage to and from the protected area through electronically controlled turnstiles. The monitoring room contains metal- and explosive-detection devices, X-ray inspection equipment, and portal monitors for surveillance of personnel and packages. The electrical equipment room contains the electrical equipment required to serve the nonhardened portion of the building. The hardened electrical and mechanical equipment rooms contain the electrical and HVAC equipment required to serve the hardened areas of the building. The lower level contains the control alarm and remote surveillance room, the UPS room, a battery room, and a mechanical equipment room, as well as a stairway up to the access control room on the ground level. The entire lower level is hardened.

(3) Only delivery vehicles and other authorized vehicles are permitted into the protected area. Vehicles approaching the double-fenced alarm zone come under the surveillance of the Protected Area Gatehouse, and are checked for authority to enter the protected area after passing through the alarm zone.

(a) Authorized vehicles enter the inspection area from the outside through the sliding gates. Further entry from the inspection area to the security area is controlled by a lift gate (arm type). Exit from the security area is controlled similarly in a reverse manner.

(b) For the Primary Storage concept, an access route is provided for direct access by the sealed storage cask transporter between the protected area and the Cask Manufacturing Facility without passing through the Protected Area Gatehouse. Because of the size and function of the transporter, a separate access point through the protected area fences is required. A guard accompanies the transporter from the protected area, providing the necessary access control card key at the gates, to the Cask Manufacturing Facility. Since materials and personnel at the Cask Manufacturing Facility have direct access to that industrial site, the guard inspects the waiting cask before it is loaded onto the transporter, and accompanies the transporter on its return route into the protected area to ensure that physical protection of the protected area is maintained.

9.4.2 MATERIALS OF CONSTRUCTION

The Protected Area Gatehouse is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a two-level, reinforced masonry walled structure, with structural steel roof framing and metal panel fascia and soffit. The lower level is entirely below grade and is a hardened, reinforced concrete structure. The vehicle inspection area is part of the roadway adjacent to the building.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls, except at hardened areas, are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

9.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1)	UBC Occupancy Class:	B2
(2)	Ceiling heights:	11'-2" for battery room and UPS room
		12'-0" for mechanical and electrical equipment rooms
		9'-4" for all other rooms except 8'-0" for toilets
(3)	Kind of traffic:	Foot traffic in the building; delivery and other authorized vehicles in the inspection area
		Pallet trucks for transporting equipment to an equipment hatch in the ground level mechanical equipment room

(4) Size of access openings: 3'-0" x 7'-0" interior and exterior personnel doors

6'-0" x 7'-0" exterior personnel doors

6'-0" x 9'-0" equipment access

24'-0" gate at delivery vehicle access

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Detection monitoring room, access control, control alarm and remote surveillance room, corridors, vestibules, storage	Vinyl tile	Rubber cove	Gypsum board (concrete at hardened areas)	Suspended acoustic tile
Toilets	Ceramic tile	Ceramic tile	Ceramic tile	Gypsum board
Mechanical equipment and UPS, electrical equipment, battery room	Concrete	Rubber cove (concrete at hardened areas)	Gypsum board (concrete at hardened areas)	Exposed structure

(6) Special equipment:

Toilets:	Toilet accessories Mirrors
Access control, control alarm, and remote surveillance area:	Consoles

9.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE HANDLING

A crawl beam mounting a 3-ton, hand-chain-operated hoist, is provided in the mechanical equipment room to move through a hatch equipment located in the control equipment and computer room, which is on the lower level.

9.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

9.7 MECHANICAL PROCESS

Potable water is provided for fire protection, drinking, restrooms, eyewash, and safety showers.

9.8 INSTRUMENTATION AND CONTROL

9.8.1 ALARM MONITORING STATIONS

Two Alarm Monitoring Stations (AMSs) provide centralized access control, monochrome CCTV monitoring, intrusion detection, alarm monitoring, and event recording for the MRS Facility. The primary AMS is located in the Protected Area Gatehouse and the redundant AMS is located in the Security Building. With the exception of the intrusion detectors, access card readers, CCTV cameras, and other detectors, all equipment at these two locations is duplicated.

Site security is provided by a double-fenced alarm zone, 100 ft wide, around the protected and storage area perimeter. A taut-wire inner fence and buried pressure-sensitive sensors between the fences provide intrusion-detection capability. Card readers and CCTV cameras, located near the R&H Building and Security Building doors, provide access control at these unmanned doors. The signals from these devices are transmitted by tamperproof and failure-indicating cables to the computerized primary and redundant (backup) AMS.

Fixed CCTV surveillance cameras are installed nominally 328 ft (100 m) apart in the alarm zone. Redundancy is provided by installing the cameras with overlapping viewing zones. Additional pan, tilt, and zoom (PTZ) cameras are interspersed with the fixed cameras within the alarm zone and at the protected area access gates. The PTZ cameras are used by security personnel to inspect suspicious-looking objects that were previously detected by the computerized motion-sensing system through the fixed CCTV cameras, as shown on Drawing H-3-56789 (sheet 1 of 4). The monitors and switching units for the CCTV cameras are located in the AMS operating consoles. The intrusion alarms are actuated by two-out-of-three logic for reliable intrusion detection. In addition to this system, a patrol road inside the inner fence facilitates routine vehicular patrol and alarm response by security personnel. The vehicles are equipped with two-way shortwave radios for maintaining communications with the AMSs. Access to the site is controlled by manned security checkpoints at the Main Gate/Badgehouse and the Inspection Gatehouse.

9.8.2 METAL, EXPLOSIVE, AND X-RAY MONITORS

The detection monitoring room is provided with metal detectors for incoming and outgoing personnel monitoring, with an explosives detector for incoming personnel and packages, and with an X-ray inspection unit for incoming packages. The metal and explosives detectors have visual and audible local alarms and alarm transmitters.

9.8.3 UTILITY SYSTEMS

All utility systems in the Protected Area Gatehouse are remotely monitored, and capable of being remotely controlled.

9.8.4 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

9.8.5 SECURITY AND FIRE ALARMS

All fire alarms in the Protected Area Gatehouse are monitored by the fire alarm monitoring system in the Fire Station, and transmitted to the AMS. All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

9.9 PIPING

9.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater.

Hot and cold water piping is insulated.

A safety shower and eyewash station to comply with ANSI Z358.1 are provided in the battery room.

Piping runs are concealed in ceilings, walls, and furred spaces.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

9.9.2 PIPING

HVAC equipment drains are provided, and are connected to the building sanitary sewer system.

A floor sump is provided in the battery room and, when necessary, it is drained by using a portable pump.

9.10 ELECTRICAL

9.10.1 POWER SERVICE

Normal building power is obtained from a unit substation located within the building. The unit substation transforms the 4.16-kV primary voltage to 480Y/277 volts, then feeds to the normal/standby switchgear, which is located in the hardened area of the Protected Area Gatehouse. Standby power at 480 volts 3 phase, 4 wire is fed from the Security Building to this normal/standby switchgear for distribution to all power and lighting loads. The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors conform to NEMA-1 type enclosures. Fixtures and installations outdoors are of weatherproof construction.

A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel are used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size.

An uninterruptible power supply (UPS) system is furnished to supply power to essential surveillance and access control equipment. Input power is obtained from the critical load center panelboard at 480Y/277 volts, 3 phase. The battery bank is sized to maintain full inverter output for a period of 90 minutes.

9.10.2 LIGHTING

9.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all indoor areas. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID luminaires with ballasts and integral mounted fuses are used on the exterior of the building.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are solar compensated, time-switch controlled with manual override.

Incandescent fixtures are provided in small rooms and in areas that are used intermittently.

9.10.2.B. Emergency Lighting System

An emergency lighting system is provided to permit continued operation of all surveillance and security devices if there is total power failure, and for safe egress lighting. Power for the emergency lighting system is obtained from the standby power system panelboard. All wiring of the emergency lighting system conforms with the applicable requirements of Article 700 of the NEC.

9.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor HID floodlighting is provided for the vehicle inspection area and HID road lighting for roads within the Protected Area, including the west patrol road.

9.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

9.10.2.E. Exit Lighting

All exit lighting is considered as part of the emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided as required by the NFPA Life Safety Code - No. 101. Only one switch and overcurrent device are installed in the supply circuit for exit lighting. Power for the exit sign lighting is obtained from the standby power system panelboard.

9.10.3 COMMUNICATIONS

9.10.3.A. Public Address System

Public address system speakers are installed in the Protected Area Gatehouse for paging. The system is provided with one paging zone. It is initiated from the Site Services Building and by telephone access from selected locations within the Protected Area Gatehouse.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas.

The public address speaker system employs the latest solid-state devices, with all speaker cables installed in a conduit.

9.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, building fire alarm system includes a small fire alarm control panel, smoke detectors, fire sensors, manual fire alarm stations, local audible alarms, an annunciator panel, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The annunciator panel is located in the vestibule for easy access. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA-101 Life Safety Code.

9.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in conduit.

9.10.3.D. Radio System

A fixed-base radio system is provided at the Protected Area Gatehouse for intercommunications with security personnel and to provide a communications link to local law-enforcement agencies.

9.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Protected Area Gatehouse is divided into three separate areas and served by three different systems.

9.11.1 NONHARDENED AREA

A single-duct, constant-volume heating and ventilating unit provides heating during the winter and ventilation during the summer. Major equipment includes the following:

(1) Air-handling unit with supply fan and filter box.

(2) Electric duct heater.

(3) Exhaust fan.

(4) Room and duct thermostats with associated controls.

(5) Mixing dampers.

During winter conditions, a minimum of outside air is mixed with return air and delivered to the rooms within this area. If additional heating is required, the room thermostat activates the electric duct heater in the supply duct.

During the summer (when mixed air temperature rises above the duct thermostat setpoint), the duct thermostat opens the outside air damper, closes the return air damper, and activates the exhaust fan.

9.11.2 HARDENED AREA - GROUND LEVEL

A single-package, air-cooled, air-conditioning unit with an electric duct heater provides the heating and cooling requirements for this area. Major equipment includes the following:

(1) Air-conditioning unit, single package, indoor type, including supply fan, condenser fan, compressor, evaporator coil, and all associated piping and controls.

(2) Filter box with 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters.

(3) Electric duct heater.

(4) Exhaust fan and gravity relief vents.

(5) Room thermostat and associated controls.

A constant volume of outside air is mixed with the return air, filtered, heated or cooled, and delivered to this area. The entire system is located inside a hardened mechanical equipment room.

The single-package, indoor-type unit was chosen to ensure HVAC operations consistent with the hardened area concept. This HVAC system provides good ventilation (constant air volume), simple controls, and effective energy use because of the elimination of simultaneous heating and cooling.

No provisions have been made to recover heat from exhaust air or to use an economizer cycle because the system is very small and the penetrations through the hardened area must be kept to a minimum.

Standby power is available for the HVAC system in this hardened area.

9.11.3 HARDENED AREA - LOWER LEVEL

A single-package, air-cooled, air-conditioning unit with an electric reheat coil provides the heating and cooling requirements for this area. Major equipment includes the following:

(1) Air-conditioning unit, single package, indoor type, including supply fan, condenser fan, compressor, evaporator coil, and all associated piping and controls.

(2) Filter box with 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters.

(3) Electric duct heaters (reheat coils).

(4) Exhaust fan and gravity relief vents.

(5) Room thermostats and associated controls.

A constant volume of outside air is mixed with the return air, filtered, and cooled (as required) before being distributed to the different rooms within the area. If heating is required in any of the rooms equipped with a thermostat, the reheat coil located in the supply air duct to the room is activated. The entire system is located inside a hardened mechanical equipment room. The system is provided with standby electrical power in case of normal power failure.

The single-package, indoor-type unit was chosen to ensure HVAC operations consistent with the hardened area concept. The reheat system was chosen in order to provide better control to the critical rooms within the area.

No provisions have been made to recover heat from exhaust air or to use an economizer cycle because the system is very small and the penetrations through the hardened area must be kept to a minimum.

Standby power is available for the HVAC system in this hardened area.

9.12 FIRE PROTECTION

Fire protection is provided througho t the Protected Area Gatehouse. It includes an automatic wet-pipe sprinkl r system, a Halon 1301 system, and portable fire extinguishers.

9.12.1 WET-PIPE SPRINKLER SYSTEM

An automatic -pipe sprinkler system is provided throughout the facility except in el rical equipment rooms. This system is designed in accordance with NFPA 13 and is complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls. Fire Department connections provide a secondary water supply for the installed sprinkler systems.

9.12.2 HALON 1301 SYSTEM

Areas of high value or of high program importance (e.g., computer areas/ control alarm, electrical equipment rooms, and remote surveillance room) are provided with a total-flooding Halon 1301 system (with sprinklers provided as a secondary system for basic building protection). The system consists of fixed piping manifolded racks, cylinders, detectors, circuits, alarms, and controls designed to provide detection, alarm, and extinguishment of fire in accordance with NFPA 12A.

The electrical equipment rooms are protected by the Halon 1301 system only.

9.12.3 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are provided for the Protected Area Gatehouse in accordance with NFPA 10.

SECTION 10

STORAGE AREA GATE STATION

10.1 INTRODUCTION

A gate station is provided at the entrance to the SF, HLW, and RHTRU Storage Facility for radiation monitoring of personnel leaving the facility.

10.2 CIVIL AND SITE DEVELOPMENT

10.2.1 PARKING

Parking is provided for site vehicles serving the Storage Area Gate Station.

10.2.2 LANDSCAPING

No landscaping is provided for this facility.

10.3 STRUCTURAL

The Storage Area Gate Station is constructed of reinforced concrete block walls, metal deck roof, and slab-on-grade floor with continuous wall footings.

10.4 ARCHITECTURAL

10.4.1 GENERAL

The Storage Area Gate Station is a separate, single-story structure with a square plan, 10 x 10 ft, and an area of 100 sq ft.

The Storage Area Gate Station provides radiation detection and monitoring for all employees leaving the storage facility.

(1) The gate station is not occupied by any assigned personnel. It is used only by personnel leaving the storage area for radiation-contamination detection and for communication with other facilities.

(2) The gate station contains only one room: a monitoring room equipped with radiation-detection equipment and a telephone.

10.4.2 MATERIALS OF CONSTRUCTION

The Storage Area Gate Station is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, reinforced masonry walled structure with structural metal decking.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose the occupied space are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

10.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B2

(2) Ceiling height: 8'-8"

(3) Kind of traffic: Foot traffic

(4) Size of access openings: 3'-0" x 7'-0" exterior personnel door

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Monitoring room:	Concrete	Concrete block	Concrete block	Exposed structure

(6) Special equipment:

Monitoring room: Radiation detection equipment

Telephone
Table, chair

10.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this building.

10.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

10.7 MECHANICAL PROCESS

Not applicable to this building.

10.8 INSTRUMENTATION AND CONTROL

10.8.1 CCTV CAMERA

A CCTV camera is provided at the Storage Area Gate Station for remote security surveillance of incoming/outgoing personnel and vehicles.

10.8.2 RADIATION MONITOR

Portable, hand-held radiation monitors are provided for self-survey of outgoing personnel for contamination detection.

10.9 PIPING

Not applicable to this building.

10.10 ELECTRICAL

10.10.1. POWER SERVICE

Building power at 480/277 volts, 3 phase, 4 wire is obtained from an outdoor, powerhouse-type unit substation. This unit substation also serves the security fence and patrol road lighting.

At the Storage Area Gate Station, a 480/277-volt, 3-phase, 4-wire load center panelboard is provided for distribution to all power and lighting loads.

The distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose types in NEMA-1 enclosures. Fixtures and installation outdoors are of weatherproof construction.

A single-phase, 480-240/120-volt, 3-wire, wall-mounted minipower center is provided for 120-volt receptacles and small loads.

10.10.2 LIGHTING

10.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

Light fixtures above exterior doors are time-switch controlled with manual override.

10.10.2.B. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor HID floodlighting is provided for the gate entrance area.

10.10.2.C. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

10.10.3 TELEPHONE SYSTEM

The main Electronic Private Automatic Branch Exchange (EPABX) equipment is located in the Site Services Building. A telephone instrument is provided at the Storage Area Gate Station. The telephone system is installed in a conduit.

10.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Storage Area Gate Station is equipped with a "through-the-wall" room air-conditioner. The single-package unit provides the required heating, cooling, and air supply to the room, and is controlled from a room thermostat. The air-conditioning unit is complete with compressor, evaporator fan, condenser, motor, and the associated controls.

10.12 FIRE PROTECTION

Portable fire extinguishers are sized, located, and installed in the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

SECTION 11

SITE SERVICES BUILDING

11.1 INTRODUCTION

11.1.1 SHOPS

The Site Services Building includes all cold maintenance and fabrication shops required to support the MRS activities. Radioactively contaminated objects are not be permitted in these shops. The shops are as follows:

- Machine
- Millwright
- Pipefitting
- Welding
- Sheetmetal
- Carpentry
- Plastics/glass/ceramic
- Electrical
- Instrument
- Paint
- Steam cleaning area
- Mockup

11.1.2 OFFICES

This building accommodates shop management and support functions, the physical plant operations personnel, and engineering personnel. It also includes a small industrial first-aid facility, purchasing and stores for all plant functions, shop warehousing, plant mail and reproduction facilities, and radiation-protection facilities, including a radiological calibration and low-level counting room.

11.1.3 OTHER AREAS

In addition to the shops and offices, the Site Services Building includes a computer room; a lunchroom; training, conference, copy machine, reproduction, and mail rooms; locker rooms; storage spaces; restrooms; janitorial facilities; mechanical equipment rooms; and a backup control room. Three small, separate buildings are provided near the maintenance facilities for paint shop/storage, oil storage, and lumber storage.

11.2 CIVIL AND SITE DEVELOPMENT

11.2.1 PARKING

Parking for employees working in the Site Services Building is provided outside the Main Gate/Badgehouse. Parking is provided adjacent to the entrance to the Site Services Building for site vehicles serving the building.

11.2.2 LANDSCAPING

The entrance area of the Site Services Building is landscaped.

11.3 STRUCTURAL

The Site Services Building is composed of low-bay areas constructed of reinforced concrete block and high-bay areas constructed of braced steel framing with metal siding and concrete block apron walls. All roofs are steel framed, with 1-1/2-in. metal roof deck. Foundations are spread footings and continuous wall footings with slab-on-grade floor.

11.4 ARCHITECTURAL

11.4.1 FUNCTIONS

The Site Services Building is a separate, single-story structure with an irregular plan, 278 x 332 ft overall, and a floor area of approximately 62,000 sq ft.

The Site Services Building consists of the following major functional areas:

- Office area
- Shop area
- Warehouse
- Mockup area
- Storage areas
- Support functions
- Building services
- Circulation

11.4.1.A. Office Area

The office area is designed to house the following:

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
Physical plant operation personnel	7	2	2	2	13
Shop management	7	1	1	1	10
Emergency first aid	1	1	1	1	4
Purchasing	5	-	-	-	5
Engineering	12	-	-	-	12
Store	3	-	-	-	3
Instrument laboratory/counting room	3	-	-	-	3
Control room	5	5	5	5	20
Total	43	9	9	9	70

(1) All offices are designed to accommodate specific functions. The physical plant operation personnel office is primarily an open office where furniture and furnishings define individual work stations. A private office for the supervisor is located adjacent to the open office. Other functions with fewer personnel are housed in appropriately sized open and private office combinations.

(2) A conference room, sized for 20 occupants, is centrally located within the office area, accessible from the corridor and near the lunchroom.

(3) A control room and uninterruptible power supply (UPS) is located at one corner of the office area, accessible from the main corridor.

(4) A photocopy machine alcove is located in the office area, adjoining the corridor.

(5) The counting room is shielded as required to reduce background radiation.

11.4.1.B. Shop Area

The shop area is designed to accommodate the following:

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
Machine	3	-	-	-	3
Servicemen	3	-	-	-	3
Millwright	5	1	1	1	8
Pipefitting	2	1	1	1	5
Welding	1	-	-	-	1
Sheetmetal	1	-	-	-	1
Carpentry	3	-	-	-	3
Electrical/instrument	9	2	2	2	15
Paint	1	-	-	-	1
Plastics, glass, and ceramic	-	-	-	-	0
Steam cleaning area	-	-	-	-	0
Tool crib	1	-	-	-	1
Total	29	4	4	4	41

(1) The shop area has exposed, structural steel roof framing and a hardened, painted, reinforced slab-on-grade concrete floor. Shop functions not requiring complete enclosure are separated from others by 10-ft-high partitions.

(2) A clear height of 14 ft above the shop floor is provided. All structural members and mechanical and electrical systems are located above 14 ft.

(3) Craft-related offices are located adjacent to various shop functions.

(4) Locker rooms, restrooms, and lunchroom are integrated into the office area of the building. Additional restrooms are located in the shop area.

11.4.1.C. Warehouse

A warehouse area is provided within the building for general storage, convenient to the shops. The clear height overhead is the same as in the shop area. Two large exterior doors and one large interior door are provided to afford sufficient access to and from the warehouse area. A receiving office is located adjacent to the warehouse and unloading areas.

11.4.1D. Mockup Area

An enclosed mockup area, occupied by 10 dayshift personnel, is provided within the building. The overhead clear height required for the planned mockups is 40 ft. One large door to the shop area aisle is provided for items and materials to be moved in and out of the mockup area.

11.4.1.E. Storage Buildings

Small, separate storage buildings are provided for the storage of potentially hazardous bulk materials, including:

(1) Lumber (near carpentry shop)
(2) Paint (including a paint spray booth)
(3) Oil

The storage buildings, as Group H occupancies, are separated from each other and the Site Services Building by a minimum of 40 ft.

11.4.1.F. Support Functions

Support functions throughout the building consist of the following:

Assignment	Number of Personnel by Shift				
	Day	2nd	3rd	4th	Total
Mail room	2	-	-	-	2
Warehouse	2	-	-	-	2
Reproduction	2	-	-	-	2
Telephone	1	-	-	-	1
Copy	-	-	-	-	0
Lockers	-	-	-	-	0
Lunchroom	-	-	-	-	0
Janitorial facilities	6	6	-	-	12
Certified vendors' information	-	-	-	-	0
Training room	-	-	-	-	0
Gas bottle storage	-	-	-	-	0
Total	13	6	-	-	19

(1) Tool Crib: The tool crib, with a small office, is centrally located within the shop area.

(2) Mail Room: A central MRS Facility mail room is provided in the office area. Mail is sorted, processed, and distributed to other facilities as applicable.

(3) Reproduction: A reproduction room containing blueline printers and other equipment is located near the engineering and research functions.

(4) Copy: A photocopy machine alcove is provided off the corridor, convenient to the office functions and adjacent to the engineering function.

(5) Locker Rooms: Locker rooms containing lockers and showers are located adjacent to both the men's and women's toilet rooms.

(6) Lunchroom: A lunchroom sized for 90 persons is provided in the office area, and includes vending machines and self-service microwave ovens.

(7) Janitorial Facilities: A central MRS Facility storage room for toilet supplies is provided near the service entrance, along with an office for the Janitorial Supervisor.

(8) Certified Vendors' Information (CVI): A room containing certified vendors' information is provided adjacent to the Purchasing Office.

(9) Training Room: A training room with movable seating (large enough to accommodate 100 persons; a storage room for tables, chairs, and training materials; and a front projection room for showing films and slides) is provided.

(1) Gas Bottle Storage: An enclosed room, with loading/unloading access doors, is provided for gas manifold and cylinder storage.

11.4.1.G. Building Services

Space is provided for the following building services for the normal operation of the building:

- HVAC equipment
- Electrical equipment
- Telephone equipment
- Plumbing equipment (restrooms, etc.)

11.4.1.H. Circulation

Adequate space is provided for both visitor and personnel circulation throughout the building. All normal pedestrian entrances and exits are provided with vestibules for weather protection. The lobby at the main entrance opens into a double corridor system, providing access throughout the office area. A separate shop entrance is provided for shop personnel.

11.4.2 MATERIALS OF CONSTRUCTION

The Site Services Building is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, mixed occupancy, steel-framed structure of varying heights according to interior needs. The exterior wall material is an insulated, panelized wall system above concrete block apron walls. Where fascias and soffits are provided for solar control, a noninsulated, fluted or ribbed panel is used.

(2) All exterior walls, roofs, and roof-ceiling assemblies are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

11.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class:

Lunchroom:	A3
Training and conference:	A3
Office areas:	B2
Shop area:	B4
Gas bottle storage:	H1
Oil storage:	H2
Paint storage:	H2
Lumber storage:	H3

(2) Ceiling heights:

Office areas:	9'-0"
Restrooms:	8'-0"
Training:	12'-0"
Shop areas and warehouse:	23'-0" (minimum to bottom of structure) (All overhead girders, ventilation ducts, electrical busses and conduits, piping, etc., must be at clear height of 14 ft.)
Mockup:	40'-0"

(3) Kind of traffic: Foot traffic
Forklift, portable floor cranes, etc.

(4) Size of access openings:
3'-6" x 9'-0" personnel
3'-0" x 7'-0" personnel
6'-0" x 9'-0" personnel
10'-0" x 12'-0" service

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Lobby, offices, conference, training	Carpet	Rubber cove	Gypsum board	Suspended acoustic tile
First aid, radiation, lunchroom, storage, receiving	Vinyl tile	Rubber cove	Gypsum board (vinyl-coated in lunchroom)	Suspended acoustic tile

Area	Floor	Base	Wall	Ceiling
Shops, warehouse, mockup, storage	Concrete (hardened)	Concrete curb	Metal liner panel	Exposed structure
Restrooms, lockers, showers	Unglazed ceramic tile (mosaic)	Ceramic tile (glazed)	Ceramic tile (glazed)	Cement plaster

(6) Special equipment:

Offices:	Desks, chairs, credenza, bookcases, file cabinets, tables
Lobby, conference:	Tables, chairs
Toilets, lockers, showers:	Metal toilet partitions Metal lockers Toilet and shower accessories Mirrors Clothing storage and soiled laundry hampers
Radiation protection/counting:	Laboratory furniture and equipment
Lunchroom:	Vending machines Microwave ovens Tables, chairs
Training room:	Audio-visual equipment Training equipment Tables, chairs
Reproduction:	Copy equipment, print machines, duplicators
Photocopy alcove:	Photocopy machine Storage and equipment
First aid:	Medical equipment and casework
Shops:	All shop equipment as required (see Material Handling section)
Warehouse/storage area:	Storage shelving, cabinets, etc.

11.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

11.5.1 GENERAL

The Site Services Building is equipped to provide uncontaminated maintenance, repair, and modification services in support of the MRS Facility. Material handling in the fabrication shops is performed by using jib cranes, portable mobile floor cranes, portable hoisting units, and dollies.

The shop areas included within this building are machine, millwright, pipefitting, welding, sheetmetal, carpentry, electrical, instrument, paint, plastics, glass, ceramics, steam cleaning, and mockup areas.

11.5.2 MACHINE SHOP EQUIPMENT

The machine shop is equipped with the following:

1. Two Monarch Series 612 Lathes, or equal, furnished with a 12-in. swing over bed and 126-in. distance between centers. Each lathe has a 12-spindle speed for adjustments of 50 to 2,500 rpm. These lathes are powered by a 5-hp motor operating on 230-volt, 3-phase, 60-Hz power.

2. A Leblond Hollow Spindle Lathe, or equal, furnished with a 15-in. swing over bed and 126-in. distance between centers. The lathe is of 12 spindle speeds for adjustments of 23 to 1,800 rpm. The lathe is powered by an 8-hp motor operating on 230-volt, 3-phase, 60-Hz power.

3. A Monarch Lathe, Series 612 or equal, furnished with a 24-in. swing over bed and 157-in. distance between centers. The lathe has 18 spindle speeds for adjustments of 17 to 1,700 rpm. The lathe is powered by a 15-hp motor operating on 230-volt, 3-phase, 60-Hz power.

4. A Varnamo U-415 milling machine, or equal, furnished with a 71- x 15-3/4-in. working surface. The milling machine is powered by a 23-hp motor operating on 230-volt, 3-phase, 60-Hz power.

5. A Lagun FTV-3 turret type milling machine, or equal, furnished with a 54- x 11-in. working surface. Milling machine is powered by a 4-hp motor powered by 230-volt, 3-phase, 60-Hz power.

6. A Steptoe-SG shaper, or equal, furnished with a 20-in. working surface. Shaper is powered by a 7-1/2-hp motor powered by 230-volt, 3-phase, 60-Hz power.

7. Bridgeport Model II milling machine, furnished with an overall table surface of 11 x 58 in. The milling machine is capable of speed ranges of 60 to 50 rpm low and 500 to 4,200 rpm high. Milling machine is powered by a 2-hp motor powered by 230-volt, 3-phase, 60 Hz power.

8. A radial-arm drill machine, furnished with a 4-ft radial arm and 36- x 60-in. base working surface. The drill has a selected spindle speed of 33 to

1,200 rpm and 50 to 1,800 rpm and is capable of drilling holes on base to center of circle of 8 ft. Unit is equipped with 5- and 7-1/2-hp motors operating on 230-volt, 3-phase, 60-Hz power.

9. A pedestal-mounted Powermatic 20 in., or equal, furnished with a variable-speed, belt-driven drive with speed ranges from 135 to 1,350 rpm. The drill is capable of drilling 2-in.-thick steel stock. Unit is powered by 1-1/2-hp motor operating on 230-volt, 3-phase, 60-Hz power.

10. A pedestal-mounted grinder, furnished with two 12- x 22- x 1-1/4-in. grinding wheels and safety shields. Grinder is powered by a 2-hp motor operating on 230-volt, 3-phase, 60-Hz power. A pushbutton starter with overload is standard equipment.

11. H-frame press unit with rated capacity of 75 tons. Press is air operated on 90- to 145-psi air pressure.

12. An optical comparator, furnished with a 30-in. screen. Worktable travel is 8 in. with a focus range of 1-3/8 in. Screen centerline to floor is 5 in. Throat clearance is 15.5 in.

13. A large steel-top layout table sized at 48 x 120 in. Table is capable of handling working surface weights of 2,000 lb. Table is of all-steel construction and weighs approximately 3,500 lb.

14. Three Lyon Model 38-1018 storage cabinets, or equal. Each cabinet is 36 in. wide x 18 in. deep x 78 in. high.

15. Three steel-top workbenches, 72 in. long x 36 in. wide, Lyon Model 2505 or equal.

16. A glove box blaster unit, 60 x 24 in., air operated.

17. A drill sharpener, furnished with a 7- x 2-in. main grinding wheel. Unit grinds points from 80 to 180 deg. Sharpening unit is equipped with a 1-1/2-hp wheelhead drive, 1/2-hp workhead drive, and 3/4-hp cross-traverse drive.

18. A tool and cutter grinder unit, furnished with 12-1/4- x 32-in. grinding capacity and powered by a 1-1/2-hp motor on 230-volt, 3-phase, 60-Hz power.

19. A carbide wheel grinder, pedestal-mounted unit, equipped with a 12- x 2-in. wheel. Unit is powered by a 1-1/2-hp motor operating on 230-volt, 3-phase, 60-Hz power.

20. Three parts bin storage units, composed of six bins each. Bin units are 3 ft wide, 1 ft deep, and 6-1/2 ft high.

21. Three 10-in. pipejaw vises with swivel bases, furnished for mounting to steel-top workbenches.

22. A portable Black Diamond drill grinding unit, or equal, with 3/4-in. grinder with pistol-type grip.

23. A bench-mounted NP 2-1/2 arbor press with pressing capacity of 3 tons. Press is manually operated, equipped with a ram 1-1/2 x 1-1/2 x 27 in. in length. Unit is capable of handling stock of 15-1/2 in. dia.

24. A Thompson surface grinder with a 24-in. grinding wheel. Grinder is capable of handling stock 18 in. in width x 60 in. in length. Wheel head is driven by 20-hp motor operating on 230/440-volt, 3-phase, 60-Hz power.

25. A Cincinnati Roll grinder machine, or equal, 18 x 72 in. Unit occupies a floor space of 26 x 12 ft and is powered by a 25-hp motor operating on 230/440-volt, 3-phase, 60-Hz power. Maximum swing over table is 19-1/2 in. Maximum weight of work handled is 10,000 lb. Grinding-wheel spindle speed is variable from 505 to 1,360 rpm.

11.5.3 MILLWRIGHT SHOP EQUIPMENT

The millwright shop is equipped with the following:

1. A steel-top fitters table, 48 x 120 in., capable of handling 2,000-lb working surface. Table is of all-steel construction and weighs 3,500 lb.

2. Two steel-top workbenches, 72 in. long x 36 in. wide, Lyon Model 2505 or equal.

3. Four Lyon Model 38-1018, or equal, storage cabinets, 36 in. wide, 18 in. deep, and 78 in. high.

4. A parts cleaner unit, 60 x 30 in., Peterson Pac 300 or equal. Unit has an inside working space of 36 x 60 in. and a solution depth of 26 in., agitated by two agitating pump units powered by a 1-1/2-hp motor; 15-kW electric heating unit. Tank shell is 12 gauge.

5. An A-frame hoisting unit of 2-ton hoisting capacity, equipped with a 2-ton, hand-operated, chain-type trolley hoist.

6. A mobile lifting crane, 2,000-lb capacity, with a hold-away feature and adjustable leg spread. Crane has a hydraulic hand pump and 62-in. lifting chain. Boom extends to 117 in. and adjusts horizontally to 80 in. Legs are equipped with 5-in.-dia wheels.

7. Two Lyon Model 3808 cabinets or equal, each cabinet 36 in. wide, 18 in. deep, and 78 in. high.

8. A bench-mounted NP 2-1/2 arbor press with approximate pressing capacity of 6 tons. Press unit handles stock of 15-1/2 in. dia. Size and length of ram is 1-1/2 x 1-1/2 x 27 in.

9. Two 10-in. pipejaw vises with swivel bases for mounting to steel-top workbenches.

10. A bench-mounted grinder equipped with two 8- x 1-in. grinder wheels with 5/8-in. arbor bore. Unit is equipped with safety glass eyeshields. Grinder 3/4-hp motor operates on 110-volt, single-phase, 60-Hz power.

11.5.4 PIPE SHOP EQUIPMENT

The pipe shop is equipped with the following:

1. A pipe bender, Pedrick Model D-15 or equal, with a bending moment of 130,000 in.-lb for bending 6-in.-dia, extra-heavy pipe. Unit has 4-1/2 spindle diameter powered by a 15-hp motor. Power supply is 230/460 volts, 3 phase, 60 Hz.

2. A pipe and bolt threading machine, capable of cutting and threading pipes up to 6 in. dia and bolt stock up to 1/2 in. dia and 4 in. long. Unit is powered by a 3-hp, 230/460-volt, 3-phase, 60-Hz motor.

3. An abrasive belt grinder, furnished with a 2- x 48-in. abrasive belt operating at surface speed of 6,000 fpm. Unit has a throat clearance of 7-1/2 in. Grinder motor is 3/4-hp, 116/230 volts, 1 phase, with "V" pulley drive.

4. Two steel-top workbenches, 72 in. long x 36 in. wide x 34 in. high, Lyon Model 2505 or equal.

5. A pedestal-mounted Powermatic 20-in. drill, or equal, with a variable-speed, belt-driven drive with speeds ranging from 135 to 1,350 rpm. Drill is capable of drilling 2-in.-thick stock. Unit is powered by a 1-1/2-hp motor operating on 230/460-volt, 3-phase, 60-Hz power.

6. A pedestal-mounted grinder with two 12- x 2- x 1-1/4-in. grinding wheels and safety shields. Grinder is powered with a 2-hp motor operating on 230/460-volt, 3-phase, 60-Hz power.

7. A bench-mounted grinder equipped with two 8- x 1-in. grinder wheels with 5/8 arbor bore and safety-glass eyeshields. Grinder 3/4-hp motor operates on 110-volt, single-phase, 60-Hz power.

8. Two 10-in., pipejaw-face vises with swivel bases for mounting to steel-top workbenches.

9. Two parts bin storage units composed of six bins each. Bin unit is 3 ft wide, 1 ft deep, and 6-1/2 ft high.

10. Four Lyon Model 38-1018, or equal, storage cabinets, 36 in. wide, 18 in. deep, and 78 in. high.

11. Oxygen and acetylene welding kit composed of 75 ft of hoses, gauges, cutting torch, rosebud tip for heating, and various sizes of welding tips.

11.5.5 WELDING SHOP EQUIPMENT

The welding shop is equipped with the following:

1. A large, steel-top welding table, 48 in. wide x 120 in. long x 34 in. high, capable of handling working surface weights of 2,000 lb. The table is of all-steel construction.

2. Steel quench tanks, 2 x 4 x 2 ft high, of all-solid-steel construction.

3. An iron worker machine, No. 1-1/2 Buffalo Model or equal, with a punch ram pressure of 73 tons, capable of punching holes and plate of 15/16 x 7/8. The machine is powered by a 3-hp motor. Unit provides 44 strokes per minute.

4. A plasma arc welder, with two torch heads, capable of cutting plate stock 60 in. wide. Unit tracing table is 48 in. wide x 48 in. long. Machine requires 115-volt, 60-Hz power.

5. A welding positioner with a rated capacity of 2,500 lb. Unit provides a 135-deg tilt and 360-deg rotation table surface, powered by a 3/4-hp motor. Positioner operates on 230/460-volt, 3-phase, 60 Hz power. Table rotates at 2 to 5 rpm.

6. One coordinate drive flame cutting machine, capable of cutting shapes of 46 by 60 in. This unit is located in welding shop section to allow for shielding.

7. A welding unit, 600 A dc, at 40 volts. Open-circuit voltage is 75. Welding amperage is 90-865. Input amperage at 230 volts is 120. Unit power usage is 47.7 kVA. Welder weighs 1,230 lb.

8. A pedestal-mounted grinder, with two 12- x 2- x 1-1/4-in. grinding wheels and safety shields. Grinder is powered by a 2-hp motor operating on 230/460-volt, 3-phase, 60-Hz power.

9. Two steel-top workbenches, 72 in. long x 36 in. wide x 34 in. high. Benches are of all-steel construction with working surface capable of handling working stock weighing 2,000 lb.

10. Three Lyon Model 38-1018, or equal, storage cabinets, each 36 in. wide, 18 in. deep, and 78 in. high.

11. Parts storage bin units composed of six bins each. Bin unit is 3 ft wide, 1 ft deep, and 6-1/2 ft high.

12. A wire-feeder welder unit with speeds of 70 to 750 in./min. Unit handles wire sizes from 0.030 to 1/8 in. dia. Wire unit has all standard equipment and features, including a variable-speed, high-torque, permanent

magnetic motor. Feeder is a two-wheel drive system with "U" grooved drive rollers.

13. Oxygen and acetylene welding kits composed of 75 ft of hoses, gauges, cutting torch, rosebud tip for heating, and various sizes of welding tips.

14. Two 10-in., pipejaw-face vises with swivel bases for mounting to steel-top workbenches.

15. Bench-mounted grinder, 8- x 1-in. wheel, 1/2-hp motor.

11.5.6 SHEETMETAL SHOP EQUIPMENT

The sheetmetal shop is equipped with the following:

1. A hydraulic shear machine equipped with 2,000-lb jib crane and capable of shearing 3/8-in. plate stock 10 ft long. Unit is powered by main 30-hp motor drive. Power is 230/460 volts, 3 phase, 60 Hz.

2. A bending brake machine equipped with 2,000-lb jib crane and capable of bending 3/16-in. plate 100 in. long. Unit is powered by a 13.5-hp motor on 230/460-volt, 3-phase, 60-Hz power.

3. A sheetmetal roll machine equipped with 2,000-lb jib crane and capable of rolling 10 gauge to 3/16-in. plate and 3 x 3 x 1/4 angle shapes. Roller is 8 in. dia. Machine handles 120-in. plate. Power for 10-hp motor is 230/460 volts, 3 phase, 60 Hz.

4. A horizontal bandsaw, W.F. Wells F15 Model or equal, capable of cutting 15-in. round stock. Unit is driven by a 3-hp motor.

5. A metal-cutting bandsaw with all standard equipment and a 24- x 24-in. table that tilts 45 deg right and 15 deg left. Blade is 3/4 in. wide with blade speed of 47 sfm. Unit has a maximum depth of cut under guide of 12 in. Saw is powered by a 3-hp motor on 230/460 volts.

6. A spot welder, Stryco-D4-18-40 or equal, 40 kVA, 18-in. throat depth, 2-in. arm diameter. Space between arms is 6 to 11 in.

7. A large, steel-top table, 48 in. deep x 120 in. long x 34 in. high, capable of handling working surface weights of 2,000 lb. The table is of all-steel construction and weighs approximately 3,500 lb.

8. Two steel-top workbenches, 72 in. long x 36 in. wide x 34 in. high, of all-steel construction and having a working surface capable of handling working stock of 2,000 lb.

9. Two 10-in., pipejaw-face vises with swivel bases for mounting to steel-top workbenches.

10. Three Lyon Model 38-1018, or equal, storage cabinets, 36 in. wide x 18 in. deep x 72 in. high.

11. Three parts storage bin units, composed of six bins each, 3 ft wide, 1 ft deep, and 6-1/2 ft high.

11.5.7 CARPENTRY SHOP EQUIPMENT

The carpentry shop is equipped with the following:

1. A wood jointer, complete with steel knives, center-mounted fence, cutterhead, guard, motor pulley, and motor controls. Cutterhead is 8 in. in width, powered by 1-1/2-hp motor on 230/460-volt power.

2. A circular bandsaw, with table, guards, guides, motor controls, and wrenches. Cutting blade is 14 in., powered by a 2-hp motor on 230/460 volts.

3. A radial-arm saw, with table, guards, guides, motor controls, blades, and wrenches. Machine is equipped with a 15-in. crosscut blade and powered by a 2-hp motor on 230/460-volt power.

4. A table saw, with all standard equipment, such as table, guards, guide cutting blades, and motor controls. Machine is equipped with a 14-in. blade saw and powered by a 2-hp motor on 230/460-volt power.

5. A belt and disc sander, with all standard equipment, such as tilt table, guards, discs, and sanding belt. Belt speed is 2,850 sfm, disc speed is 2,400 rpm. Belt size is 6 x 48 in., with a supporting table under belt of 6-1/2 x 14-1/2 in. Disc wheel is 12 in., with a table 7 x 17-3/4 in. Motor is 1-1/2 hp operating on 230/460 volts at 1,800 rpm.

6. A pedestal-mounted drill, Powermatic Model 1200 or equal. Drill is a variable-speed, belt-driven unit, mounted on a table 24 x 40 x 34 in. high. Maximum distance from spindle to table is 25-1/4 in., drill stroke is 6 in. Motor is 2 hp on 230/460-volt, 3-phase, 60-Hz power.

7. A woodworking hardwood top, 36 x 72 x 34 in. high. Benches are Lyon models or equal.

8. A storage cabinet, Lyon Model 38-1018 or equal, 36 in. wide, 18 in. deep, and 72 in. high.

9. Rotary storage nail and screw parts bin units, 3 ft dia, four-tier style units, Lyon model or equal.

10. Parts storage bin cabinets, composed of six bins, each 3 ft wide, 1 ft deep, and 6-1/2 ft high.

11. Floor rolling material and handling carts.

11.5.8 ELECTRIC AND INSTRUMENT SHOP EQUIPMENT

The electric and instrument shop is equipped with the following:

1. A pedestal-mounted drill, Powermatic Model 1200 or equal. Drill is a variable-speed, belt-driven unit, mounted on a table 24 x 24 x 34 in. high. Maximum distance from spindle to table is 25-1/4 in. Drill stroke is 6 in. Motor is 2 hp, 230/460 volts, 3 phase, 60 Hz.

2. Three test benches, with bonded wood top, 1-3/4 in. thick, set on steel leg framing. Benches are 36 x 6 x 34 in. Bench units include electrical outlet strips, bottom shelving, and aerial selving attachments.

3. Storage cabinets, Lyon Model 38-1018 or equal, 36 in. wide x 18 in. deep x 72 in. high.

4. A despatch oven unit, 48 in. wide x 67 in. long x 62 in. high. Unit is driven by a 3-hp, 230/460-volt motor. Maximum operating temperature is 500°F.

5. An insulation shear machine, Peerless 45669 Model or equal, hand operated. Unit requires a 4- x 4-ft floor area.

6. A bench-mounted, No. 2-1/2 arbor press, with approximate pressing capacity of 6 tons. Press unit handles stock of 15-/12 in. dia. Size and length of ram is 1-1/2 x 1-1/2 x 27 in.

7. A bench-mounted grinder, equipped with two 8- x 1-in. grinding wheels, with a 5/8-in. arbor bore. Unit is equipped with safety-glass eyeshields. Grinder 3/4-hp motor operates on 120-volt, single-phase, 60-Hz power.

8. Three 10-in., pipejaw vises with swivel bases furnished for mounting to steel-top workbenches.

9. Storage bin units, Lyon Model 3800 or equal. Steel bin units are six bins each, 3 ft wide, 1 ft deep, and 6-1/2 ft high.

11.5.9 PLASTIC, GLASS, AND CERAMIC SHOP EQUIPMENT

The plastic, glass, and ceramic shop is equipped with the following:

1. A bench-mounted belt grinder, supplied with 2-1/2- x 60-in. belt; 1-1/2- hp, 230/460-volt, 3-phase motor. Belt speed is 8,000 surface ft/min. Contact wheel is 7 ft dia x 2-1/2 in.

2. A bandsaw, with all standard equipment, including a 24- x 24-in. table that tilts 45 deg right and 15 deg left. Blade is 3/4 in. wide with blade speed of 47 sfm. Unit has a maximum depth of cut under guide of 12 in. Saw requires a 3-hp motor powered by 230/460 volts.

3. A masonry saw, 20 in., Everett Model 20 or equal, equipped with a 10-hp motor powered by 230/460 volts, 3 phase, 60 Hz.

4. A pedestal-mounted drill, Powermatic Model 1200 or equal, variable-speed, belt-driven unit. Unit is mounted on a table 24 x 40 x 34 in. high. Maximum distance from spindle to table is 25-1/4 in.; drill stroke is 6 in. Motor is 2 hp, powered by 230/460 volts, 3 phase, 60 Hz.

5. A hardwood-topped bench, 36 in. wide x 72 in. long x 34 in. high.

6. A cutting table, topped with a marble cutting surface, 36 in. wide x 72 in. long x 34 in. high.

7. Storage cabinets, Lyon Model 38-1018 or equal, 36 in. wide x 18 in. deep x 72 in. high.

8. Two vertical-style storage racks, with 6-in. slotted opening, 3 ft wide x 5 ft high, for storing plate glass and plastic sheets vertically.

11.5.10 PAINT SHOP

The paint shop is provided with the following:

(1) One spray-gun painter unit.

(2) One spray booth, 26 x 16 ft, equipped with fume-exhaust ventilation and drying heat lamps.

(3) Two steel-top workbenches for paint mixing; bench size 48 x 72 in.

(4) Storage shelving and cabinets for paint.

(5) Three vibrating paint mixer units.

(6) One shower and eyewash station for employee safety.

11.5.11 STEAM CLEANING AREA

The steam cleaning area provides capability to degrease and clean equipment and components, using hot water at 210^{o}F minimum and pressure of 2,000 psi. The flow rate of hot water is 10 gpm.

The steam cleaning area floor is sloped toward a central drain for collection of wash water, soap, and grease.

Equipment and components requiring cleaning are moved into and out of the steam cleaning area by rolling material handling carts, forklift trucks, and mobile floor cranes.

11.5.12 MOCKUP AREA

The mockup area provides the capability of full-height mockup of cask-to-cell transfers and remote manipulations in the hot cells of the R&H Facility. The mockup area is a high bay adjacent to the shops in the Site Services Building.

The mockup area is equipped with a metal, movable-wall system to depict the hot-cell walls of the R&H Building. The wall system has false viewing windows and through-wall manipulators identical to the manipulators in the hot cells. The area representing the hot cell is equipped with remote-handling equipment and an overhead crane identical to those provided in the hot cells of the R&H Facility.

11.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

11.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided by a compressor system. The air system consists of a compressor, coolers, separator, filters, receiver, dryers, and associated controls and instrumentation.

The hot water boiler system requires supply of fuel oil, natural gas (if available), and process water.

The fuel-oil system consists of a day tank and a supply pump supplying No. 2 diesel oil to the boiler at a winter peak rate of 13.8 gph and 30 psig. Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 1,921 scfh.

Process water is used for makeup water to the boiler, and is continuously supplied at the winter peak rate of 1.5 gpm.

Potable water is used for fire protection, drinking, restrooms, eyewashes, and safety showers.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. It is collected by gravity flow to a collection tank located near the Site Services Building at the maximum drainage flow rate of 5.6 gpm.

Cylinders of compressed gas for shop use are provided.

11.8 INSTRUMENTATION AND CONTROL

11.8.1 DISTRIBUTED CONTROL SYSTEM

All of the centralized process and utility monitoring control and alarm systems are contained in two redundant, distributed control systems (DCSs). The control consoles and CCTV monitors for the primary system are located in the R&H Building control room. The identical equipment for the redundant DCS is located in the Site Services Building control room. To preclude the possibility of plant shutdowns caused by sabotage or failure of control room equipment, the redundant DCS is configured to assume control of all centralized plant operations automatically when initiated by a self-diagnostic command or by manual switchover. During normal operations, the DCS provides only supervisory monitoring of the spent fuel (SF), remote handled transuranic waste (RHTRU), and high-level waste (HLW) operations in the four shielded process cells and the two canyon cells. Local, interactive control of these fuel- and waste-handling operations is accomplished by means of individual cathode-ray tube (CRT), hard-wired control stations, and CCTV monitors located at the cell viewing windows. If necessary, the control room operator can perform a controlled shutdown of all in-cell SF, RHTRU, and HLW handling, consolidation, and other activities at the DCS console located in the control room.

The DCS operator consoles are interfaced with hot-cell local control panels, and provide shutdown of certain process and cell functions and monitoring of all process and handling operations by means of a distributed input/output system. All site-support functions and utilities are remotely monitored and capable of being controlled by the DCS.

The operator consoles permit displays of current process status, process alarms, and radiation monitoring and alarms, and include the capability for control room operators to modify selected process operating parameters. The process cell supervisor is able to shut down the cell operations normally controlled at the hot cell window locations by actuating controlled access switches on the operator console dedicated to that particular cell. These shutdowns are initiated by such occurrences as criticalities, process upsets, and administrative decisions.

Such records as the results of sample analyses in the analytical laboratory and analyzer room; health physics personnel exposure records; HVAC, radwaste, and utility process status and alarms; accountability of stored waste materials; and process cell and remote handled equipment maintenance room status and alarms are kept in the DCS central memory.

The control room has data retransmission capabilities for providing remote locations with required process, alarm-status, monitoring, and trending information, and historical data.

The DCS operating system is programmed with operational safeguards so that the local CRT panel operator may only initiate certain assigned cell operations by use of controls on the local process cell operating panel. Such operations as the movement of fuel bundles from the shipping cask to the upender, positioning of the laser cutter assembly inside a PWR bundle support tube, and the initiation of laser cutting may be begun by means of these controls. After initiation, the operational logic is automatically completed by means of programmable logic controllers (PLCs) mounted within some of the local operating panels.

Other, higher-level control parameters may only be changed at the control room console. At this location, such parameters as closed-loop analog setpoints and alarm trip points may be changed by supervisory personnel. Other, more critical parameters (such as closed-loop controller mode settings, signal conditioner and transmitter zero and full-scale settings, and counter and timer settings) may only be changed by properly authorized engineering and maintenance personnel, using controls that are not accessible to operating personnel.

Full graphics, annunciation, indicating, and recording capabilities are provided by the DCS. Information, in engineering units, is stored in computer memory, and is available for presentation in trending plots, alarm printouts, process-variable printouts, and graphics presentations. Historical data presentations and management reports are available in hard-copy form as obtained from rigid disk or magnetic tape memory devices.

Instrumentation is designed to provide for the accountability of all transuranic (TRU) material stored and handled within the MRS Facility. Serial numbers of all incoming shipping casks are recorded and checked against shipping records. In addition, the serial numbers and locations of all incoming, onsite-generated, and outgoing containers and their contents (spent fuel bundles; HLW, RHTRU, HAW, LLW, and CHTRU drums; and waste-containing metal boxes) are recorded. These records are used to perform periodic physical inventories to confirm the presence of all accountable materials within the R&H Building and the MRS storage facilities.

Process, HVAC, solid and liquid radwaste, and all utility monitoring and control for the R&H Building are shown on the process and instrumentation diagrams (P&IDs) and the material handling drawings. Similar information for the support facilities and utilities is shown on separate P&IDs, as applicable.

The DCS interface with the support facilities consists of process-variable and alarm signal input monitoring only. No control is provided by the DCS for any of the support facilities, the CHTRU storage facilities, or the SF, HLW, and RHTRU storage areas. Control is provided to the support and storage areas outside the R&H Building by means of dedicated controllers and other hard-wired components wherever required.

The DCS is powered by the uninterruptible power supply (UPS) system that receives power from the emergency generators if normal, utility-supplied power is lost. In this manner, the DCS will remain operational long enough to maintain the safe operation or shutdown of all safety-related R&H Building systems if any Category I incident, criticality, or radiation excursion should occur. Direct-current (dc) power to all process transmitters, current-to-pressure converters, and other equipment, including logic components, is supplied by an auctioneered, redundant, primary 24-volt dc power supply system located in the R&H Building control room I/O cabinets. A drop in dc voltage by 10% or more causes an automatic switchover to the redundant dc supply located in cabinets in the I/O cabinet room.

All of the analog signals requiring a ground are connected to the R&H Building analog ground bus. This bus enters earth ground at only one point to preclude interferences caused by common mode, electromagnetic, and electrostatic interactions as much as possible. A separate digital system ground bus is provided for all of the discrete system components to similarly preclude interferences in these systems, and to prevent interactions with the analog circuits. This bus also enters earth ground at only one point at the R&H Building.

The major system components for the DCS are shown on the MRS Instrumentation, Control, and Monitoring System Block Diagram, Drawing H-3-56786.

The DCS equipment is maintained by direct contact because all of the I/O cabinets, instrumentation, and control components are located in environmentally favorable areas that are accessible. Maintenance is accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

Detectors, switches, and final control system actuators that are located in radioactive areas are designed for remote manipulator replacement. Even though they are made of radiation-resistant materials, infrequent replacement will be required because of such phenomena as aging, wear, and unusual occurrences.

11.8.2 RADIATION MONITORING SYSTEM

The radiation monitoring system uses two redundant control terminals containing microprocessors, which serve as interfaces between the control room operators, the distributed control system (DCS), and the process radiation monitors. One control terminal is located in the R&H Building control room and the other is located in the Site Services Building control room. Each interfaces with colocated DCS control room equipment, respectively, so that failure of one control terminal or signal transmission line will not result in the loss of any of the protective functions of the radiation monitoring system. The control terminals perform engineering calculations on the detector signals to provide localized information on dose rates, alarm conditions, operational status, or criticality conditions within seconds of their occurrence. The automatic acquisition of historical data and the transfer of these data to a peripheral device or to the DCS may be initiated for any channel by the operator or, upon interrogation, by the DCS. System annunciators are included on the front panel to provide visual and audible indication of the composite status of the system.

System status, as indicated by the built-in annunciator, is defined by seven lights, in order of least to highest priority, as follows:

(1) NORMAL will be lighted if any channel in the system is in normal or alarm-off status.

(2) MAINTENANCE will be lighted if any channel in the system is in calibrate, maintenance, check source, standby, or flush mode.

(3) FAIL will be lighted if any channel is in a failed condition or if the redundant radiation control terminal is offline.

(4) TREND will be lighted if any channel is in trend alarm status.

(5) ALERT will be lighted if any channel is in alert alarm status.

(6) HIGH ALARM will be lighted when any channel is in high alarm or flow alarm status.

(7) CRITICALITY (red light) will be lighted when a criticality condition exists at any field unit.

11.8.3 PROCESS CCTV SYSTEM

The process closed-circuit television (CCTV) system permits the monochrome viewing of handling and processing operations in the shielded process cells, the canyon cells, the shipping cask unloading areas, and the storage cask loadout areas. All of the process CCTV cameras have pan, tilt, and zoom (PTZ) capability and are radiation-resistant because they are all located in high-radiation areas. They are also designed for remote maintenance or replacement by remote-handling equipment, when required.

Near the R&H Building shielded process and canyon cell viewing windows, dedicated 14-in. CCTV viewing monitors are provided to aid the operator in performing the in-cell mechanical handling operations associated with fuel assembly removal from shipping casks, end fitting and fuel channel removal, movement into and out of lag storage, fuel pin consolidation, transfer of fuel bundles, insertion into canisters, canister welding, canister leak checking, and loadout of canisters into storage casks or transporter shields for transfer to the storage areas. Other in-cell operations for transferring and handling the HLW and RHTRU drums are aided by the process CCTV cameras located in the canyon cells. Two cameras are located in each cask unloading area to aid the operator in the semiautomatic fuel assembly unloading operations. Two cameras are located in each loadout area to aid in positioning the canisters inside casks or transporter shields for transfer to the storage area. Drawing H-3-56787 is a block diagram of the process CCTV system.

As shown on Drawing H-3-56787, a 14-in. monitor is dedicated to an in-cell camera. The PTZ controls for these cameras are located at small control stations near the cell windows in the galleries. Additional limited-access PTZ controls are located in the R&H Building and Site Services Building control rooms. Six 17-in. monitors are located in ceiling-mounted fixtures above the DCS console in the R&H Building and Site Services Building control rooms. These monitors can be switched to any camera in the system, using the primary controls in the R&H Building control room or the backup controls in the Site Services Building control room. The control room supervisory monitors can be used in a scanning mode to view all or a selected subgroup of cameras sequentially, or to monitor an individually selected camera.

Switching is accomplished by means of a primary microprocessor-controlled switcher located in the R&H Building control room, which is backed up by a redundant switcher located in the input/output (I/O) cabinet room near the control room. All signal conditioning, monitoring, and switching equipment is designed to enable modular replacement of components for minimum maintenance downtime.

The locations of all process CCTV cameras are shown on Drawing H-3-56789, Sheets 1 through 3.

11.8.4 GENERAL-PURPOSE COMPUTER TERMINAL

A remote, general-purpose computer terminal with CRT, keyboard, send/receive (KSR) printer, and modems is provided in the R&H Building control room. This terminal is interconnected with the general-purpose computer in the Administration Building. Full computational and operating system software is included with this system. It is used by various departmental personnel for materials requisitioning; cask, spent fuels, and nuclear waste inventory control; maintenance control; engineering support; and scheduling activities.

11.8.5 RADIATION COUNTING SYSTEMS

An area is provided for radiation protection facilities, including a radiological instrument calibration laboratory and a low-level counting room. Localized shielding is provided where necessary to reduce the background radiation to the required levels.

Standardized instrumentation provides the capability for radiation calibration and counting.

11.8.6 UTILITY SYSTEMS

All utility systems in the Site Services Building are remotely monitored, and capable of being remotely controlled.

The hot water boiler is monitored remotely as well as locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, along with a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel oil supply day tank (TK-505) contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning on and off the transfer pump by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel oil supply pumps are controlled from the boiler control panel. Only status light signals are transmitted to the DCS, as shown on Drawing H-3-56937, Site Services Building, Hot Water Boiler.

Oil-free, dried plant and instrument air is provided by a compressor, backed up by a spare. The compressor is controlled locally from a vendor-furnished panel and monitored remotely for motor on-off status. The plant air is dried and the pressure is dropped to 100 psig, and monitored remotely for pressure before entering the distribution header. The instrument air is dried to a dewpoint of -40°F, the pressure is reduced to 100 psig, and the air is remotely monitored for moisture content and pressure.

11.8.7 SECURITY AND FIRE ALARMS

All fire alarms in the Site Services Building are monitored by the fire alarm monitoring system in the Fire Station, and transmitted to the Alarm Monitoring Station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

11.8.8 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

11.9 PIPING

11.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered.

A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by electric hot water heaters and drinking water by electric water coolers.

Plumbing fixtures meet requirements for the physically handicapped.

Safety shower and eyewash stations are provided in compliance with ANSI Z358.1.

Piping runs are concealed in ceilings, walls, and furred spaces in the office area of the building and are exposed in the shops and mockup area.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

11.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas, if applicable, are connected to the MRS Facility distribution system. Fuel-oil and fuel-gas usage for the building are metered.

Equipment and funnel oily drains are provided in the boiler room, and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC equipment drains are provided, and connected to the MRS Facility process sewer system.

A floor drain is provided in the steam cleaning room, installed with a grease trap, and connected to the process sewer system.

Process water is supplied at 100 psig from the building potable water supply. A reduced-pressure principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Process water is provided for heating system makeup and utility stations in the shops for washdown, quench tank filling, and other uses.

Hot water at 210°F and 2,000 psig is provided in the steam cleaning room, supplied from a hot water cleaning machine installed in the room.

Plant air and instrument air are supplied from equipment in the compressor room of the building.

Plant air utility stations for air-tool use are provided in the boiler room, mechanical equipment room, shops, and mockup area. A supply is also provided to the H-frame press and glove box blaster.

Instrument air is provided in the boiler room, mechanical equipment room, and mockup area.

Compressed gases are provided to the welding shop from the gas bottle storage room.

Piping runs are exposed in the shops and mockup area. Overhead piping will be located above a clear height of 14 ft in the shops.

The complete installation is in compliance with ANSI B31.1.

11.10 ELECTRICAL

11.10.1 POWER SERVICE

Building power is obtained from an outdoor, pad-mounted transformer. It transforms the primary voltage to 480Y/277 volts for distribution to all power and lighting loads.

Standby power at 480 volts, 3 phase, 4 wire is fed from the Security Building to the Site Services Building main switchgear for critical and emergency power.

An uninterruptible power supply (UPS) is provided to prevent loss of memory in the computer. The telephone system is provided with its own battery backup power system.

The shop areas are provided with 480-volt, 3-phase, plug-in bus duct service. At service aisles and assembly/storage pads, auxiliary outlets are provided at 208 and 120 volts.

Isolated and/or regulated voltage is provided at the radiation protection room and at the computer station.

11.10.2 LIGHTING

11.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all interior areas except high-bay areas. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps. Fluorescent fixtures in storage areas and mechanical and electrical equipment rooms are of the industrial type with rapid-start lamps. Fluorescent fixtures in shop areas are of the industrial type with very-high-output lamps. HID lighting is used in high-bay areas. All ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID luminaires are used on the exterior of the building. Select HID light fixtures are equipped with separate tungsten-halogen lamps to provide illumination during restrike time of HID lamps. Ballasts with integral fuses are suitable for use with metal-halide or mercury-vapor lamps.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are time-switch controlled with a manual override.

11.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system automatically switches to an individual, self-contained battery unit upon loss of normal power. Emergency lighting is supplied at stairways, corridors, control room, and shop areas.

The batteries have capacity for 90 minutes of continuous operation. The emergency lighting is supplied from a standby source and is panel-switched. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

11.10.2.C. Outdoor Floodlighting and Area Lighting

General-purpose street and area lighting for ramps, parking areas, and lighting in outdoor and night operational areas is of the HID type.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor floodlighting is provided as required for drive-up and parking areas.

11.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination are determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

11.10.2.E. Exit Lighting

The entire exit lighting system is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided for all emergency exits and passageways as required by the NFPA Life Safety Code - No. 101.

The electrical power source for the exit lighting system is connected to the standby or normal power source. The exit lighting system consists of self-contained, battery-powered, individual emergency lighting units.

Exit lights and signs are combined in an internally illuminated fixture with translucent globe or letters, as approved by Underwriters' Laboratories, Inc., for this service.

11.10.2.F. Explosionproof Light Fixtures

Lighting fixtures and installation in the paint/storage area, gas cylinder manifold and storage area, spray booth, and oil storage area are explosionproof in accordance with Chapter 5, Article 500, of the NEC.

11.10.3 COMMUNICATIONS

11.10.3.A. Telephone System

The main EPABX equipment for the MRS Facility is located in the Site Services Building. The system includes, but is not limited to, the basic switching equipment, station equipment, battery backup, distribution frame, house cable, and other peripheral or ancillary equipment. The EPABX is of solid-state and digital design, and is linked to the national telephone network via cable or a private microwave system. Provision is made for direct ringdown (hot lines) for use by security or other emergency requirements. The switch is compatible with the public switched network and the Federal Telecommunications System (FTS) CCSA network. The EPABX is the primary system for all other communications systems and interfaces with the public address system, mobile-fixed radio system, and security system.

11.10.3.B. Public Address System

A public address system is installed in the Site Services Building for paging. The public address system is accessed through the telephone system from selected locations. The system is provided with 12 paging zones, and operates as follows:

(1) Zone 1: All calls; this zone covers all areas of the Site Services Building.

(2) Zone 2: All shop areas.

(3) Zone 3: All office areas.

(4) Zones 4 to 12: These zones provide paging for other buildings.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all large paging areas.

The public address system employs the latest solid-state devices, and all speaker cables are installed in a conduit.

11.10.3.C. Fire Alarm and Detection System

The electrically supervised, noncoded, zoned, building fire alarm system includes a fire alarm control panel, smoke detectors, fire sensors, manual fire alarm stations, annunciator panel, standby batteries, connections to the sprinkler system, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station. The annunciator panel is located in the lobby area. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA-101 Life Safety Code.

11.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

In the Site Services Building, six different HVAC systems are provided to meet the diverse functions and occupancies of the building.

11.11.1 OFFICE AREA

A double-duct, variable-air-volume system - equipped with economizer cycle and conventional (pneumatic/electric) automatic and local manual controls - provides the HVAC requirements for the office area.

Major equipment includes the following:

(1) Air-handling unit, blow-through type, including filter box, direct-expansion cooling coil, hot water heating coil, and supply fan with inlet vane airflow rate capability control.

(2) Return/exhaust fan with inlet vane capacity control.

(3) Air-cooled condensing unit with refrigerant piping and controls.

(4) Economizer cycle control dampers.

(5) Variable/constant-volume-type, dual-duct mixing boxes.

(6) Exhaust fans and gravity relief vents.

(7) Hot water boiler with supply and return water lines and associated controls.

(8) Hot water pumps.

(9) Hot water unit heater.

(10) Zone room thermostats and associated controls.

Upon system startup, the supply and return/exhaust fans energize and the minimum outside airflow damper opens. With low outside air temperatures, a minimum of outside air mixes with a maximum of return air. The mixed air then passes through the filters, the cooling and heating coils, and is supplied to the building.

The office area is divided into 10 temperature zones. Each temperature zone is provided with a zone room thermostat that, when room temperature is low, initially throttles the air volume of the mixing damper located in the zone supply air duct. With further drop in room temperature, the thermostat continues to modulate cold air flow down to a minimum setpoint, after which the cold air valve of the mixing box begins to close, and the warm air valve opens to a point at which the higher supply air temperature handles the load conditions.

When the outside air temperature rises to 60°F, the sensible heat economy cycle control places the system on 100% outside air, and the cooling system is deenergized. Upon continuing rise in outside air temperature to 70°F, the outside air dampers are returned to the minimum open position. The refrigeration system is energized to maintain desired supply air temperature. Zone room thermostats modulate the zone variable air-volume dampers to increase air supply to each zone as required to maintain room design temperatures.

In the heating cycle (or lower cooling requirements), as the variable air dampers throttle the zone airflow rates, the pressure in the supply duct increases. In turn, the inlet vanes on the supply fan decrease the supply air flow to match the action of the dampers. The decrease in supply air is monitored, and the information is transmitted to a flow-control system. This system in turn monitors and controls the flow through the return/exhaust fan, maintaining the constant differential flow rate necessary to maintain building pressurization and provide the necessary intake of outside air to balance the air lost through the various exhaust fans.

Smoke detectors, located in the main supply and return air ducts, shut down the HVAC system in case of fire. A capability is provided to manually place the system in a 100% exhaust mode for smoke purging.

In addition to the 10 temperature zones, the boiler room (not supplied from the office area HVAC system) is provided with a roof exhaust fan (operating continuously) and a hot water unit heater to provide heating and ventilating requirements.

The dual-duct, variable-air-volume system was chosen for this building because it provides flexibility of zone control; air source for both heating and cooling at all times; effective energy use because of the elimination of simultaneous heating and cooling; reduced operating cost because of lower fan power consumption; and ability to select HVAC equipment for maximum instantaneous peak loads, rather than the sum of all peaks, resulting in reduced initial capital costs.

No provisions have been made to recover heat from exhaust air because only a minimum of outside air will be brought into the building to offset exhaust and pressurization requirements. The economizer control described in this subsection is a sensible heat type.

11.11.2 COMPUTER ROOM

The computer room is served by the double-duct HVAC system described in Section 11.11.1; however, in addition, a self-contained computer room air-conditioning unit (consisting of supply fans, evaporator coil, compressor, humidifier, filters, electric reheat coil, and all associated piping and controls) provides the cooling and humidification requirements for the computers.

The unit is located inside the computer room, and delivers constant-temperature air via an under-floor duct system. The computer room air-conditioning unit is provided with standby electrical power in case of normal power failure.

11.11.3 SHOP AREA

A single-duct, single-zone, constant-volume system, equipped with an economizer cycle, provides heating, cooling, and ventilation for the shop area.

Major equipment includes the following:

(1) Air-handling unit, draw-through type, including filter box, direct-expansion cooling coil, hot water heating coil, and supply fan.

(2) Return/exhaust fan.

(3) Air-cooled condensing unit with refrigerant piping and controls.

(4) Economizer cycle control dampers.

(5) Exhaust fans, including hoods as required for the different shop areas.

(6) Dust collection system.

(7) Gravity relief vents.

Upon system startup, the supply and return/exhaust fans energize, and the minimum outside air damper opens. With low outside air temperatures, a minimum of outside air mixes with a maximum of return air. The mixed air is filtered, heated, and then delivered to the different shop areas.

When the outside air temperature rises to 60°F, the sensible heat economy cycle control places the system on 100% outside air, and the cooling system is energized. Upon continuing rise in outside air temperature to 78°F, the outside air dampers are returned to the minimum open position. Refrigerant flow rate through the air-handling unit cooling coil is modulated, as necessary, to maintain desired supply air temperature.

Exhaust fans, hoods, dust collector, etc., provide required exhausts for the different shops. Several of these exhaust fans operate on an as-needed basis. When any or all exhaust fans are not running, the excess air is exhausted or returned (as required by the economizer cycle) by the return/exhaust fan.

No provisions have been made to recover heat from exhaust air because only a minimum of outside air is brought into the building to offset exhaust and pressurization requirements. The economizer control described in this subsection is a sensible heat type.

11.11.4 SPRAY BOOTH AREA

A single-duct, single-zone, two-speed system provides heating, ventilating, and exhaust makeup for the spray booth area.

Major equipment includes the following:

(1) Air-handling unit, draw-through type, including filter box, electric heating coil, and two-speed supply fan.

(2) Spray booth exhaust fan.

(3) Area exhaust fan.

(4) Control thermostat and hand switch with associated controls.

When the paint spray booth is not operating, a fixed amount of outside air is filtered and heated (if required) and delivered to the spray booth and paint storage areas by the supply fan operating at low speed. The air is then exhausted to the outside.

When the paint spray booth is in operation, the spray booth exhaust fan is activated, and the air-handling unit supply fan is turned to high speed to provide exhaust makeup air.

11.11.5 STORAGE BUILDINGS (Lumber and Oil)

Each storage building is provided with a roof exhaust fan and an intake louver to provide year-around ventilation. The entering air is not filtered and heating is not provided for either of the two storage buildings.

11.11.6 ELECTRICAL ROOM

The electrical room is equipped with a roof exhaust fan and an electric unit heater to provide required heating and ventilation. Unfiltered and unheated outside air is drawn into the building through an intake louver.

11.12 FIRE PROTECTION

Fire protection is provided throughout the Site Services Building and the three small separate buildings which are provided near the maintenance facilities for paint shop/storage, oil storage, and lumber storage. The Site Services Building includes an automatic wet-pipe sprinkler system, a Halon

1301 system, and portable fire extinguishers. The three small separate buildings are each provided with an automatic dry-pipe sprinkler system and portable fire extinguishers.

11.12.1 WET-PIPE SPRINKLER SYSTEM

An automatic wet-pipe sprinkler system is provided throughout the Site Services Building except in electrical equipment rooms. This system is designed in accordance with NFPA 13 and is complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls. Fire Department connections provide a secondary water supply for the installed sprinkler system.

11.12.2 DRY-PIPE SPRINKLER SYSTEM

An automatic dry-pipe sprinkler system is provided throughout the paint shop/storage, oil storage, and lumber storage buildings. This system is designed in accordance with NFPA 13 and is complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls. Fire Department connections provide a secondary water supply for the installed sprinkler system.

11.12.3 HALON 1301 SYSTEM

Areas of high value or of high program importance (e.g., computer areas/control alarm, electrical equipment rooms, and remote surveillance room) are provided with a total-flooding Halon 1301 system (with sprinklers provided as a secondary system for basic building protection). The system consists of fixed piping manifolded racks, cylinders, detectors, circuits, alarms, and controls designed to provide detection, alarm, and extinguishment of fire in accordance with NFPA 12A.

The electrical equipment rooms are protected by the Halon 1301 system only.

11.12.4 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are provided for the Site Services Building in accordance with NFPA 10.

SECTION 12

WAREHOUSE

12.1 INTRODUCTION

The Warehouse, used for storing supplies in support of operations, is located near the Site Services Building. It is provided with both truck and rail access.

12.2 CIVIL AND SITE DEVELOPMENT

12.2.1 PARKING

Parking for the employees working in the Warehouse is provided outside the Main Gate/Badgehouse. Additional parking for trucks and onsite vehicles is provided adjacent to the Warehouse.

12.2.2 LANDSCAPING

No landscaping is provided for this facility.

12.3 STRUCTURAL

The Warehouse is a braced steel building with metal roof, spread footings, and slab-on-grade floor. Office and support areas are constructed of light-gauge steel framing

12.4 ARCHITECTURAL

12.4.1 GENERAL

The Warehouse is a separate, single-story structure with a rectangular plan of overall size 275 x 150 ft; however, the actual net floor area is approximately 39,000 sq ft.

The Warehouse is located near the Site Services Building, and serves as the main storage location for the MRS support facilities.

(1) The Warehouse is normally occupied by eight warehouse personnel as follows:

Assignment	Number of Personnel by Shift Day	2nd	3rd	4th	Total
Supervisor	1	-	-	-	1
Clerks	2	-	-	-	2
Warehousemen	2	1	1	1	5
Total	5	1	1	1	8

(2) The Warehouse has a waiting area, receiving room, and toilet rooms for both men and women. A room is also provided for electrical equipment.

(3) The Warehouse has two loading/unloading areas: one for railcars and one for trucks. Each area has dock levelers of the appropriate type.

12.4.2 MATERIALS OF CONSTRUCTION

The Warehouse is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The Warehouse is a one-story, preengineered, metal building consisting of a structural steel frame covered with insulated, preformed metal siding and roof panels. The railcar unloading area has a preformed metal canopy and fascia.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

12.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B-2

(2) Ceiling heights: 9'-0" for waiting, receiving and electrical equipment rooms

8'-0" for toilets

24' (approximately) for high-bay storage areas

(3) Kind of traffic: Foot traffic
Forklifts
Truck pallets
Delivery trucks

(4) Size of access openings: 10'-0" x 10'-0", 12'-0" x 12'-0", 12'-0" x 16'-0" personnel/equipment access doors

3'-0" x 7'-0" personnel

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Waiting, receiving	Vinyl tile	Rubber cove	Gypsum board	Suspended acoustic tile
Toilets	Ceramic tile	Ceramic tile	Ceramic tile	Cement plaster

(6) Special equipment:

Waiting, receiving	Desks, chairs, file cabinets Vending machines
Toilets	Metal toilet partitions Toilet accessories Mirrors
Warehouse	Dock levelers

12.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

The material handling equipment includes industrial trucks with fork and drum-handling attachments.

12.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

12.7 MECHANICAL PROCESS

Potable water is provided for fire protection, drinking, and restrooms.

12.8 INSTRUMENTATION AND CONTROL

12.8.1 GENERAL-PURPOSE COMPUTER TERMINAL

A remote, general-purpose computer terminal with CRT, keyboard, send/receive (KSR) printer, and modems is provided in the Warehouse. It is used by personnel for material requisitioning and inventory control.

12.8.2 UTILITY SYSTEMS

All utility systems in the Warehouse are remotely monitored and capable of being remotely controlled.

12.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Warehouse are monitored by the fire alarm monitoring system in the Fire Station, and transmitted to the Alarm Monitoring Station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

12.9 PIPING

12.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

Hot and cold water piping is insulated.

Piping runs are concealed in ceilings, walls, and furred spaces in the office area.

Pipe runs are exposed in the Warehouse.

The complete installation is in compliance with the Uniform Plumbing Code, state ordinances, and DOE Order 6430.1.

12.9.2 PIPING

Not applicable to this facility.

12.10 ELECTRICAL

12.10.1. POWER SERVICE

Building power is obtained from an outdoor, pad-mounted transformer. It transforms the 4.16-kV primary voltage to 480Y/277 volts for a motor control center (MCC) distribution unit located within the warehouse area including service to the heliport.

The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose type in NEMA-1 enclosures.

A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel are used in a radial-type distribution system for receptacles and other small loads.

12.10.2 LIGHTING

12.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. Local switching is provided on all lighting circuits.

HID lighting fixtures are used in the storage areas. Fluorescent fixtures in office areas have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, and energy-efficient type.

HID luminaires with ballasts and integrally mounted fuses are used on the exterior of the building.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are time-switch controlled, with manual override.

12.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system automatically switches to emergency power upon loss of normal power, and consists of self-contained, battery-operated emergency equipment with 120-volt ac output.

The batteries have a capacity for 90 minutes of continuous operation. The emergency lighting circuit is panel-switched. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

12.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectric relay-controlled, with a manual switch override. Outdoor HID floodlighting is provided for the dock and ramp area of the Warehouse.

12.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

12.10.2.E. Exit Lighting

All exit lighting is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided as required by the NFPA Life Safety Code - No. 101.

12.10.3 COMMUNICATIONS

12.10.3.A. Public Address System

Public address system speakers are installed in the Warehouse building for paging. The system is provided with three paging zones, and is initiated from the Site Services Building for a priority call or by access through the telephone system from within the Warehouse.

Zone 1: All calls from the Site Services Building
Zone 2: Warehouse - storage area
Zone 3: Warehouse - receiving and waiting area

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas. The public address speaker system employs the latest solid-state devices, and all speaker cables are installed in conduit.

12.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, zoned, building fire alarm system includes a fire alarm control panel, smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The annunciator panel is located at the Warehouse lobby. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA 101 Life Safety Code.

12.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate, 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in a conduit.

12.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Warehouse is provided with heating, cooling, and ventilation in the receiving and waiting area, and heating and ventilating only in the Warehouse area.

12.11.1 RECEIVING AND WAITING AREA

A single-duct, single-zone, constant-volume system is used for the receiving and waiting area. The system includes the following equipment:

(1) Air-handling unit, including filter box, direct-expansion cooling coil, and supply fan.

(2) Air-cooled condensing unit.

(3) Electric duct heater.

(4) Exhaust fan.

(5) Room thermostat and associated controls.

A fixed amount of outside air, mixed with the return air, is filtered, cooled (if required), and delivered to the different rooms within the receiving and waiting area.

If heating is required in the receiving area, the room thermostat activates an electric duct heater to provide the required heating. This system was chosen for the receiving and waiting area to satisfy the small amount of heating and cooling requirements for the area. Because of the small size of the system, heat recovery or an economizer cycle was not considered.

12.11.2 WAREHOUSE AREA

Major equipment of the heating and ventilating systems includes the following:

(1) Roof exhaust fans.

(2) Electric unit heaters.

(3) Motorized inlet dampers with filters.

(4) Room thermostats with associated controls.

During winter conditions, unit heaters with built-in thermostats provide heating for the area. Upon rising indoor temperature, the unit heaters are deactivated and the exhaust fans activated by the room thermostats to provide the required ventilation. Each roof fan is interlocked with two motorized dampers that open when their respective fans are operating.

12.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Warehouse. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and supervisory signal to the main fire protection annunciator.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 13

VEHICLE MAINTENANCE BUILDING

13.1 INTRODUCTION

The Vehicle Maintenance Building has facilities for all motor vehicle service and maintenance, routine service and minor maintenance of railroad yard engines, shielded transporters, and related rolling stock. It is served by a rail spur.

A service island for dispensing fuel and oil to motor vehicles is located in the vicinity of the Vehicle Maintenance Building.

13.2 CIVIL AND SITE DEVELOPMENT

13.2.1 PARKING

Parking for employees working in the Vehicle Maintenance Building is provided outside the Main Gate/Badgehouse. A parking area is also provided adjacent to the Vehicle Maintenance Building for vehicles waiting for service.

13.2.2 LANDSCAPING

No landscaping is provided for this building.

13.3 STRUCTURAL

The Vehicle Maintenance Building is composed of low-bay areas for which the wall construction is reinforced concrete block and high-bay areas for which the wa l construction is braced steel framing with metal siding and concrete blocks. Roof construction consists of steel-framed metal deck roof. Foundations are isolated spread footings and continuous wall footings with slab-on-grade floor.

13.4 ARCHITECTURAL

13.4.1 GENERAL

The Vehicle Maintenance Building is a separate, single-story structure with a rectangular plan, 155 x 115 ft, and a floor area of approximately 18,000 sq ft.

The Vehicle Maintenance Building provides facilities for routine maintenance and service for all vehicles dedicated for use at the MRS Facility, including yard vehicles (cask transporters, storage yard crane, bulldozers, and the like) that cannot be serviced inside the building because of their size.

(1) The Vehicle Maintenance Building is normally occupied by 13 personnel on a single day shift as follows:

Assignment	Number of Personnel
Shop manager	1
Service advisor	1
Clerks	3
Mechanics	4
Electrician/mechanic	1
Servicemen	3
Total	13

(2) The Vehicle Maintenance Building contains several rooms and spaces clustered about a central aisle and workspaces. One corner of the building contains a shop manager's office, service advisor's counter, lunchroom, toilets and lockers, storage, parts, tool crib, and electrical equipment room. Another corner is occupied by mechanical equipment. Enclosed bays in a third corner are for the painting and body shop and for the wash and steam cleaning spaces, each with separate outside vehicle entrances. Also with outside vehicle entrances are an alignment bay, overhaul bay, and a lube pit. The fourth corner contains a semitruck repair and a railcar service area. Adjacent to the central area is a machine shop, a tire shop, glass and upholstery shops, a battery storage room, and spaces for tuneup, lubrication, overhaul, and maintenance.

(3) The Vehicle Maintenance Building is a completely separate structure, with separate entrances and exits to various service and maintenance areas. All rooms and spaces are also accessible from the interior.

(4) Both the heavy-vehicle and the railcar service areas include pits for undercarriage service. Lube and oil storage alcoves are located adjacent to the service areas.

(5) Adjacent to and east of the Vehicle Maintenance Building is a vehicle service island, providing four diesel pumps and two unleaded gasoline pumps. The pumps are of the self-service type, actuated by magnetic identification cards. Two underground storage tanks (5,000-gal unleaded gasoline and 10,000-gal diesel fuel) are provided. No overhead canopy is provided.

13.4.2 MATERIALS OF CONSTRUCTION

The Vehicle Maintenance Building is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, reinforced masonry walled structure with structural steel roof framing and metal panel fascias and soffits.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls are constructed of gypsum board on light-gauge framing.

(4) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

13.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1)	UBC Occupancy Class:	H4
(2)	Ceiling heights:	9'-0" for all rooms except 8'-0" for toilets and corridors 12'-0" to 15'-6" for low-bay work areas 21'-0" to 26'-6" for high-bay work areas
(3)	Kind of traffic:	Foot traffic in the building Railroad and transport vehicles in service area Light-duty vehicles
(4)	Size of access openings:	3'-0" x 7'-0" interior and exterior personnel doors 6'-0" x 7'-0" exterior personnel doors Upward-acting sectional doors: 12' x 20' at south heavy-vehicle access doors 12' x 15' at east and west light-vehicle access doors 12' x 10', 10' x 10' at mechanical equipment and machine shop

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Lunchroom, offices	Vinyl tile	Rubber cove	Gypsum board	Suspended acoustic tile
Toilets, lockers, showers	Ceramic tile	Ceramic tile	Ceramic tile	Suspended cement plaster
Service bays, aisles	Concrete	Concrete block	Concrete block and metal liner panels to 9'-0"; gypsum board above 9'-0"	Exposed structure

(6) Special equipment:

Parts storage:	Storage shelving
Toilets:	Metal toilet partition Toilet accessories Mirrors Lockers Shower facilities
Shop manager:	Desk, chairs, file cabinet
Lunchroom:	Tables, chairs

13.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

13.5.1 GENERAL

The Vehicle Maintenance Building is equipped with shop equipment for all maintenance to be performed on motor and rail vehicles. The facility is designed on a unit operation basis to fulfill overall plant vehicle maintenance requirements.

13.5.2 EQUIPMENT

All shop equipment selected meets the appropriate requirements of the latest edition of the codes. The selection of equipment in the Vehicle Maintenance Building is primarily based on vehicle servicing, parts replacement, and emergency repair and overhaul. All of the selected servicing equipment is capable of servicing and hoisting vehicles with gross weight of 6,000 to 18,000 lb.

The following shop equipment is provided.

13.5.2.A. Vehicle Maintenance Equipment

1. One front-wheel alignment unit, Visualiner or equal, is provided for front-wheel alignment of automobiles and trucks. The alignment unit can handle vehicles with tire sizes up to 11:20 x 20 and axle loading of 14,000 lb. The alignment unit is equipped with 100-in. front beam to provide for tread width from 48 to 90 in., optical projection heads and stands, special wheel mirror assemblies, and necessary checking fixtures.

2. One 24,000-lb capacity post-dual lift, Weaver, equipped with hydraulic power unit, quick-adapter spotting device, floor-level control valves, automatic lift lock, required piping fittings, and prefit pipelines. Maximum contact height of lift is 67 in.

3. One 8,000-lb capacity, single-post lift, Weaver, equipped with dead-man remote wall-control valves, wheel chock, multiple-height swivel adapters, and nonrotator with automatic lift lock. Maximum contact height of lift is 69 in.

4. One 4-reel lube system for gear lube, oil, air, and grease. Overhead reel system provides reels with 25-ft hoses for grease, gear oil, motor oil, and air. Unit is air-operated.

5. Two combination bearing-packer and utility-lubricator units with a 30:1 ratio, air-operated, high-pressure pumping unit. Packs bearings 5/8 in. dia to 3-1/4 in. dia. Unit includes quick-to-attach greasing adapter for ball-joint or chassis lubrication. Unit is complete with band-type dolly, 5-ft hose, and follower plate.

6. Lube cartridge guns; screw-type, positive-feed guns; suction guns; and push-type oil guns.

7. Electric-hydraulic tire-changer machine is provided for servicing flat-base rims 15 through 28 in. and tubeless rims 17.5 through 24.5 in. Unit handles all tire sizes through 14:00 x 24. Pump unit is 3.0 gpm, 1,500 psi. Hydraulic motor drives wheel at 7.8 rpm, powered by 2-hp motor, 1 phase, 230 volts, 3,450 rpm.

8. A Stewart-Warner dynamic balancing machine, equipped with 2-hp, variable-speed drive with a balancing speed of 450 rpm.

9. Tire-test tank, Bishman Model 885 BT, constructed of 1/4-in. aluminum plate.

10. Two tire-storage racks, Lyon Model 7501. Units are three-tier, 48 in. wide x 16-1/8 in. deep x 84 in. high.

11. Safety cage, five-bar style, to handle all tire sizes, including 14:00 x 24. Five steel pipes are welded to heavy base bars, with angle-iron guides for centering tires. Dimensions are 23 x 40 x 55-1/2 in. and weight is 235 lb.

12. Standard air-impact and torque wrenches.

13. One Universal Model 525 wheel dolly, having a capacity of 2,500 lb.

14. Two Weaver floor jacks, equipped with large wheels and casters with roller bearings, relief valve, and lubrication fittings at all critical points. One 4-ton-capacity unit and one 2-ton-capacity unit.

15. Steel-top workbenches, 72 in. long x 36 in. wide x 34 in. high. Benches are of all-steel construction and have a working surface capacity of handling working stock weighing 2,000 lb.

16. Engine analyzer unit equipped with 15-in.-dia oscilloscope screen, 3-scale ampere and dwell meter, 3-scale tachometer, volt- and ohmmeters, and a 2-scale vacuum gauge.

17. Mobile lifting crane of 2,000-lb capacity with a fold-away feature, adjustable leg spread, hydraulic hand pump, and 62-in. lifting chain. The boom extends to 117 in. The overall height of the crane with the boom in horizontal position is 80 in. Legs are equipped with 5-in.-dia wheels.

18. Parts cleaner unit, Peterson Mac 100, for cleaning engine blocks, carburetors, and crankshafts. Inside dimensions are 36 in. long, 23-3/4 in. wide, and 24 in. deep. Unit is complete with basket unit, agitator unit with 1-hp motor, 115/230-volt, 1-phase, electric heating unit, and manually operated hoist as standard equipment.

19. Bearing-cap grinding machine with a 8-3/4- x 5-in. working capacity; working area is 32 x 19 in. Grinding wheel is 7 in. dia. Unit motor is 1-hp, 110-volt, single-phase type.

20. Brake-drum lathe with feed rates of 5/16, 1/2, 5/8, 7/8, 1, and 1-1/2 in./min. The spindle speed is variable from 40 to 160 rpm. The lathe can turn drums of 32 in. dia maximum. The spindle motor is 2 hp, 240/440 volts, 3 phase, and grinding attachment motor is 1/2 hp.

21. Mobile or stationary motor and transmission stand with a capacity of 2,000 lb. Standard equipment includes screw-type floor brake anchors, built-in hydraulic jacks for tilting, and gear-turning device for rotating engine 360 deg.

22. A-frame hoisting unit, 2-ton hoisting capacity, equipped with a 2-ton, hand-operated, chain-type trolley hoist.

23. Stationary battery-charging unit is one for parallel type multiple battery charging. Standard equipment includes thermal overload device to protect both battery and charger, ampere and voltage meters, pilot light, and 10-ft-long charging leads for connection to bus bar. Maximum rating of discharged batteries is 50 A.

24. Portable battery-charging unit having the capability to check amount of charge in battery; test condition of battery using built-in load (140 A, 12 volts); check condition of generator or alternator, voltage regulator, starter, and battery cables; and detect shorts or leakage in 6-, 12-, and 24-volt electrical system. Maximum rating discharge is 120/90/60 A, with cranking power of 300 A.

25. Pedestal-mounted grinders, furnished with two 12- x 2- x 1-1/4-in. grinding wheels and safety shields. Grinder is powered by a 2-hp motor operating on 230/460-volt, 3-phase, 60-Hz power.

26. Pedestal-mounted drill press, Powermatic 20 in., furnished with a variable-speed, belt-driven unit with speeds ranging from 135 to 1,350 rpm. The drill is capable of drilling 2-in. stock. Unit is powered by a 1-1/2-hp motor, operating on 230/460-volt, 3-phase, 60-Hz power.

27. Tool roller cabinets, 5-drawer style, with attachable 5-drawer tool chest. Units are furnished with locks, keys, and pull handles.

28. Parts storage bins.

29. Two 10-in., pipejaw-faced vises, furnished with swivel-type base for mounting on steel-top bench.

30. Electric welding unit rated at 400 A dc at 36 volts. Open-circuit voltage is 75. Welding amperage is 40-325, 60-500. Input amperage at 230 volts is 80. Unit power usage is 31.9 kVA.

31. Portable cleaning unit, Hotsy, with 1,200-psi cleaning pressure on a 4-gpm discharge capacity. Pump unit is powered by a 15-hp, 460-volt, 3-phase, 60-Hz motor. Standard equipment includes thermostat, flow switch, pressure bypass valve, soap valve, float valve, gun with trigger-type shutoff with wand assembly, nozzle, and pressure hose.

32. Oxygen and acetylene welding unit consisting of 75 ft of hoses, gauges, cutting torch, rosebud heating tip, and various sizes of welding tips.

33. Valve servicing kit, including seat-grinder drill, grinding wheel drive adapters, bearing wheel dresser, eccentrimeter, tool-carrying kit toolbox, and expanding tabored arbors.

34. Valve-grinder machine, with built-in breaking mechanism, 45-deg angle drive, hex grinder unit, heavy-duty dresser tool, and mounting storage cabinet for accessory storage. Machine is operable on both ac and dc power.

35. H-frame press, with rated capacity of 25 tons. Press is air-operated with movable head frame. Press operates on 90- to 145-psi air pressure.

36. Engine-block grinder, Bergo Model RSC 950, capable of grinding blocks 38 in. long. Motor drive is 5 hp.

37. Engine-head grinder, Tobin-TA 20, to grind engine heads 37 in. long. The motor drive is 6 hp.

38. Diesel nozzle analyzer, Bacharach Model 65-0051, portable. Unit tests nozzles to 5,000 psi.

39. Electric-air tire-changer machine, services flat-base rims 13 through 15 in. Changer is powered by air motor.

40. Boring engine cylinder machine, with capacity of 51-in., c to c boring, powered by a 3-hp motor.

41. Engine-honing machine, capable of honing cylinder 2 to 8 in. dia. Unit is powered by a 3-hp motor

42. Hydraulic pump tester for testing hydraulic pressures from zero to 1,500 psi.

43. Hydraulic hose assembler machine, Parker 432.

13.5.2.B. Cranes and Hoists

1. Bridge Crane. A bridge crane is provided with a 20-ton main hoist and 5-ton auxiliary hoist. The hook travel of both the main and auxiliary hoists is 27 ft. Bridge and hoist control is a pushbutton, pendant-control box from the bridge. Bridge operating speed and trolley travel speed are 25 fpm. Main hoist speed is 8 fpm and auxiliary hoist speed is 10 fpm.

2. Jib Crane. A jib crane is provided with 4-ton capacity. The jib crane is equipped with a 16-ft boom span on a motorized, 15-ft-high rotating mast. The jib crane is provided with a 4-ton, motor-driven trolley unit, with 13-ft hook travel. Operating control is a pushbutton, pendant-control box. Operating speed of hoist is 8 fpm and that of trolley is 6 fpm.

3. Carry Deck Crane. The 7-1/2-ton carry deck crane is equipped with the following: a three-section boom extending to 20 ft, with a 360-deg swing; hook block (7-1/2-ton); operator cab lights; and backup alarm and horn. Crane is a diesel-engine style, equipped with hydraulic outriggers; three-speed, foot-operated transmission; power steering; and four-wheel power brakes.

4. Crawler Crane. A 40-ton, crawler-mounted crane is provided with the following specifications: crane unit is powered by a three-stage torque power transmission, operating all converter drives to a 50-ft hoisting boom,

swing clutches, and boom stops. Crane unit is mounted to a crawler-carrier unit, with hydraulic crawler travel system. Crawler unit is diesel-powered. Crawler is 20 ft long and 36 in. wide.

13.5.2.C. Transport Vehicles

1. Passenger Vehicles, mid-compact type. Each is equipped with automatic transmission.

2. Patrol Vehicles, Blazer or Bronco, 4 x 4 wheel drive units, equipped with siren, two-way radio units, and emergency flashing lights and spotlights.

3. Patrol Vehicles, van type, 4 x 4 wheel drive units, equipped with siren, two-way radio units, and emergency flashing light unit and spotlight.

4. Utility Vehicles, 2-ton truck style, equipped with 2-ton, heavy-duty suspension chassis; automatic transmission; 8-ft-wide x 12-ft-long flatbed; and hydraulic-powered, tailgate-hoisting elevator attachment unit.

5. Service Truck, 3/4 ton, equipped with 3/4-ton, heavy-duty suspension chassis; automatic transmission; and side-mount storage compartment units.

6. Service Truck, 3/4 ton, equipped with 3/4-ton, heavy-duty suspension chassis; automatic transmission; side-mount storage compartment units; and gasoline-engine-operated, portable welding unit.

7. Service Truck, 4 ton, 4-wheel drive, equipped with heavy-duty, 4-ton truck chassis; rear-chassis, side-mount storage and parts cabinet units; a 250-gal fuel storage supply tank, with pump and hose assembly; lube and oil storage supply tanks (50-gal capacity), with hose and services nozzles; pressure air-supply tank, with supply hose; emergency lights and backup alarm; and mechanical repair tools for tires, engine, and hydraulic repair capabilities.

8. Truck With Telescoping Manlift, 2 ton, furnished with flatbed and suspension system capable of handling a 40-ft, telescoping manlift, platform-mounted to truck bed. Telescoping unit is an electric-hydraulic unit, controlled from ground and raised platform. Unit rotates 360 deg at 2.5 mph. Platform capacity is 1,000 lb. Platform is equipped with interlocking safety system, with instability warning device.

9. Tow Truck, 2-ton capacity, 4 wheel, equipped with hydraulic hoisting arm crane with sling attachments, tow bars and winch cables, emergency light units, side-mount tool and parts storage cabinets, and portable, gas-driven air compressor.

13.5.2.D. Yard Equipment

1. Three Forklift Trucks, 10,000 lb, equipped with 48-volt, 24-cell battery; 6- x 48-in. forks; battery-charging unit; power steering; two independent hydraulic pump and motor assemblies; and power-disc-type brakes. Maximum fork height is 183 in. at 24-in. load center.

2. Three Forklift Trucks, 10,000 lb, equipped with 4-cycle gasoline engine, 6- x 48-in. forks, power steering, two independent hydraulic pump assemblies, and power-disc-type brakes. Maximum fork height is 183 in. at 24-in. load center.

3. Railcar Mover, an on-track/off-track vehicle, equipped with a diesel engine and 4-speed forward and reverse transmission, to travel on both road and rail tracks. Maximum speed in 4th gear is 22 mph, and 1st gear maximum speed is 3 mph. Drawbar pull capacity is 33,000 lb. The railcar mover is also equipped with hydrostatic power steering; four-wheel, air over hydraulic disc brakes; 12:00 x 22.5, tubeless-type tires and wheels; and 3-position, pressure-selection, constant-flow, low-pressure hydraulic system. Standard equipment includes lights, cab unit, fuel and hydraulic tanks, and air-power system tanks and compressor. Vehicle weight is 43,000 lb.

4. Front-End Loader, equipped with 6-cylinder, 466-in.-displacement diesel engine; 4-speed planetary power-shift transmission; 4-wheel, power-actuated, wet-disk brakes; loader-function hydraulic system; power steering; 2-yd, hydraulically controlled bucket unit; backup alarm; and operating light(s).

5. D9 Crawler-Style Bulldozer, equipped with diesel engine and all standard equipment. Unit is equipped with angular-type scraper blade and rear-mounted ripper units. The bulldozer also has backup alarm, enclosed cab unit, headlights, and all required hydraulic controls.

6. Backhoe Unit, tractor type is equipped with a trench-digging, bucket-arm unit. Attached to the front is a hydraulically controlled, 3/4-yd bucket unit for hauling and scraping operations in yard and ground maintenance. The tractor unit is equipped with power steering; bucket digging-arm unit; power outrigger units; 3/4-yd, hydraulic, front-mounted bucket unit; and an enclosed cab.

7. Support Dolly Trailer, with a 5th-wheel adaptor unit, for transferring low-boy trailer through washdown and receiving areas. Trailer unit is an 8-wheel Phillips Model TFUS 600 or equal, with a Model 5MS10 Fontaine Company or equal 5th-wheel adaptor. Trailer is equipped with wrench cable eyebolts for car-puller hookup.

8. Trailer Jockey-Style Trucks, provided with dual-tandem axles for off-highway moving. Trucks are equipped with standard 5th-wheel adaptor, and have a Cummins V8, 210-hp diesel engine with a 504-cu in. displacement; transmission is Allison Model MT-643, with 4-speed range selection.

9. Cask Transfer Trailer, provided for transporting 300,000-lb load capacity. Trailer bed is 10 ft wide and 20 ft long, equipped with support saddles and tie-down bracket; trailer has 16 wheels, with two tires per wheel; Phillips, Inc., Model 16-TFUSN-3000 or equal.

10. Lighting Trailer, tow style, 4-wheel unit, provided with a gas-driven portable electric generator unit and four adjustable-stand-style floodlight units. Electric power pack is capable of 5,000-W output for 120/240-volt, 60-Hz power. Unit is complete with 12-volt battery and solid-state idle control. Floodlights are adjustable, stand-mounted, 300-W reflector, incandescent lamps with sealed wiring.

13.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

13.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided by a compressor system.

The air system consists of a compressor, coolers, separator, filters, receiver, dryers, and associated controls and instrumentation.

The hot water boiler system requires a supply of fuel oil, natural gas (if available), and process water.

The fuel-oil system consists of a day tank and a supply pump supplying No. 2 diesel oil to the boiler at a winter peak rate of 23.6 gph and 30 psig.

Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 3,298 scfh.

Process water is used for makeup water to the boiler, and is continuously supplied at the winter peak rate of 2.0 gpm.

Potable water is used for fire protection, drinking, and restrooms, eyewash, and safety showers.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. It is collected and drained by gravity flow to a collection tank, located near the Site Services Building, at the drainage flow rate of 11.4 gpm.

13.8. INSTRUMENTATION AND CONTROLS

13.8.1 GENERAL-PURPOSE COMPUTER TERMINAL

A remote, general-purpose computer terminal with CRT, keyboard, send/receive (KSR) printer, and modems is provided in the Vehicle Maintenance Building. It is used by personnel for inventory control.

13.8.2 UTILITY SYSTEMS

All utility systems in the Vehicle Maintenance Building are remotely monitored and capable of being remotely controlled.

The hot water boiler is monitored remotely as well as locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, along with a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler, are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel oil supply day tank (TK-507) contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning on and off the transfer pump by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel oil supply pumps are controlled from the boiler control panel. Only status light signals are transmitted to the DCS, as shown on Drawing H-3-55159, Vehicle Maintenance Building, Hot Water Boiler.

Oil-free dried plant and instrument air is provided by a compressor backed up by a spare. The compressor is controlled locally from a vendor-furnished panel and monitored remotely for motor on-off status. The plant air is dried and the pressure is dropped to 100 psig, and monitored remotely for pressure before entering the distribution header. The instrument air is dried to a dewpoint of -40°F, the pressure is reduced to 100 psig, and the air is remotely monitored for moisture content and pressure.

13.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Vehicle Maintenance Building are monitored by the fire alarm monitoring system in the Fire Station, and transmitted to the Alarm Monitoring Station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

13.8.4 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

13.9 PIPING

13.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

Hot and cold water piping is insulated.

Plumbing fixtures meet the applicable requirements for the physically handicapped.

A safety shower and eyewash station are provided at the battery room in compliance with ANSI Z358.1.

Piping runs are concealed in ceilings, walls, and furred spaces in the office area, locker rooms, and lunchroom; piping runs are exposed in the shops, boiler room, and mechanical equipment room.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

13.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping. Fuel oil and fuel gas, if applicable, are connected to the MRS Facility distribution system. Fuel-oil and fuel-gas usage for the building are metered.

Equipment and funnel oily drains are provided in the boiler room and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC equipment drains are provided and connected to the MRS Facility process sewer.

Floor drains are provided in the wash and steam-cleaning room, installed with a grease trap, and connected to the process sewer.

Process water is supplied at 100 psig from the building potable water supply. A reduced-pressure principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Process w-ter is provided for heating system makeup and utility stations in the shops for washdown, tire-test tank filling, and other uses.

Hot water at 210°F and 2,000 psig is provided in the wash and steam-cleaning room, supplied from a hot water cleaning machine installed in the room.

Plant air and instrument air are supplied from equipment in the mechanical equipment room.

Plant air utility stations for air-tool use are provided in the boiler room, mechanical equipment room, and shop. A supply is also provided for the H-frame press, tire-changing machine, and vehicle lube equipment.

Instrument air is provided in the boiler room and mechanical equipment room.

Plant air and instrument air are supplied to the Water Treatment Building from the air systems of this Vehicle Maintenance Building.

Piping runs are exposed in the shop area, boiler room, and mechanical equipment room.

The piping is in compliance with ANSI B31.1.

13.10 ELECTRICAL

13.10.1 POWER SERVICE

Building power is obtained from an outdoor, pad-mounted transformer located near the Vehicle Maintenance Building. The transformer provides 480Y/277-volt service for all lighting loads and for all 480-volt, 3-phase power loads.

The electrical distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose type in NEMA-1 enclosures. Fixtures and installation outdoors are of weatherproof construction.

A dry-type transformer serves all 208Y/120-volt receptacle and small power loads, and motors less than 1/2 hp in size.

Welding receptacles and special power and/or regulated power supplies are provided, as required.

13.10.2 LIGHTING

13.10.2.A. General

In general, 277-volt power is used for fluorescent and high-intensity discharge (HID) lighting. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all areas unless otherwise specified. Fluorescent fixtures have prismatic lenses and rapid-start lamps. Fluorescent fixtures in the shop areas are of the industrial type with rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID lighting fixtures are used in the high-bay open shop areas. Selected HID lighting fixtures are equipped with separate tungsten-halogen lamp to provide illumination during restrike time of HID lamps.

HID luminaires with ballasts and integral mounted fuses are used on the exterior of the building.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are time-switch controlled with manual override.

13.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system automatically switches to emergency power upon loss of normal power, and consists of individual, battery-operated emergency equipment with 120-volt ac output.

The batteries have a capacity for 90 minutes of continous operation. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

13.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor HID floodlighting is provided at vehicle entrance areas, as required.

13.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

13.10.2.E. Exit Lighting

All exit lighting is considered as an emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided as required by the NFPA Life Safety Code - No. 101.

13.10.3 COMMUNICATIONS

13.10.3.A. Public Address System

Public address system speakers are installed in the Vehicle Maintenance Building for paging. The system is provided with a paging zone from the Site Services Building and a second paging zone is accessed through the telephone system from within the Vehicle Maintenance Building.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas.

The public address speaker system employs solid-state devices, and all speaker cables are installed in conduit.

13.10.3.B. Fire Alarm and Detection System

The electrically supervised, noncoded, building fire alarm system includes a small fire alarm control panel, smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The annunciator panel is located near the entrance vestibule. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in accordance with the NFPA 101 Life Safety Code.

13.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in conduit.

13.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Vehicle Maintenance Building is served by two separate systems. One single-duct, constant-volume system provides heating and ventilating for the shop area, and another single-duct, constant-volume system provides heating, cooling, and ventilating in the office area.

13.11.1 SHOP AREA

A single-duct, single-zone, constant-volume system, equipped with an economizer cycle, is used for the shop area. Major equipment includes the following:

(1) Air-handling unit, draw-through type, including filter box, hot water heating coil, and supply fan.

(2) Return/exhaust fan.

(3) Economizer cycle control dampers.

(4) Exhaust fans and gravity exhaust vents.

(5) Tailpipe exhaust system.

(6) Hot water boiler with supply and return water lines and associated controls.

(7) Hot water pumps.

(8) Hot water unit heaters (door type).

(9) Room thermostats and associated controls.

Upon system startup, the supply and the return/exhaust fans energize, and the minimum outside airflow damper opens. When outside air temperature is low, a minimum of outside air mixes with a maximum of return air. The mixed air is filtered, passed through the hot water coil (if required), and then supplied to the respective areas. When outside air temperature rises, the sensible-heat economy cycle control places the system on 100% outside air.

In addition to the above system, the painting and body shop is provided with an additional outside air-handling unit to provide an outside air intake (including filters, electric heating coil, and supply fan) and exhaust fan, which operate only when painting is being performed.

The boiler room (not supplied from the single-duct, single-zone, constant-volume system) is provided with a roof exhaust fan (operating continuously) and a hot water unit heater to provide heating and ventilating requirements.

Exhaust fans, tailpipe exhaust, etc., provide required exhausts for the different shops. Several of these exhaust fans operate on an as-needed basis. When any or all exhaust fans are not running, the excess supply air is exhausted or returned (as required by the economizer cycle) by the return/exhaust fan.

The single-duct, single-zone, constant-volume system was chosen for this area because it provides good ventilation and exhaust air makeup and has simple controls.

No provisions have been made to recover heat from exhaust air because only a minimum of outside air is brought into the building to offset exhaust and pressurization requirements. The economizer control described in this section is a sensible heat type.

13.11.2 OFFICE AREA

A single-duct, single-zone constant-volume system is used for the office area. The system includes the following equipment:

(1) Air-handling unit, including filter box, direct-expansion cooling coil, hot water heating coil, and supply fan.

(2) Air-cooled condensing unit.

(3) Room thermostat and associated controls.

A fixed amount of outside air, mixed with the return air, is filtered, heated or cooled, and delivered to the different areas.

This system was chosen to satisfy the small amount of heating and cooling requirements in a simple and economical way by using simple controls and eliminating simultaneous heating and cooling.

13.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Vehicle Maintenance Building. This system is fed from the MRS Facility water distribution grid.

It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and supervisory signal to the main fire protection annunciator. In addition to NFPA 13, the design also considers NFPA 30 (flammable and combustible liquid storage) and NFPA 33 (spray applications using flammable and combustible materials).

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system for the Vehicle Maintenance Building. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 14

FIRE STATION

14.1 INTRODUCTION

The Fire Station includes facilities for fire protection personnel, including locker rooms, lunchroom, training room, fire protection equipment rooms, and ambulance and paramedic facilities. The Fire Station also includes the plant emergency and industrial first-aid facilities.

14.2. CIVIL AND SITE DEVELOPMENT

14.2.1 PARKING

Parking for employees working in the Fire Station is provided outside the Main Gate/Badgehouse. Parking for site vehicles is provided in the Security Building parking lot.

14.2.2 LANDSCAPING

Landscaping is provided around the entrance to the Fire Station.

14.3 STRUCTURAL

The Fire Station is a reinforced concrete block wall building with steel-framed metal deck roof, continuous wall footings, and a slab-on-grade floor.

14.4 ARCHITECTURAL

14.4.1 GENERAL

The Fire Station is a separate, single-story structure with an essentially rectangular plan of overall size 145 x 79 ft; however, the actual net floor area is approximately 8,400 sq ft.

(1) The Fire Station provides complete facilities to house firefighting equipment, paramedic/ambulance personnel and equipment, fire protection personnel (full-time and on-call), and limited combined cooking, dining, exercise, and training facilities.

(2) Personnel for the Fire Station are as follows:

Assignment	Number of Full-Time Personnel by Shift: Days	2nd	3rd	4th	Number of On-Call Personnel (all shifts)	Total Full Time
Firefighters (full-time)	1	1	1	1	-	4
Firefighters (on-call)	-	-	-	-	(9)	
Officers: Chief	1	-	-	-	-	1
Assistant Chief	1	1	1	1	-	4
Training Officer	1	-	-	-	-	1
Radio Dispatcher	1	1	1	1	-	4
Nurse	1	1	1	1	-	4
Emergency Medical Technician (EMT)	1	1	1	1	-	4
Total	7	5	5	5	(9)	22

(3) The following rooms are provided in the Fire Station:

Main apparatus room
Offices (4)
Lunch/squad room with kitchenette
Extinguisher charging room
Breathing air cylinder charging room
Men's toilet, showers, and lockers
Women's toilet, showers, and lockers
Administration toilet, shower, and lockers
Mechanical equipment room
Boiler room
Electrical room
Janitor's room
Nurse reception/waiting room, exam/treatment room, and medical storage room (first-aid station)

(4) The building is divided into three major functional areas:

- Firefighting apparatus and equipment
- Personnel facilities
- Building services

The main apparatus room is flanked by the remaining facilities at both ends, thus providing ready access to the firefighting apparatus from any point in the building. The apparatus is parked side-by-side in a single row, providing direct access to the exterior for each unit.

14.4.2 MATERIALS OF CONSTRUCTION

The Fire Station is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story structure with reinforced masonry walls and structural steel roof framing, with metal panel fascia.

(2) All exterior walls, roofs, and roof-ceiling assemblies are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All interior walls are constructed of gypsum board on light-gauge framing.

(4) Al fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

14.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B-2

(2) Ceiling heights:

Main apparatus room:	14'-6" (at low point)
Offices, lunch/squad room, extinguisher charging room, breathing air cylinder charging room, and radio dispatch:	9'-0"
Nurse reception/waiting room, exam/treatment room, and medical storage room (first-aid station):	9'-0"
Toilets, lockers, showers:	8'-0"

(3) Kind of traffic: Foot traffic
Fire apparatus

(4) Size of access openings:
6'-0" x 7'-0" personnel (exterior)
3'-0" x 7'-0" personnel (exterior)
3'-0" x 7'-0" personnel (interior)
12'-0" x 14'-0" apparatus
24'-0" x 9'-0" ambulance and chief parking

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Main apparatus room, mechanical/electrical room, breathing air cylinders, and extinguisher charging rooms	Hardened concrete	Concrete	Concrete block, gypsum board	Exposed structure

(5) Finishes (Contd):

Area	Floor	Base	Wall	Ceiling
Offices	Carpet	Rubber cove	Concrete block, gypsum board	Suspended acoustic tile
Vestibules, corridors, lunch/squad room	Vinyl tile	Rubber cove	Concrete block, gypsum board	Suspended acoustic tile
Nurse exam/ treatment	Sheet vinyl	Integral vinyl cove	Concrete block, gypsum board	Suspended acoustic tile
Toilets, showers, lockers	Ceramic tile	Ceramic tile	Ceramic tile	Cement plaster

(6) Special equipment:

Offices:	Desks, chairs, file cabinets, training aids and equipment
Lunch/squad room:	Unit kitchen, tables, chairs
Supply storage:	Storage shelving
Toilets, showers, lockers:	Metal toilet and shower partitions Toilet and shower accessories Mirrors Lockers (double-tier)
Nurse/reception/ waiting room, exam/ treatment room, and medical storage room (first-aid station):	Medical furniture and cabinets

14.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

14.5.1 GENERAL

The fire-protection equipment is provided for added capability to fight and control fire in buildings and fires in remote areas of the site. An ambulance is provided to respond to medical emergencies and to transport patients to offsite hospital facilities.

14.5.2 FIREFIGHTING EQUIPMENT

The following firefighting equipment is provided:

14.5.2.A. Emergency and Firefighting Vehicles

1. Ambulance Unit. The ambulance is provided with the following equipment:

(1) Van-style chassis with heavy-duty suspension

(2) Emergency lights

(3) Two-way radio

(4) Storage cabinet for first-aid equipment

(5) Siren

(6) Racks for stretcher storage

(7) Collapsible gurney

2. Fire Chief's Car. The Fire Chief's vehicle is provided with the following equipment:

(1) Van-style chassis with heavy-duty suspension

(2) Four-wheel drive (on- and offroad service)

(3) Two-way radio

(4) Emergency lights

(5) Siren

3. Firetruck Pumper Units. Two firetruck pumper units are provided with the following standard equipment:

(1) A heavy-duty truck frame chassis

(2) Heavy-duty suspension

(3) Four-wheel drive (on- and offroad service)

(4) Cab-mounted master electric console

(5) Emergency lights

(6) Siren

(7) Electric rewind booster reel with 150 ft of hose

(8) 750-gpm, two-stage pump unit with pump operating control panels with gauges

(9) 750-gal water supply tank

(10) Dual battery system

(11) Side hose and equipment storage compartments

(12) Running boards and handrails

(13) Two-way radio

4. Firetruck Pumper Unit With Spartan Telesquirt With Ladder and Spray Nozzle. The firetruck pumper unit with ladder is provided with the following equipment:

(1) A heavy-duty truck frame chassis

(2) Heavy-duty suspension

(3) Four-wheel drive (on- and offroad service)

(4) Cab-mounted master electric console

(5) Emergency lights

(6) Siren

(7) Electric rewind booster reel with 150 ft of reel

(8) 750-gpm, two-stage pumping unit with operating control panel with gauges

(9) 750-gal water supply tank

(10) Dual battery system

(11) Side hose and equipment storage compartments

(12) Two-way radio system

(13) 200 ft of 2-1/2-in. polyester firehose with coupling

(14) Running boards and handrails

5. Firetruck Tanker Units. Two firetruck tanker units are provided with the following equipment:

(1) A heavy-duty truck frame chassis

(2) Heavy-duty suspension

(3) Emergency lights

(4) Siren

(5) Two-way radio system

(6) Side hose and equipment storage compartments

(7) 1,250-gal water storage tank

(8) 2-1/2-in. suction and discharge outlets

(9) Electric rewind booster reel with 1-1/2-in. hose and nozzle

(10) Four-wheel drive (on- and offroad service)

(11) 400 ft of 2-1/2-in. polyester hose with coupling

(12) Master electric console

14.5.2.B Related Equipment

1. One hose-drying oven.

2. Accessory firefighting equipment includes:

(1) Fire-retarding clothing
(2) Firemen's helmets
(3) Firehose and nozzles
(4) Firemen's axes and picks
(5) First-aid kits
(6) Oxygen cylinders and breathing apparatus
(7) Fire extinguishers
(8) Gloves and boots

14.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

14.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) is provided from the compressor system located in the Security Building.

The hot water boiler system requires supply of fuel oil, natural gas (if available), and process water.

The fuel-oil system consists of a day tank and a supply pump supplying No. 2 diesel oil to the boiler at a winter peak rate of 6.0 gph and 30 psig. Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 843 scfh.

Process water is used for makeup water to the boiler and is continuously supplied at the winter peak rate of 0.5 gpm.

Potable water is used for fire protection, drinking, restrooms, first-aid sink, and kitchenette sink.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. It is collected by gravity flow to a collection tank located near the Security Building at the drainage flow rate of 3.5 gpm.

Breathing-air cylinders are provided. Individual air-pack bottles are refilled from breathing-air cylinders only.

14.8 INSTRUMENTATION AND CONTROL

14.8.1 FIRE ALARM COMPUTER

All of the fire alarms in the MRS Facility are monitored by the fire alarm monitoring computer located in the Fire Station, and transmitted to the Alarm Monitoring Station (AMS) for security force response (if needed). This alarm is instantly transmitted to the DCS, where it is presented as a group alarm.

14.8.2 UTILITY SYSTEMS

All utility systems in the Fire Station are remotely monitored and capable of being remotely controlled.

The hot water boiler is monitored remotely as well as locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, and a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler, are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel oil supply day tank (TK-508) contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning on and off the transfer pump by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel oil supply pumps are controlled from the boiler control panel. Only status light signals are transmitted to the DCS, as shown on Drawing H-3-55100, Sheet 1.

14.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Fire Station are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the AMS. All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

14.8.4 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure their proper and accurate performance in operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

14.9 PIPING

14.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces the potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater and drinking water by an electric water cooler.

Hot and cold water piping is insulated.

Plumbing fixtures meet requirements for the physically handicapped.

Piping runs are concealed in ceilings, walls, and furred spaces in the personnel quarters of the building.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

14.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas, if applicable, are supplied to the boiler from the MRS Facility distribution system. Fuel-oil and fuel-gas usage for the building are metered.

Equipment and funnel oily drains are provided in the boiler room and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC equipment drains are provided and are connected to the MRS Facility process sewer system.

Process water for heating system makeup is provided at 100 psig from the potable water supply to the building. A reduced pressure backflow preventer is installed to prevent any possibility of contaminating potable water.

Plant air and instrument air are supplied from the Security Building air systems.

Plant air utility stations for air tools are provided in the boiler room and mechanical equipment room.

Instrument air is provided in the boiler room and mechanical equipment room.

Piping runs are exposed in the boiler room and mechanical equipment room.

The complete installation is in compliance with ANSI B31.1.

14.10 ELECTRICAL

14.10.1 POWER SERVICE

Building power is obtained from the normal and standby bus, located at the Security Building, at 480Y/277 volts for distribution to all power and lighting loads.

The entire distribution system is coordinated for selective fault protection. Electrical equipment and installation indoors are general-purpose types in NEMA-1 enclosures. Fixtures and installations outdoors are of weatherproof construction.

A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel are used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size.

14.10.2 LIGHTING

14.10.2.A. General

In general, 277-volt power is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts when incandescent fixtures are used. Local switching is provided on all lighting circuits.

Fluorescent lighting fixtures are used in all office areas. Fluorescent fixtures in these areas have prismatic lenses and rapid-start lamps. HID luminaries are used in the main apparatus room. Fluorescent lamp ballasts are of the thermally protected, Class P, CBM-certified, high-power-factor, energy-efficient type.

HID luminaires with ballasts and integral mounted fuses are used on the exterior of the building.

Panel-switched night-lighting circuits are provided. Light fixtures above exterior doors are time-switch controlled with manual override.

Incandescent fixtures are provided in small rooms and in areas that are used intermittently, such as storerooms.

14.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during total power outage. This system consists of individual battery-operated emergency units with 120-volt ac output. Emergency lighting is supplied at the dispatch room.

The batteries have a capacity for 90 minutes of continuous operation. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

14.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor HID floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectric relay-controlled with manual switch override. Outdoor HID floodlighting is provided for the vehicle parking and driveway areas.

14.10.2.D. Illumination Levels

The interior lighting intensities are 50 ft-c at task level for work stations, 30 ft-c at walking surface in general work areas, and 10 ft-c at walking surface in nonworking areas. When higher levels of illumination were determined to be necessary for special tasks, personnel safety, or security reasons, they are provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

14.10.2.E. Exit Lighting

All exit lighting is considered as part of the emergency system, and is installed in conduit or tubing in accordance with Article 700 of the NEC.

Illuminated exit signs are provided as required by the NFPA Life Safety Code - No. 101.

14.10.3 COMMUNICATIONS

14.10.3.A. Public Address System

Public address system speakers are installed in the Fire Station for paging. The system is provided with one paging zone and is initiated from the Site Services Building or by access through the telephone system from within the Fire Station building.

The public address system provides a paging sound level of approximately 6 db and is consistent within 3 db for all paging areas.

The public address speaker system employs the latest solid-state devices, and all speaker cables are installed in conduit.

14.10.3.B. Fire Alarm and Detection System

A local fire alarm system is provided for the Fire Station. The alarm annunciator panel is located in the dispatch room. The system includes smoke detectors, fire sensors, manual fire alarm stations, and a local audible alarm. The dispatch room also contains the central fire alarm computer and event recorder/printer for the plantwide fire alarm system. The fire alarm computer is UL-listed and is connected to equipment in the redundant alarm monitoring stations. A repeater system is located in the Security Building. All fire alarm systems are designed in accordance with NFPA 72A, Local Protective Signaling System; NFPA 72D, Proprietary Protective Signaling System; and NFPA 72E, Automatic Fire Detectors. All fire alarm systems and equipment are UL-listed and/or FM approved, and are installed and located in accordance with NFPA 101, Life Safety Code. All fire alarm systems are connected to the radio dispatch room at the Fire Station and the Security Building. The fire alarm system is equipped with an integral, uninterruptible power supply (UPS) and sized to carry the full inverter output for 90 minutes.

14.10.3.C. Telephone System

A telephone terminal board consisting of a 3/4-in. plywood backboard, terminal blocks, and appurtenances is installed in the electrical equipment room for termination of all station cables for this building. A separate 20-A, 120-volt, duplex receptacle is provided at the terminal board. Telephone stations are provided. All telephone cables are installed in conduit.

14.10.3.D. Radio

A fixed-base and mobile UHF radio system is provided to support communications between the Fire Station and mobile firefighting equipment personnel. The radio system is equipped with an integral 90-minute, battery-powered, backup power supply.

14.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Fire Station is served by two separate HVAC systems. A constant-volume, single-duct, reheat system is used in the office area, and an air-handling unit, interlocked with roof exhausters, provides ventilation in the main apparatus room.

14.11.1 OFFICE AREA

A single-duct, constant-volume system is equipped with an economizer cycle and four hot water heating coils to provide zone control for the four diverse areas.

A fifth zone is provided for future expansion. In order to accommodate this future expansion, the supply and return/exhaust fans are equipped with variable-inlet vanes.

Major equipment includes the following:

(1) Air-handling unit, draw-through type, including filter box, direct-expansion cooling coil, hot water preheat coil, and supply fan with variable-inlet vanes to accommodate future expansion.

(2) Return/exhaust fan with variable-inlet vanes to accommodate future expansion.

(3) Air-cooled condensing unit with refrigerant piping and controls.

(4) Economizer cycle control dampers.

(5) Exhaust fans and gravity exhaust vents.

(6) Hot water boiler with supply and return water lines and associated controls.

(7) Hot water pumps.

(8) Hot water reheat coils.

(9) Hot water unit heater.

(10) Zone room thermostats.

Upon system startup, the supply and return/exhaust fans energize, and the minimum outside airflow damper opens. With low outside air temperatures, a minimum of outside air mixes with a maximum of return air. The mixed air is filtered, passed through the hot water preheat coil, and then supplied to the respective areas. If additional heating is required, the zone room thermostats energize their respective reheat coils.

When outside air temperature rises to 60°F, the sensible heat economy cycle control places the system on 100% outside air, and the cooling system is energized. Continuing rise in outside air temperature to 78°F causes the outside air dampers to be returned to the minimum open position. Refrigerant flow rate through the air-handling unit cooling coil is modulated, as necessary, to maintain desired supply air temperature through the cooling cycle. The zone room thermostats modulate hot water flow through the reheat coil if tempering of the air is required in any zone.

The boiler room (not supplied from the building HVAC system) is provided with a roof exhaust fan (operating continuously) and a hot water unit heater to provide heating and ventilating requirements.

The single-duct, constant-volume reheat system was chosen for this area because of its small size and the diverse HVAC requirements of the areas to be served. The system provides good ventilation at all times (constant air flow), flexibility of zone control, and good temperature control for each zone.

No provisions have been made to recover heat from exhaust air because only a minimum of outside air will be brought into the building to offset exhaust and pressurization requirements. The economizer control described in this section is a sensible heat type.

14.11.2 MAIN APPARATUS ROOM

The HVAC system for the main apparatus room includes the following major equipment:

(1) Air-handling unit, including filter box and supply fan.

(2) Roof exhaust fans.

(3) Hot water unit heaters.

(4) Inlet air mixing dampers.

(5) Room thermostat with associated controls.

During winter conditions, built-in thermostats activate hot water unit heaters to provide required heating. Ventilation is provided by the air-handling unit (mixing dampers in the minimum outside air position) interlocked with the continuously operating exhaust fan.

When indoor temperature rises, unit heaters are deactivated. If indoor temperature continues to rise, the room thermostat activates the two additional exhaust fans and sets inlet air mixing dampers to the maximum outside air position to provide additional ventilation.

14.12 FIRE PROTECTION

14.12.1 GENERAL

Fire protection is provided throughout the Fire Station. It includes an automatic wet-pipe sprinkler system and portable fire extinguishers.

14.12.2 WET-PIPE SPRINKLER SYSTEM

An automatic wet-pipe sprinkler system is provided throughout the facility. The system is designed in accordance with NFPA 13, and is complete, including piping, valves, fittings, sprinkler heads, and all required accessories and equipment.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

14.12.3 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are a part of the fire protection system provided for the Fire Station. They are sized, located, and installed throughout the facility in accordance with NFPA 10.

SECTION 15

STANDBY GENERATOR BUILDING

15.1 INTRODUCTION

Standby power is provided by generators centrally located to serve the required loads. The generators provide service to standby transformers at the various buildings. Loss of normal power to the site also starts the standby generators and connects them to the standby power grid.

15.2 CIVIL AND SITE DEVELOPMENT

15.2.1 PARKING

Parking is provided adjacent to the building for maintenance vehicles.

15.2.2 LANDSCAPING

No landscaping is provided for this building.

15.3 STRUCTURAL

The Standby Generator Building is a reinforced concrete structure with concrete roof, walls, mezzanine floors, slab-on-grade floor, continuous wall footings, and spread footings for columns.

All concrete walls are used as bearing walls for vertical loads and shear walls for lateral loads (wind or earthquake).

15.4 ARCHITECTURAL

15.4.1 GENERAL

The Standby Generator Building is a separate, single-story structure with a rectangular plan, 195 x 87 ft overall, providing a roofed area of approximately 15,775 sq ft, and a floor area (enclosed) of approximately 11,250 sq ft.

The Standby Generator Building provides electrical power to the site if normal power to the site is lost.

(1) The Standby Generator Building is normally unoccupied except for routine maintenance personnel.

(2) The Standby Generator Building contains five main generator rooms. Each room contains a generator unit and all accessory equipment, including a mezzanine for filters. A fifth room houses all electrical switchgear. In addition, there is a 12-ft-wide, open air covered exhaust passage between the generator room and the switchgear room. Along the other side of the building, an earth berm protects the fresh air intakes. The switchgear room floor level is raised 8 ft above the ground to enable electrical bus ducts from transformers in the main switchyard to pass underneath the floor and turn up to penetrate the floor directly beneath the switchgear.

15.4.2 MATERIALS OF CONSTRUCTION

The Standby Generator Building is designed to satisfy the requirements of the Functional Design Criteria, using the following materials of construction:

(1) The building is a single-story, reinforced concrete structure with reinforced concrete mezzanines in each generator room. The roof is reinforced concrete.

(2) All exterior walls, roofs, and roof-ceiling assemblies are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All fixtures, furnishings, and equipment (FF&E) are provided as required for operation.

15.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1)	UBC Occupancy Class:	B4
(2)	Ceiling heights:	23'-0" for all generator rooms (except 10'-0" above mezzanines) and 15'-0" for electrical switchgear room
(3)	Kind of traffic:	Foot traffic in the building
(4)	Size of access openings:	10'-0" x 12'-0" removable wall panel equipment access openings 3'-0" x 7'-0" exterior personnel doors

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Generator rooms, switchgear room	Concrete	Concrete	Metal liner panels and insulation on concrete	Concrete

15.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

A monorail beam is provided above each generator unit to support a 4-ton-capacity, hand-operated hoist for lifting of heavy components during maintenance.

15.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

15.7 MECHANICAL PROCESS

Refer to Drawing H-3-56946, Standby Diesel Generators Utility Flow Diagram. During power outage, when the main power supply goes out, the standby generators (GEN-550A-D) start automatically to pick up the critical load. To meet this demand, each diesel generator has a dedicated air receiver capable of holding a sufficient supply of air for starting the engine at least three times. The air receivers are tied into a common supply manifold from the air compressors (COM-550A/B), which start automatically whenever the pressure in any of the receivers drops below the setpoint.

Each air compressor is a 3-stage unit, motor-driven, with belts and belt guards mounted on top of the receiver. The finned tube, intercooler, and aftercooler cool the discharge air within 50°F above ambient temperature.

The 8,000-gal No. 2 fuel oil storage tank (TK-510) supplies fuel oil to the standby generators. The tank is replenished and filled with fuel oil on level control. Whenever the fuel in the tank reaches a set low level, the automatic inlet valve opens and also starts the supply pump at the main site fuel oil storage.

Oil-free, dried instrument air (100 psig) is provided from the compressor system located in the R&H Building.

Gravity-flow process sewer drains are provided to handle a peak flow of 1 gpm from areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel-oil day tank. It is collected by gravity flow to a collection tank located near the Site Services Building at the drainage flow rate of 1.1 gpm.

Process water is provided for generator cooling makeup.

15.8 INSTRUMENTATION AND CONTROL

15.8.1 STANDBY GENERATOR

Standby power is provided by four skid-mounted, diesel-engine-powered generators with all accessories as a vendor package. The generators are started automatically and in sequence upon power failure.

The standby generators are monitored and controlled locally from a vendor-furnished control panel (switchgear), and remotely monitored for current, voltage, and power output in addition to a single failure alarm initiated by high temperature, vibration, or out-of-tolerance power output. The remotely monitored signals and alarms are transmitted to the DCS by multiplexers centrally located to serve several buildings.

The diesel engines are equipped with air and electric starters. The starter air is supplied from a dedicated air receiver. The high pressure in the receiver is maintained by two air compressors controlled from high-pressure switches installed on the receivers.

The fuel oil to the diesel generators is supplied from the generator fuel oil storage tank (TK-510). A level transmitter is provided and a 4- to 20-mA dc signal is transmitted to the DCS via multiplexers for monitoring and maintaining the high level in the tank by activating the supply pump and opening the control valve at the site main storage tank from the level switch in the SCS, as shown on Drawing H-3-55123, Sheet 1. The fuel-oil flow rate is remotely monitored and totaled for consumption and inventory-keeping.

15.8.2 UTILITY SYSTEMS

All utility-type systems in the Standby Generator Building are remotely monitored and capable of being remotely controlled.

15.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Standby Generator Building are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the alarm monitoring station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

15.8.4 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

15.9 PIPING

15.9.1 PLUMBING

The roof drainage is in compliance with the Uniform Plumbing Code and DOE Order 6430.1. There are no other requirements for plumbing in the Standby Generator Building.

15.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping. In general, piping runs are in trenches to maintain overhead clearance required for maintenance of diesel engines.

Starting air is supplied from equipment located in the building.

Diesel fuel is provided to the building from an underground storage tank located adjacent to the building.

Oily equipment drains are collected and connected to the MRS Facility oily sewer system.

Nonoily equipment and funnel drains are provided and connected to the MRS Facility process sewer system.

Floor drains are provided that will collect firewater from the automatic sprinkler system. These drains are collected in an oily water separator before the effluent is connected to the process sewer.

Process water for cooling system makeup is supplied at 100 psig from the MRS Facility water distribution system. A reduced-pressure, principal backflow preventer is installed to prevent any possibility of contaminating potable water. Water usage for the building is metered.

The complete installation is in compliance with ANSI B31.1.

15.10 ELECTRICAL

15.10.1 POWER SYSTEM

The Standby Generator Building is a Non-Category I structure housing the diesel-generator units for the MRS Facility standby power system. In addition, the building includes the associated standby power and main substation switchgear.

The standby power system consists of four installed diesel-generator units with space for a future fifth unit. The skid-mounted, diesel-generator units are located in separate compartments, each with its own radiator, control panel, day tank, and roof-mounted exhaust silencer.

The standby power is generated at 4.16 kV and fed to the 5-kV switchgear by a nonsegregated, nonventilated, indoor bus duct system from each unit.

The 5-kV switchgear is in three main sections: Bus No. 1, Transfer/Generator (TG), and Bus No. 2.

Building power is obtained from separate dry-type transformers at 4.16 kV-480Y/277 volts for power and lighting loads. The electrical distribution system is coordinated for selective fault protection. Electrical equipment and installation conform to NEMA-1 type enclosures for indoor use. Fixtures and installation outdoors are of weatherproof construction. Dry type transformers serve all 208Y/120-volt receptacles and small motors less than 1/2 hp in size.

15.10.2 LIGHTING

15.10.2.A. General

High-efficiency fluorescent lighting fixtures are used throughout the interior of the building. Fixtures are of the industrial type with rapid-start lamps. Fluorescent lamp ballasts are of the thermally protected Class P, CBM-certified, high-power-factor type, and are of the energy-efficient type.

High-intensity discharge (HID) luminaires with ballasts and integral mounted fuses are used on the exterior of the building.

15.10.2.B. Emergency Lighting System

An emergency lighting system is provided for safe egress during normal power outage. This system is fed from a standby power panelboard and is automatically switched to emergency power upon loss of normal or standby power, and consists of individual battery-operated emergency unit equipment.

The batteries have a capacity for 90 minutes of continuous operation. All wiring of the emergency lighting system conforms to the applicable requirements of Article 700 of the NEC.

15.10.2.C. Illumination Levels

Lighting intensity is consistent with the recommendations of the latest edition of the IES Lighting Handbook. Lighting intensity at 30 in. above floor level for various areas is as shown in Table 1 of this handbook.

15.10.2.D. Exit Lighting

All exit lighting is considered as an emergency system, and is installed in a conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs are provided as required by NFPA Life Safety Code No. 101.

15.10.3 COMMUNICATIONS

15.10.3.A. Public Address System

Public address system speakers are installed in the Standby Generator Building for paging. The system is provided with a paging zone from the Site Services Building only. Unless otherwise directed, all speaker cables are installed in conduit.

15.10.3.B. Fire Alarm and Detection System

An electrically supervised, noncoded, building fire alarm system is provided. The system includes smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The fire alarm system is in accordance with NFPA 72A, 72D, and 72E; is UL-listed; and is installed in conformance with the NFPA 101 Life Safety Code.

15.10.3.C. Telephone System

The main Electronic Private Automatic Branch Exchange (EPABX) equipment is located in the Site Services Building. A telephone instrument is provided at the Standby Generator Building. The telephone system is installed in a conduit unless otherwise directed.

15.11 HEATING, VENTILATING, AND AIR-CONDITIONING

15.11.1 HEATING AND VENTILATING

The heating and ventilating system for the Standby Generator Building includes the following equipment:

(1) Two heating and ventilating units, including 30% efficiency filters, electric heating coils, supply fans, and motors.

(2) Unit heaters with electric heating coils.

(3) Exhaust fans.

(4) 30% efficiency supply air inlet filters for generator rooms.

(5) Dampers and controls.

(6) Room thermostats.

15.11.2 STANDBY GENERATOR ROOMS

Standby generators with radiators and fans use filtered outdoor air for cooling purposes and combustion air during generator operation. Air is discharged to the outdoors on full cooling during summer and recirculated during winter with modulating dampers. Generator rooms are ventilated year around and heated during the winter.

15.11.3 SWITCHGEAR ROOMS

The electrical switchgear room is provided with filtered air, with heating as required, using two air-handling units. The systems include economy cycles.

15.12 FIRE PROTECTION

15.12.1 GENERAL

The Standby Generator Building is a noncombustible Non-Category I structure housing the diesel-driven 1,400 kW emergency generators and 5 kV switchgear. Each diesel-driven generator unit will be located in a separate room isolated from each other by a 12-in.-thick concrete wall. The 5 kV switchgear, including Bus No. 1, transfer bus and Bus No. 2, will be located in one large room separated from the rest of the generator building by a 24-in.-thick concrete wall. The Non-Category I structure provides adequate fire separation between each generator and associated switchgear.

The generator compartments are protected with a standard automatic, pre-action sprinkler system. The switchgear room is equipped with a smoke detection system to provide early warning of a fire. A fire suppression system is not provided in the switchgrear room because the room is isolated by a fire-rated barrier, lack of combustible materials (noncombustible wire insulation) in the room, and the entire structure is of noncombustible construction.

The 14 mVA transformers in the adjacent switchyard are spaced in accordance with factory mutual (FM) requirements from each other and the Standby Generator Building, and will not require automatic water spray systems.

15.12.2 PREACTION SPRINKLER SYSTEM

Automatic preaction sprinkler systems are complete, including piping, valves, fittings, sprinkler heads, detectors, and all required attachments and devices to provide a hydraulic water motor alarm, an electric alarm and supervisory signal to the main fire protection annunciator. The number and zoning of the fire sprinkler risers for the automatic sprinkler systems protecting the building will be determined after fire protection systems have been finalized.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Standpipe and hose cabinets are provided in accordance with NFPA 14.

15.12.3 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are part of the fire protection system provided for the Standby Generator Building. Portable fire extinguishers are sized, located, and installed throughout the facility in accordance with NFPA 10.

15.12.4 FIRE ALARM SYSTEM

A fire alarm system is provided throughout the building. The system will be designed in accordance with NFPA 72A, "Local Protective Signaling System," NFPA 72D, "Proprietary Protective Signaling System," and NFPA 72E, "Automatic Fire Detectors." All fire alarm, detection, manual pull stations, and signaling systems, components, and equipment are UL-listed and/or FM-approved, and installed in accordance with NFPA 101, "Life Safety Code."

SECTION 16

SEWAGE TREATMENT FACILITY

16.1 INTRODUCTION

The Sewage Treatment Facility provides for noncontaminated process and sanitary sewage treatment. Noncontaminated process sewage treatment uses neutralization tanks, clarifiers, and press filter before disposal in the Clinch River. Sanitary sewage treatment is by an extended aeration, filtration, and chlorination before disposal in the Clinch River.

16.2 CIVIL AND SITE DEVELOPMENT

16.2.1 PARKING

Parking is provided for the site vehicles serving this facility.

16.2.2 LANDSCAPING

Landscaping is provided around this facility and the area extending out to the Main Gate/Badgehouse and the front of the limited access area.

16.3 STRUCTURAL

The Sewage Treatment Facility is composed of below-grade tanks and a small concrete block building. The building is constructed of a metal deck roof, continuous wall footings, and slab-on-grade floor.

16.4 ARCHITECTURAL

16.4.1 FUNCTIONS

The Sewage Treatment Facility provides an enclosure for five rooms: a main equipment room, blower room, chemical storage, electrical equipment room, laboratory and office, with sufficient laboratory space for sampling. Except for routine maintenance personnel and those concerned with sampling, the building is normally unoccupied.

16.4.2 DESIGN DESCRIPTION

(1) The building is a single-story, reinforced masonry walled structure with structural steel roof framing.

(2) All exterior walls, roof, and roof-ceiling assemblies that enclose heated spaces are insulated in accordance with the energy insulation requirements of DOE 6430.1, General Design Criteria.

(3) All fixtures, furnishings, and equipment (FF&E) are provided as required for operation.

(4) The building will be approximately 60 x 64 ft or 3,840 sq ft.

16.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B-2

(2) Ceiling heights: 13'-0" (minimum) for all rooms (sloped roof)

(3) Kind of traffic: Foot traffic in the building
Forklift

(4) Size of access openings:

3'-0" x 7'-0"	personnel doors
6'-0" x 7'-0"	personnel doors
6'-0" x 9'-4"	equipment access doors
14'-0" x 10'-0"	equipment access doors

(5) Finishes:

Floor	Base	Wall	Ceiling
Concrete	Rubber cove	Gypsum board and insulation over concrete block	Exposed framing

16.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE HANDLING

Not applicable to this facility.

16.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

16.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided by a compressor system. The air system consists of a compressor, coolers, separator, filters, receiver, dryers, and associated controls and instrumentation.

Potable water is provided for fire protection, utility stations, eyewash, safety shower, and process water.

Gravity-flow process sewer drains are provided to handle a peak flow of 110 gpm from filter backwash and areas containing waste that may be harmful to the sanitary sewer system.

16.8 INSTRUMENTATION AND CONTROL

16.8.1 UTILITY SYSTEMS

All utility-type systems in the Sewage Treatment Facility are remotely controlled and capable of being remotely controlled.

Oil-free, dried plant and instrument air is provided by a compressor backed up by a spare. The compressor is controlled locally from a vendor-furnished panel and monitored remotely for motor on-off status. The plant air is dried, and the pressure is dropped to 100 psig and monitored remotely for pressure and temperature before entering the distribution header. The instrument air is dried to a dewpoint of -40^{o}F, the pressure is reduced to 100 psig, and the air is remotely monitored for moisture content and pressure.

16.8.2 SECURITY AND FIRE ALARMS

All fire alarms in the Sewage Treatment Facility are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the alarm monitoring station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

16.8.3 MAINTENANCE

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this building are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

16.9 PIPING

16.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between the interior plumbing and exterior water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered.

A pressure regulator reduces the potable water system to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater.

A safety shower and eyewash station is provided near the chemical handling area and supplied with cold potable water.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

16.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior water piping.

Utility stations of plant air for tool use and process water are provided.

Plant air is also supplied to the filter press and sludge pumps.

Plant air and instrument air are supplied from equipment in the building.

Process water is supplied at 100 psig from the building potable water supply.

A reduced-pressure, principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Floor drains, equipment drains, and laboratory sink/drain are provided and connected to the MRS Facility process sewer.

The complete installation is in compliance with ANSI B.31.1.

16.10 ELECTRICAL

16.10.1 POWER SERVICE

Power at 480Y/277 volts, 3 phase, 4 wires, is provided at the Sewage Treatment Facility from a service feeder originating in the Security Building. The service feeder terminates in an outdoor NEMA 3R motor control center for distribution to all power loads.

A 480-208Y/120-volt dry-type transformer, located within the motor control center, provides power for area and indoor small motor and the receptacle load.

16.10.2 LIGHTING

All outdoor area fixtures are of the high-intensity discharge (HID) type, of 277 volts. All indoor laboratory lighting fixtures are of the fluorescent, high-power factor and energy-efficient type.

16.11 HEATING AND VENTILATING

The heating and ventilating systems for the Sewage Treatment Facility include the following equipment:

(1) Power roof ventilators

(2) Electric unit heaters

(3) Filters

(4) Automatic dampers and controls

(5) Room thermostats

The Sewage Treatment Facility is provided with a heating and ventilating system. Filtered air is drawn into spaces through wall louvers with automatic dampers, and discharged to the outdoors by power roof ventilators. Electric unit heaters are used for space heating.

16.12 FIRE PROTECTION

16.12.1 WET-PIPE SPRINKLER SYSTEM

An automatic wet-pipe sprinkler system is provided throughout the Sewage Treatment Facility. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and supervisory signal to the main fire protection annunciator.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system for the Sewage Treatment Facility. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

16.12.2 FIRE ALARM SYSTEM

A fire alarm system is provided throughout the Sewage Treatment Facility. The system is designed in accordance with NFPA 72A, Local Protective Signaling System; NFPA 72D, Proprietary Protective Signaling Systems; and NFPA 72E, Automatic Fire Detectors. All fire alarm, detection, and signaling system components and equipment are UL listed and/or FM-approved, and are installed and located in accordance with NFPA 72E.

SECTION 17

WATER TREATMENT FACILITY

17.1 INTRODUCTION

The Water Treatment Facility consists of chlorination equipment. In addition to the domestic and firewater pumps, it provides proper enclosures for the substation room, chlorinator room, and firewater pumproom.

17.2 CIVIL AND SITE DEVELOPMENT

17.2.1 PARKING

Parking is provided for the vehicles that service this facility.

17.2.2 LANDSCAPING

Landscaping is provided around this facility and the area extending to the Main Gate/Badgehouse and the front of the limited access area.

17.3 STRUCTURAL

The Water Treatment Facility is a small, concrete block building with metal deck roof, slab-on-grade floor, and continuous wall footings.

17.4 ARCHITECTURAL

17.4.1 FUNCTIONS

The Water Treatment Facility provides enclosures for the chlorinator, distribution pump system, the firewater pump system, and all related controls and equipment.

(1) The Water Treatment Facility is normally unoccupied except for routine maintenance personnel.

(2) The Water Treatment Facility contains four rooms: a main equipment room, an electrical equipment room, a firewater pumproom, and a chemical storage room.

(3) The Water Treatment Facility is a separate structure, having separate entrances to each room, and is located in close proximity to the water storage tank.

17.4.2 DESIGN DESCRIPTION

(1) The building is a single-story, reinforced masonry walled structure with structural steel roof framing.

(2) All exterior walls, roofs, and roof-ceiling assemblies that enclose heated spaces are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupation.

(4) The building is approximately 34 x 40 ft, or 1,360 sq ft.

17.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class: B-2

(2) Ceiling heights: 13'-0" for all rooms (sloped)

(3) Kind of traffic: Foot traffic in the building

(4) Size of access openings:

	3'-0" x 7'-0"	personnel doors
	3'-0" x 9'-0"	equipment access doors
	6'-0" x 9'-0"	equipment access doors
	14'-0" x 10'-0"	equipment access doors

(5) Finishes:

Area	Floor	Base	Wall	Ceiling
Equipment room, electrical equipment room, firewater pumproom, and chemical storage room	Concrete	Rubber cove	Gypsum board and insulation over concrete block	Exposed framing

17.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this facility.

17.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

17.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided from the compressor system located in the Vehicle Maintenance Building.

Potable water is provided for fire protection, utility stations, eyewash, and safety shower.

Gravity-flow process sewer drains are provided to handle a peak flow of 100 gpm for equipment draining.

Fuel oil is provided for the auxiliary firewater pump.

Oily sewer drains are provided to collect oil drips and drainage. They are collected and drained by gravity flow to a collection tank, located near the Site Services Building, at the drainage flow rate of 3.5 gpm.

17.8 INSTRUMENTATION AND CONTROL

17.8.1 WATER TREATMENT FACILITY

The water is pumped to the Water Treatment Facility for chlorination before it is pumped to the storage tank for site use.

The chlorination package is a vendor-furnished item, controlled and monitored from local control panel. The differential pressure alarm, level alarm, and motor status signals are transmitted to the DCS for monitoring.

The water flow rate and the level in the storage tank are monitored remotely, and maintained at a high, predetermined value.

17.8.2 UTILITY SYSTEMS

All utility-type systems in the Water Treatment Facility are remotely monitored and capable of being remotely controlled.

17.8.3 SECURITY AND FIRE ALARMS

All fire alarms in the Water Treatment Facility are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the alarm monitoring station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

17.8.4 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this facility are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards as determined by self-diagnostic or manual troubleshooting methods.

17.9 PIPING

17.9.1 PLUMBING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior water piping.

Potable water at 100 psig is supplied from the MRS Facility water distribution system and its usage for the building is metered.

A pressure regulator reduces the potable water system pressure to 80 psig.

A safety shower and eyewash station are provided near the chemical handling area and supplied with cold potable water.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

17.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Utility stations of plant air for tool use and process water are provided.

Plant air and instrument air are supplied from equipment in the Vehicle Maintenance Building.

Process water at 100 psig is supplied from the MRS Facility water distribution system.

A reduced-pressure, principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Water usage for the Water Treatment Facility is metered.

Nonoily equipment and floor drains are provided and connected to the MRS Facility process sewer.

Diesel fuel is supplied to the diesel-engine-driven fire pump day tank from the MRS Facility fuel oil distribution system.

Oily equipment drains are collected and connected to the MRS Facility oily sewer system.

The complete installation is in compliance with ANSI B31.1.

17.10 ELECTRICAL

17.10.1 POWER SERVICE

Normal and standby power at 480Y/277 volts, 3 phase, 4 wires, is provided at the Water Treatment Facility from a service feeder originating in the Security Building. The service feeders terminate in an indoor NEMA-I, split bus, load center for distribution to all power loads in the water treating and transfer pump station. The firewater pump (300 hp) is fed from the 5-kV standby bus in the main switchgear room.

A 480-240Y/120-volt, 1-phase, dry-type transformer provides power for receptacles and other single-phase loads.

17.10.2 LIGHTING

A lighting panel provides distribution and protection for all lighting circuits. Area and indoor lighting is at 277 volts.

17.11 HEATING AND VENTILATING

The heating and ventilating systems for the Water Treatment Facility include the following equipment:

(1) Power roof ventilators

(2) Electric unit heaters

(3) Filters

(4) Automatic dampers and controls

(5) Room thermostats

The Water Treatment Facility is provided with a heating and ventilating system. Filtered air is drawn into spaces through wall louvers with automatic dampers, and discharged to the outdoors by power roof ventilators. Electric unit heaters are used for space heating.

17.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Water Treatment Facility. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and supervisory signal to the main fire protection annunciator.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 18

CASK MANUFACTURING FACILITY

18.1 INTRODUCTION

The concrete storage casks are fabricated in a cask manufacturing plant by an assembly-line process on the site. Completed casks are placed in the staging area.

18.2 CIVIL AND SITE DEVELOPMENT

18.2.1 PARKING

Parking for employees working at this facility and for site vehicles serving this facility is provided adjacent to the entrance of the facility.

18.2.2 LANDSCAPING

No landscaping is provided for this facility.

18.3 STRUCTURAL

The Cask Manufacturing Facility consists of a steel building, a steel canopy, and yard structures.

The building is a twin-bay, steel-framed structure with metal deck roof and metal siding, slab-on-grade floor, and isolated spread footings. The high-bay structure is composed of two 100 ft bays with a 225-ton bridge crane in each bay riding on 36-in. runway girders supported by 36-in. building columns. Eight-foot roof trusses span 100 ft to building columns. The trusses and building columns form rigid frames to resist lateral loads (wind or earthquake) in the transverse direction. Steel bracings, in the longitudinal exterior walls, are designed to resist lateral load in the longitudinal direction.

The canopy is an open steel structure with a metal deck roof.

The yard structures (including conveyor support, platforms, and unloading stations) are of steel and concrete construction. The conveyors are supported by steel trusses on steel columns and isolated footings. The unloading stations have concrete pits and steel platforms.

18.4 ARCHITECTURAL

18.4.1 FUNCTIONS AND OCCUPANTS

The Cask Manufacturing Facility consists of five major functions:

(1) Office area
(2) Twin shop areas
(3) Materials storage laboratory
(4) Laboratory
(5) Building services

18.4.1.A. Office Area

The office area includes two offices designed to house two shift supervisors for each of three shifts.

Locker rooms, toilet and change/shower rooms, and a lunchroom are provided near the office area and convenient to the shop area.

18.4.1.B. Shop Areas

(1) The twin shop areas are designed to accommodate the following:

- Concrete batch plant
- Forming and casting area
- Curing area

(2) The Cask Manufacturing Facility is designed to be operated by the following personnel of an independent operator:

Assignment	Number of Personnel			
	Day	2nd	3rd	Total
Plant Manager	1	-	-	1
Supervisor	1	-	-	1
Foreman	3	2	1	6
Clerk	1	-	-	1
Front-end loader operator	2	2	-	4
Rebar tying	12	12	-	24
Concrete pouring	6	6	-	12
Rebar fabrication	6	6	6	18
Instrumentation/electrical	4	4	1	9
Crane operator	1	1	1	3
General laborer	12	12	12	36
Laboratory technician	2	-	-	2
	51	45	21	117

(3) The requirements of the shop areas are satisfied as follows:

(a) The shop areas have exposed structural roof framing and a hardened, reinforced concrete, slab-on-grade floor.

(b) A clear height of approximately 56 ft above the floor is provided. All structural members and mechanical and electrical systems are located above this height.

(c) Two 225-ton-capacity bridge cranes with auxiliary 25-ton hooks and maximum hook heights of 40 ft are provided. The bridge cranes span the width of each bay (100 ft) and the runway rails travel the length of the building (460 ft). The bridge cranes are used primarily to move the cast concrete casks to the curing area as well as to assist in the various manufacturing operations.

18.4.1.C. Materials Storage

An attached, roofed, outside storage area is provided for the storage of prefabricated rebar, liner storage, and shop-related items. The storage area will be adjacent to the shop area. A forklift will be provided for handling materials.

18.4.1.D. Laboratory

A laboratory for storing and testing concrete samples of the mixes used in cask fabrication is provided.

18.4.1.E. Building Services

Space is provided for the following building services, as required for the normal operation of the building:

(1) HVAC equipment
(2) Electrical equipment
(3) Telephone equipment
(4) Plumbing equipment (restrooms, etc.)

18.4.2 DESIGN DESCRIPTION

(1) The building is envisioned as a single-story, steel-framed structure consisting of a main twin high-bay shop building with lower, attached appendages of varying heights according to interior needs. The high-bay structure is of a rectangular plan, 460 x 216 ft, with a floor area of 99,360 sq ft; the two attached appendages are 120 x 42 ft consisting of offices, laboratory, and toilet rooms with an enclosed area of 5,040 sq ft and an open-sided appendage, 60 x 210 ft steel consisting of storage and fabrication, with a roofed area of 12,600 sq ft. The exterior wall material is an insulated, panelized wall system above concrete block apron walls.

(2) All exterior walls, roofs, and roof-ceiling assemblies are insulated in accordance with the energy-insulation requirements of DOE 6430.1, General Design Criteria.

(3) All fixtures, furnishings, and equipment (FF&E) are provided as required for occupancy.

18.4.3 ADDITIONAL DESIGN AND CONSTRUCTION FEATURES

(1) UBC Occupancy Class:

Office and laboratory area	B2
Shop area	B4
Storage areas	B4

(2) Ceiling heights:

Office and laboratory area	9'-0"
Toilet and locker rooms	9'-0"
Shop areas	56' approximately
Storage	24' approximately

(3) Kind of traffic: Foot traffic
Front-end loaders
Transporter
Forklift

(4) Size of access openings: 3'-0" x 7'-0" personnel
6'-0" x 9'-0" personnel
12'-0" x 12'-0" service (loaders)
20'-0" x 30'-0" service (transporters)

(5) Special equipment:

Office:	Fixtures, furnishings, and equipment Photocopy machine
Toilets, lockers, change/shower rooms:	Metal toilet partitions, metal lockers Toilet and shower accessories Mirrors
Lunchroom:	Vending machines Microwave ovens Tables, chairs
Laboratory:	Fixtures, furnishings, lab casework, and testing equipment

Shops: All shop equipment as required (see Material Handling section)

Storage areas: Storage shelving, cabinets, etc.

18.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

18.5.1 MATERIAL REQUIREMENTS

Based on output of 35 to 40 casks per month (8 to 9 casks per week, 416 to 468 casks per year) requires the following materials and estimated volumes of railcar shipments:

(1) Aggregate: 40 cars at 70 tons or 4,000 cu yd/month
(2) Sand: 26 cars at 70 tons or 2,600 cu yd/month
(3) Cement (bulk): 13 cars at 70 tons or 1,300 cu yd/month
(4) Steel liners (prefab): 20 cars at 2 liners/car or 40 liners/month
(5) Steel rebars (preformed rings and verticals): 22 cars/month

18.5.2 MATERIAL DELIVERY

The aggregate, sand, and cement raw materials for the Cask Manufacturing Facility are delivered to the site on railroad cars. The steel liners and preformed rebar components, which are fabricated offsite and are assembled in the rebar cage fabrication area of this facility, are also delivered on railroad cars.

18.5.3 MATERIAL UNLOADING STATIONS

Four unloading stations are used for unloading the delivered material from railroad cars. Three stations are assigned for unloading aggregate, sand, and cement. The fourth station is used to unload incoming steel liners and preformed rebar. The unloading stations for aggregate and sand are designed to unload railcars of 70-ton capacity in 10 to 15 minutes depending upon the condition of material. The cement unloading station is designed to unload railcars of 70-ton capacity in 2 to 3 hr.

18.5.3.A. Method of Unloading Aggregate, Sand, and Cement

1. Railroad Car Mover. A mover (30,000-lb drawbar pull) positions the railcar to be unloaded into the respective station. Aggregate or sand is discharged by gravity through the hopper car bottom, and falls into the inlet chute of the undertrack unloader (Barber Greene Model PR-50 or equal, 600-ton/hr maximum capacity). Bulk cement is unloaded from its hopper car in the cement unloading station by means of a pneumatic car-unloading system.

2. Vibrating Platform. To facilitate the unloading of aggregate, sand, and cement, each of these three unloading stations is provided with a vibrating platform (Stanfield railcar unloading system or equal) installed underneath each pair of rails, 10-ft-long sections.

3. Conveyors. Two belt conveyors, 24 in. wide x 200 ft long (maximum) with 400 tons/hr capacity each, are used to stockpile aggregate (80-ft base diameter by 30-ft-high cone, maximum) and sand (70-ft base diameter by 26-ft-high cone, maximum).

4. Cement Storage. Two bulk cement silos (12 ft dia by 48 ft high) are provided to receive the railcar shipments. A pneumatic conveying system is used to transfer cement from either of the two cement silos to a cement supply bin (8 ft sq by 20 ft high).

18.5.3.B. Method of Unloading Steel Liners and Rebar

A fourth unloading station is provided for the incoming steel liners and preformed rebars. A 10,000-lb capacity forklift truck is used to unload and to transport these steel materials to the prefabricated rebar and liner storage area.

18.5.4 OUTDOOR MATERIAL HANDLING

Outdoor storage is provided for stockpiling aggregate and sand. Feeding of aggregate and sand to the batch mixing plant is provided by 2-cu-yd, front-end loaders, which dump their loads into aggregate and sand supply feed bins. Aggregate and sand are then moved by individual belt conveyors to the weigh bins at an elevation of 15 ft (approximate).

18.5.5 CASK MANUFACTURING PROCESS

18.5.5.A. Concrete Batch Mixing Plant

1. Automatic Control. The concrete batch mixing plant is a fully automatically controlled operating plant from the supply bins to mobile belt placer unit. An automatic control unit will provide controlled batch mixing quality assurance, a step-by-step monitoring of the mixing operation, and a batch mixing history tape.

2. Mixing Process. Sand and aggregate are fed from the supply bins onto 12-in. belt conveyors and fed to batch mixer weigh bins. The belt length is approximately 35 ft. Automatic controls will conduct all of these operations to ensure preset batch mix material quantities. Metered cement is also fed from the supply bin by screw conveyor. Metered amounts of sand, aggregate, cement, and water are fed to a 2-cu-yd batch mixer for concrete batch mixing. Mixed concrete is next fed from the batch mixer into a concrete pumping unit to supply a movable-belt- type concrete placer unit (Morgan design or equal). The movable placer unit can be elevated and turned for cask pouring.

18.5.5.B. Sequence of Cask Forming Process

1. The cask internal mild steel liner is transferred to the rebar cage fabrication area from its storage area.

2. The internal liner is lowered onto the pad; the preformed base structure of the liner allows the liner to set at the correct elevation. Scribed center lines on the pad permit positioning the liner in an "X" and "Y" axis location.

3. The rebar cage is formed by using the preformed circular rings and vertical upright rebars. The forming starts from the bottom. All intersection joints are wire-tied. Adequate scaffolding is provided to the proper height.

4. Instrumentation personnel are present at the rebar forming location to install instrumentation at various required elevations within the cage.

5. The 225-ton bridge crane is used to move the formed rebar cage and liner to the appropriate form (mold).

6. Continuous pouring of the concrete can now begin, using vibrators to ensure that there are no voids in the concrete. The approximate pouring time is 5 hours.

7. The curing time for the casks is 2 days in the form (mold), 12 days in place after the mold removal, and 14 days in the staging area before they can be transported to the R&H Building.

18.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

18.7 MECHANICAL PROCESS

Oil-free, dried plant air (125 psi) and instrument air (100 psi) are provided by a compressor system. The air system consists of a compressor, coolers, separator, filters, receiver, dryers, and associated controls and instrumentation.

The hot water boiler system requires a supply of fuel oil, natural gas (if available), and potable water.

The fuel oil system consists of a day tank and a supply pump, supplying No. 2 diesel oil to the boiler at a winter peak rate of 9.0 gph and 30 psig. Natural gas (if available) is supplied as an alternate fuel at the winter peak rate of 1,250 scfh.

Potable water is provided for fire protection, drinking, utility stations restrooms, and process water. Process water is used for makeup water to the boiler and is continuously supplied at the winter peak rate of 1.1 gpm.

Gravity-flow process sewer drains are provided to handle a peak flow of 10 gpm from the hot water boiler blowdown and other areas containing waste that may be harmful to the sanitary sewer system.

Oily sewer floor drains are provided to collect drips and off-specification waste from the fuel oil day tank. It is collected by gravity flow to a collection tank, located near the Cask Manufacturing Facility, at the drainage flow rate of 3.5 gpm.

18.8 INSTRUMENTATION AND CONTROL

18.8.1 UTILITY SYSTEMS

All utility-type equipment and systems in the Cask Manufacturing Facility are remotely monitored and capable of being remotely controlled.

The hot water boiler is monitored remotely as well as locally for fuel/natural gas consumption in addition to the hot water discharge temperature and pressure. These variables, and a boiler failure alarm initiated by low water level, high/low pressure, or high temperature in the boiler, are indicated locally and in the DCS control rooms in the R&H Building and Site Services Building, respectively.

The hot water boiler fuel-oil supply day tank contains a level control to maintain the liquid level above a preset low value. This is accomplished by turning the transfer pump on and off by means of the level switch in the DCS. Building hot water supply pumps and boiler fuel-oil supply pumps are controlled from the boiler control panel. Only status-light signals are transmitted to the DCS.

Oil-free, dried plant air and instrument air are provided by a compressor backed up by a spare. The compressor is controlled locally from a vendor-furnished panel, and monitored remotely for motor on-off status. The plant air is dried; the pressure is dropped to 100 psig and monitored remotely for pressure before entering the distribution header. The instrument air is dried to a dewpoint of -40^{o}F, the pressure is reduced to 100 psig, and the air is remotely monitored for moisture content and pressure.

18.8.2 SECURITY AND FIRE ALARMS

All fire alarms in the Cask Manufacturing Facility are monitored by the fire alarm monitoring system in the Fire Station and transmitted to the alarm monitoring station (AMS). All security alarms are monitored by the AMS. These two alarms are transmitted to the DCS, where they are presented separately as group alarms.

18.8.3 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this facility are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

18.9 PIPING

18.9.1 PLUMBING

The interior plumbing extends to a point 5 ft outside the building, where a connection is made between interior plumbing and exterior sewerage and water piping.

Potable water is supplied at 100 psig from the MRS Facility water distribution system and its usage for the building is metered. A pressure regulator reduces potable water system pressure to 80 psig.

Hot water is supplied at 110°F by an electric hot water heater. An electric (drinking) water cooler is provided.

Eyewash stations to comply with ANSI Z358.1 are provided and supplied with cold potable water. Plumbing fixtures meet requirements for the physically handicapped.

Piping runs are concealed in ceilings, walls, and furred spaces in the office area and exposed in the shop and equipment room.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1

18.9.2 PIPING

The interior piping extends to a point 5 ft outside the building, where a connection is made between interior piping and exterior piping.

Fuel oil and fuel gas (if available) are supplied to the boiler from the MRS Facility distribution system. Fuel oil and fuel gas usage for the building are metered.

Equipment and funnel oily drains are provided in the boiler room and are connected to the MRS Facility oily sewer system.

Boiler blowdown and HVAC mechanical equipment drains are provided and are connected to the MRS Facility process sewer.

Process water for the heating system makeup, concrete mixing, and utility stations is provided at 100 psig from the potable water supply to the building. A reduced-pressure, backflow preventer is installed to prevent any possibility of contaminating potable water.

Utility stations of plant air for tool use and process water are provided.

Instrument air is provided in the boiler room and mechanical equipment room.

Plant air and instrument air are supplied from equipment in the mechanical equipment room.

A settling sump is provided to collect effluent from floor drains and funnel drains from the manufacturing area. The sump pump discharge is connected to the process sewer.

Piping runs are exposed in the shops and equipment room.

The complete installation is in compliance with ANSI B.31.1.

18.10 ELECTRICAL

18.10.1 POWER SERVICE

Power service to the Cask Manufacturing Facility (train I and train II) is obtained from outdoor unit substations. Primary power at 4.16 kV is transformed to 480Y/277 volts for distribution, by means of motor control centers, to all power loads.

Electrical equipment installed outdoors is installed in NEMA Type 3R enclosures. All major indoor electrical equipment is installed in pressurized NEMA Type 12 enclosures. The entire electrical distribution system is coordinated for selective fault protection.

Dry-type, 480-208Y/120-volt, 3-phase transformers and distribution panelboards are used for service to receptacles, other small loads, and motors less than 1/2 hp in size.

18.10.2 LIGHTING

18.10.2.A. General

In general, 277 volts is used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system is 120 volts, when incandescent fixtures are used. Local switching is provided on all lighting circuits when it is possible to use this approach.

Fluorescent light fixtures are used in all indoor areas except for the forming and pouring areas (and during building). HID lighting is used for all high bays and outdoor areas and on the crane.

18.10.2.B. Emergency Lighting System

Individual, self-contained, battery-operated emergency unit equipment is used throughout the facility to permit safe egress for personnel and safe process control shutdown.

18.10.2.C. Outdoor Floodlighting and Area Lighting

Outdoor floodlighting and area lighting are provided for illumination during nighttime operation.

Lighting is photoelectrically relay-controlled with manual override.

18.10.3 COMMUNICATIONS

18.10.3.A. Public Address System

Public address system speakers are installed in the Cask Manufacturing Facility for paging. The system is provided with two paging zones; it is initiated from the Site Services Building and from the Cask Manufacturing Facility by telephone access.

18.10.3.B. Telephone System

Telephone station equipment is provided as required for the Cask Manufacturing Facility, and is connected to the main Electronic Private Automatic Branch Exchange (EPABX) located in the Site Services Building.

Location and type of station equipment will be developed during the final design phase. All telephone systems are installed in conduit.

18.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

The Cask Manufacturing Facility is provided with heating, ventilating, and air-conditioning as follows:

(1) Two heating and ventilating units, including 30% efficiency filters, hot water heating coils, supply fans, and motors.

(2) Air-conditioning unit, including 85% efficiency filters, hot water heating coil, Freon cooling coil, fan, and motor.

(3) Air-cooled condensing unit, including compressor, fans, and controls.

(4) Power roof ventilators.

(5) Unit heaters (hot water).

(6) Dampers and controls.

(7) Room thermostats.

The office area air-conditioning system uses recirculated air year around. The manufacturing area uses recirculated air during winter and 100% outdoor air during summer.

Mechanical and electrical equipment rooms are heated and ventilated by unit heaters and power roof exhausters. Toilet areas are provided with power roof exhausters.

18.12 FIRE PROTECTION

An automatic wet-pipe sprinkler system is provided throughout the Cask Manufacturing Facility. This system is fed from the MRS Facility water distribution grid. It is designed in accordance with NFPA 13, and is complete with the necessary attachments and devices to provide a hydraulic water motor alarm, an electric alarm, and supervisory signal to the main fire protection annunciator.

Fire-stopping material is provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections are provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers are a part of the fire protection system. They are sized, located, and installed throughout the facility in accordance with NFPA 10 to provide means to fight a fire in its incipient stage.

SECTION 19

ELECTRICAL DISTRIBUTION SYSTEM

19.1 INTRODUCTION

Electrical power is obtained from the nearest commercial or public utility capable of meeting the MRS Facility requirements. Standby electrical power is provided by standby generators at the site. The telephone system is linked to the National Telephone Network via a private microwave network.

19.2 CIVIL AND SITE DEVELOPMENT

Not applicable to this system.

19.3 STRUCTURAL

Not applicable to this system.

19.4 ARCHITECTURAL

Not applicable to this system.

19.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this system.

19.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this system.

19.7 MECHANICAL PROCESS

Not applicable to this system.

19.8 INSTRUMENTATION AND CONTROL

Interruption of the commercial dual-feeder power supply and standby generator startup, and also the return from standby power to commercial power, are monitored by the DCS for supervisory control and recordkeeping purposes.

The commercial power interruption signal is initiated by a voltage drop across three undervoltage relays connected to three different power buses. Two of the relays are connected to the commercial dual-feeder buses and one to the standby generator bus. Voltage-to-current transducers are provided to convert the voltage signal from the voltmeters to a 4-20 mA dc signal, which is transmitted via multiplexers, centrally located to serve different buildings, to the DCS, located in the R&H Building control room, for indication and alarming.

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation.

19.9 PIPING

Not applicable to this system.

19.10 ELECTRICAL

19.10.1 POWER SERVICE AND DISTRIBUTION

Normal electrical power is provided by two 161-kV transmission lines from the nearest electrical utility company that is capable of meeting the MRS Facility requirements. The transmission lines may originate at the same utility substation or switchyard, but are routed on separate steel towers to the MRS Facility. The transmission lines are designed for the seismic zone appropriate to the area, and are segregated laterally so that a tornado-generated missile 1 ft-2 in. dia and 35 ft long will not cause simultaneous failure of both transmission lines. Design of the transmission lines provides clearances above ground of at least 125% of the minimum required by the National Electrical Safety Code (Table 232-1). Tower spacing and height are designed to limit the maximum stress to 75% of the allowable stress for the selected conductors. Overhead static ground wires and tower grounding are provided for lightning protection for each transmission line. Footing design includes an overturning factor of safety of 100% above the maximum uplift produced by working loads under the most severe conditions.

The transmission lines terminate at the MRS Facility main substation in an outdoor switchyard structure. The last tower of each line is of the dead-end type, designed to withstand 150% of the maximum design stress, and is located 1/4 mile outside the MRS Facility. The incoming feeder circuits are then routed underground to avoid interference with the MRS perimeter security and surveillance system.

The MRS Facility main substation includes an outdoor, high-voltage switchyard; power transformers; and indoor, medium-voltage switchgear. The switchyard includes one 3-pole, 169-kV power circuit breaker, SF_6 insulated, with two 3-pole, 169-kV, group-operated, air-isolating disconnect switches for each transmission line. One cubicle in each medium-voltage switchgear lineup located in the hardened switchgear room of the Standby Generator Building is provided for all high-voltage controls, protection relays, and metering. An inside battery bank provides closing and tripping power for the switchyard. Primary transmission line protection is a directional-comparison, pilot-wire scheme, with relay and breaker failure backup causing simultaneous tripping of both the sending-end and the receiving-end power circuit breakers. The maximum voltage rating for the switchyard is 169 kV. The power transformers are of the outdoor, oil-immersed type, on air/forced air (OA/FA), 55/65°C temperature rise, 161 to 5 kV, delta-wye, with resistance neutral grounding. The OA rating of each transformer is equal to or greater than 100% of the entire load of the MRS Facility at the 55°C rating. Each transformer is furnished complete with the following minimum features:

(1) Primary line bushings

(2) No load-tap changer equipment

(3) All accessories as required by ANSI C57.12.10

(4) Sealed tank system

(5) Pressure-vacuum bleeder

(6) Neutral resistance grounding system

(7) Secondary throat connection for bus-duct to medium-voltage switchgear

(8) Fault, sudden-pressure relay

(9) Surge arrestors

Transformer protection includes harmonic-restraint differential relays and secondary-backup overcurrent relays.

The secondary bus duct to the medium-voltage switchgear is a 4.16-kV, nonsegregated-phase bus with epoxy-coated conductors. The minimum current rating is 125% of the maximum full-load amperes (FLA) rating of the transformer.

The medium-voltage switchgear is of the 5-kV class, indoor, air- or vacuum-break, metal-clad type. Three switchgear assemblies are provided [one for each of the power transformers and one for the transfer/generator (T/G) bus]. Each assembly includes one main incoming circuit breaker, except that the T/G bus has five (including one for future) incoming and two tie-breakers to control transfer and isolation of the two incoming lines and the standby power generation to the MRS Facility. A transfer relay system is provided, and will be actuated by loss of voltage with time restraint to allow for one reclosure of the primary power circuit breaker. Breaker control is by direct current from battery banks contained within the switchroom building. Each assembly contains a metering cubicle with summation transducers to indicate kVA (with maximum demand), kVAR, and kW/h for each transformer, and for the overall facility.

Power is distributed from the medium-voltage switchgear to unit substations at or near the respective buildings via an underground duct bank system. Cables pertaining to one switchgear assembly are segregated from those pertaining to the other assembly to ensure that no single failure could compromise both systems. Dual feeders are provided to each double-ended unit substation and for each primary selective substation. All feeders are for a radial-type distribution service. All cables are 5 kV, 3-conductor, with ground wires, ethylene propylene rubber or thermosetting insulation, 90°C, moisture- and flame-retardant, with overall moisture-resistant jacket.

Double-ended unit substations are provided for all essential services where standby power is also required. Each substation within the protected area is located inside the respective building. Transformers are ventilated, dry type, limited to 1,500/2,000 kVA AN/FN, with NEMA standard impedance, 5kV-480Y/277 volts, delta-wye, with solidly grounded neutral and air-interrupter, primary-disconnect switches. Outside the protected area, the unit substations are outdoor-type walk-in-aisle switchgear, with liquid-cooled transformers. One common substation is provided for two or more buildings where the required load is small. Transformers for nonessential buildings are of the outdoor, liquid-cooled, pad-mounted type, with adjoining oil-filled, pad-mounted primary selector switches. Such switches have load-break/fault-make capability to manually select the alternate feeder, when one normal power is down. Primary fuses are provided for each transformer where two or more share a common radial feeder. Unfused primary-disconnect switches are provided for all other transformers. Secondary switchgear for all double-ended unit substations, and for the Site Services Building, are of the drawout type, airbreak, with solid-state, direct-acting tripping, manual closing. Local kW/h metering is provided at each substation. A local main-disconnect switch is provided at all subfed distribution panels and motor control centers. Nonautomatic, molded-case circuit breakers are not used for this service. For secondary selective tripping, the main disconnect is rated to withstand the maximum prospective short-circuit fault current for the time necessary for the upstream power-feeder breaker to trip on short time setting. Motors of less than 250 hp are controlled by combination motor starters, either contained within a motor control center or local. Motors 250 hp and larger are controlled by circuit breakers of the unit substation switchgear.

Standby power is generated onsite by diesel-engine-driven generators. Four generators are provided, each with a continuous rating of at least 33% of the maximum standby load. The diesel-generator sets are in accordance with IEEE Standard 387-IEEE Standard: Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations. The voltage rating is 4,160 volts, 3 phase, 60 Hz. The generator is of the brushless, synchronous type. The diesel engine is equipped for automatic starting under conditions of total power failure. The starting system will support three consecutive attempts to start, synchronize, and accept power.

The generator is wye-connected, with neutral grounding arranged so as to avoid third harmonics. The generator breakers form a part of an assembly of 5-kV switchgear. The assembly is of the indoor, air- or vacuum-break, metal-clad type, complete with metering and synchronizing controls. Provisions are made to periodically exercise the diesel-generator under load to maintain their operational readiness.

Within each building where standby power is required, power is distributed from the 5-kV standby switchgear to standby unit substations via an underground duct bank system. The standby duct bank is segregated from the normal power duct bank(s) by 2 ft minimum. All cables are 5 kV, 3 conductor, with ground wires, ethylene propylene rubber or thermosetting insulation, 90°C, moisture and flame retardant, with overall moisture-resistant jacket.

Standby unit substations are provided within each building where standby power is required. The substation is located in a room segregated from the normal power substation room. Transformers are ventilated, dry type, 4.16 kV to 480Y/277 volts, delta-wye, with solidly grounded neutral and air-interrupter, unfused, primary-disconnect switches. Secondary switchgear is of the drawout type, air break, with solid-state, direct-acting tripping, electrically operated.

Normal operation is with both main power transformers connected to the 5-kV switchgear assemblies, but with one tie-breaker open. If one normal power source fails, the second power transformer will assume the full MRS Facility load after the isolation of the failed power source. All double-ended substation feeders could be transferred to the now-preferred normal power source. When it is determined that the failed service will not return, the tie-breaker on the dead bus opens.

Should there be a second power failure of the other normal power source, both tie-breakers and the feeder breakers will open. The concurrent startup and synchronization of all diesel-generator units is initiated and automatic transfer to the standby bus takes place. Thereby power to all standby power loads is provided.

In the above condition for starting the standby generators, the voltage at the bus of the standby unit substations will be zero. Therefore, automatic synchronizing of the standby generators is only necessary between generators. Manual synchronizing is provided to facilitate testing of the standby generators. Alarms are provided to annunciate loss of secondary voltage at all unloaded substation transformers, as well as the loaded transformers.

The standby power system includes provisions for periodic testing and exercising of its functional operability and capacity, including the full operational sequence of each system or equipment item, and for systems transfer between the normal and standby power source. The above provisions are in compliance with the applicable paragraphs of 10 CFR 72.72.

A grounding loop is provided to surround each building with multiple interconnections, both to adjacent buildings and to the main substation ground. Each unit and standby substation is connected to the ground loop. All major electrical equipment is grounded by means of ground wires contained within the power-distribution cables. The cable ground wires are connected to the respective switchgear ground bus, which in turn is connected to both the building ground loop and, via the feeder-cable ground wires, to the medium-voltage switchgear ground bus. All building steel is connected to the ground loop on the basis of a minimum of two connections at any building, with additional connections to provide one per 100 ft of building perimeter. Each ground loop contains sufficient ground rods of diameter and length to limit the ground potential to the limits acceptable to IEEE Standards for the determined soil resistivity. Lightning protection is provided for all larger buildings and structures. The lightning conductors are connected to the building ground loop.

Uninterruptible power supply (UPS) systems are provided for each building where essential services require continuous power supply. The UPS systems operate from 480-volt, 3-phase input to the battery charger and with 480Y/277-volt, 3-phase output from the inverter. The battery banks are of the lead-calcium type, 125 volts (60 cells) for units rated up to 37.5 kVA, and 250 volts (120 cells) for larger units. Each system includes a bypass and synchronizing equipment for use in case of inverter failure.

19.10.2 LIGHTING

Except as noted otherwise, all lighting operates on 277 volts with the greatest possible use of 3-phase, 4-wire distribution techniques to minimize voltage drop in the lighting circuits. At least two lighting circuits serve all major areas, as well as areas where loss of lighting could result in personnel hazards or equipment malfunction. In addition, selected lighting fixtures in an area are connected to a standby power system.

Emergency lighting is provided as necessary to permit safe egress of personnel from the buildings and to permit continued function of essential security-surveillance and safety equipment. Emergency lighting fixtures are battery-backup-type, automatic units, with a self-contained battery charger. Convenience receptacles are provided throughout the facility at 120 volts, 1 phase, 60 Hz from a 208Y/120-volt system. One or more receptacle transformers and panelboards are provided at each building. Transformers are dry type, distribution service, delta-wye, 480-208Y/120 volts, 3 phase.

Street lighting and area lighting are provided throughout the MRS Facility. Luminaires will be of the high-intensity discharge (HID) type, with photo-electric control. Average illumination level will be 0.9 ft-c for major roads and intersections, 0.6 ft-c for secondary roadways, and 1.0 ft-c for parking lot areas.

19.10.3 COMMUNICATIONS

19.10.3.A. Telephone System

An Electronic Private Automatic Branch Exchange (EPABX) is provided and located at the Site Services Building. Each building or facility is connected to the exchange by an underground cable network installed in a conduit system. The EPABX main is linked to the National Telephone Network via a private microwave system. Provisions have been made for a small number of telephone lines wired for direct ring-down (hot lines) for security and data transmissions to offsite locations.

19.10.3.B. Radio System and Radio Paging

A land-mobile UHF radio system, including handheld portable radios, is provided for intrafacility communications. Dedicated channels are provided for:

(1) Facility operation
(2) Facility security
(3) Maintenance
(4) Medical and emergency

Mobile and/or handheld radios capable of operation on one or more channels are provided, as well as a dedicated radio system (VHF-band) to permit voice communication with train engineers to control facility railroad operations.

A radio paging system (beepers) is provided, as well as pocket pagers for key personnel.

19.10.3.C. Site Warning System

In addition to the building criticality warning systems, a site warning system is provided. The system consists of sirens located at the MRS Facility and interconnected to the Security Building and R&H Building control centers.

19.10.3.D. Instrumentation

Wiring for temperature and radiation monitoring of the storage facilities is provided. Wiring is installed in a rigid, concrete-encased conduit system, complete with junction pullboxes and hand- and manholes. Electrical power is provided to field-mounted multiplexer stations, installed in NEMA 4R enclosures.

19.11 HVAC

Not applicable to this system.

19.12 FIRE PROTECTION

Not applicable to this system.

SECTION 20

WATER DISTRIBUTION SYSTEM

20.1 INTRODUCTION

The MRS Facility water distribution system provides treatment and distribution for the combined requirements of domestic, process, and fire-protection water for all facilities on the site. The basic system concept is depicted on Drawing H-3-56955; the system layout is shown on Drawing H-3-55958, Sheets 1 and 2 for the primary storage concept, and Drawing H-3-56960, Sheets 1 and 2 for the alternate storage concept.

20.2 CIVIL AND SITE DEVELOPMENT

20.2.1 WATER TREATMENT AND DISTRIBUTION

The MRS Facility primary storage concept receives potable water from the water filtration plant that serves the Oak Ridge Gaseous Diffusion Plant. The pressure on the discharge side of the filtration plant is 100 psig. The MRS Facility water system uses the existing 8-in.-dia line that originally served the Clinch River Breeder Reactor Project construction site to transmit the filtered water to the storage tank (see Appendix F).

The potable water is chlorinated by the sodium hypochlorite chlorination package. This is a batch chemical-preparation process, and will require the hypochlorite solution to be prepared approximately twice per week. The additional chlorine is required to be added because of the long detention time in the water storage tank (2.8 days). In lieu of a backup water supply, the water storage tank is sized for a minimum of 24 hr domestic and process water requirements.

The 1-million-gal water storage tank is provided for firewater requirements as well as process and potable water requirements. A total of 4 hr of fire-protection water (480,000 gal), for the highest rate of flow (R&H Building), is assured by the use of a vertical standpipe in the water storage tank. The water above the standpipe opening is provided for the following requirements:

(1) Potable usage (24 hr minimum) and peaking requirements
(2) Process water (24 hr minimum)

The 480,000 gal reserve below the standpipe is used at a rate of 2,000 gpm (fire in the R&H Building), the remaining 600 gpm is process and potable water from "above" the standpipe and also makeup water.

An electric water heater is provided in the storage tank in accordance with NFPA 22 to prevent freezing during the winter months.

During normal operations, the water distribution pumps draw from the vertical standpipe to distribute potable water to all facilities in the MRS Facility. There are three electric-motor-driven water distribution pumps (two on line; one spare), each rated for 300 gpm at 120 psi. The pumps maintain a minimum pressure of 100 psi in the mains. All three pumps are connected to standby power.

There are two fire-protection water pumps, each rated for 2,600 gpm at 130 psi. The primary pump is electric-motor-driven (with reduced voltage starter), which is also on standby power; the backup pump is diesel-motor-driven with a diesel-fuel day tank capacity for minimum 4 hr of flow. The primary fire-protection water pump starts when the two on-line water distribution pumps cannot keep mainline pressure at a minimum of 100 psi, and a fire alarm is activated. When the fire-protection water pumps are activated, the water distribution pumps will be automatically shut off to prevent reverse flow burnout. The fire-protection pumps are sized for the combined peak flows of all MRS Facility water requirements.

A localized fire (i.e., one or two sprinklers) may be handled by the water distribution pumps if the combined peak flow (domestic, process, and fire-protection water) does not exceed the combined capacity of the two on-line water distribution pumps (approximately 600 gpm).

A pressure control valve opens the recirculation line back to the water storage tank to prevent vibration damage to the fire-protection water pump if the flow rate falls well below the rated capacity of the fire-protection water pump.

After the occurrence of a major fire (requiring use of the fire-protection water pump) that draws the water below the level of the standpipe, the fire pumps are shut off manually, the water distribution pumps are returned to on-line status, and the water storage tank bypass valve is opened. This procedure allows the tank to refill while not leaving the MRS Facility totally without water. After such a fire, the facility will shut down to allow for quicker restoration of the fire-protection water reserves (approximately 24 hr).

The water distribution network is a looped system of polyvinyl chloride (PVC) pipe, supplying water to all facilities onsite. The main lines are sized to allow one main to be out of service and still provide adequate fire protection. All water distribution pipes are in separate trenches. Fire hydrants are spaced a maximum of 300 ft apart and are located around each facility. All nonfire-protection water is metered, as well as all water into the system, for conservation reasons. Potable water connections to buildings contain a pressure reducer set for 80 psi. All process lines contain a backflow preventer. Winterization of the distribution network is accomplished by burial of the pipe 1 ft below frost penetration depth, or 3 ft minimum. In the R&H Building, potable water is treated further by deionization or softening, as required (see Section 21.7). All of the equipment, the chlorination system, water storage tank, water distribution pumps, fire-protection pumps, and the pipe network are sized for a facility with 3,600-MTU throughput.

The alternate storage concept is similar to the primary concept, less the Cask Manufacturing Plant.

20.3 STRUCTURAL

Not applicable to this system.

20.4 ARCHITECTURAL

Not applicable to this system.

20.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this system.

20.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this system.

20.7 MECHANICAL PROCESS

Not applicable to this system.

20.8 INSTRUMENTATION AND CONTROL

20.8.1 UTILITY SYSTEM

The water distribution and fire-protection water pumps are controlled remotely and automatically from the DCS, as well as locally and manually. If the pressure in the main line drops below 100 psi and a fire alarm is activated, the firewater pumps are activated, and water distribution pumps are shut off from a pressure switch and a flow switch in the DCS to prevent reverse flow burnout.

The diesel-engine-driven standby firewater pump is a vendor-furnished item, with all the accessories, including a diesel oil day tank. The tank contains a level transmitter for remote monitoring and controlling of the tank level by activating the fuel oil transfer pumps from the level switch in the DCS, as shown on Drawing H-3-56970, Sheet 2.

All of the alarms, status lights, and 4- to 20-mA dc signals that are monitored remotely are transmitted to the DCS via multiplexers located centrally to serve buildings in the immediate vicinity.

20.8.2 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments of this system are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

20.9 PIPING

20.9.1 PLUMBING

The potable water supply at 100 psig from the MRS Facility water distribution system to the various buildings within the MRS Facility extends to a point 5 ft outside the buildings, where a connection is made to the buildings' interior plumbing system.

Potable water usage for each building is metered. Pressure regulators reduce the potable water pressure in the buildings to 80 psig.

Metallic underground piping is protected against corrosion by protective wrap.

The complete installation is in compliance with the AWWA Standards for water pipe and water storage tanks, Uniform Plumbing Code, and DOE Order 6430.1.

20.9.2 PIPING

The process water supply at 100 psig to the various buildings is supplied directly from the MRS Facility water distribution system or from the potable water supply to the building.

Reduced-pressure principal backflow preventers are installed to prevent any possibility of contaminating potable water.

Metallic underground piping is protected against corrosion by protective wrap.

The complete installation is in compliance with AWWA Standards for water pipe and water storage tanks and DOE Order 6430.1.

20.10 ELECTRICAL

Not applicable to this system.

20.11 HVAC

Not applicable to this system.

20.12 FIRE PROTECTION

Not applicable to this system.

SECTION 21

SANITARY SEWER SYSTEM

21.1 INTRODUCTION

The sanitary sewer system collects and treats all domestic sewage that is generated onsite. The system concept is shown on Drawing H-3-56956, Sheets 1 and 2. The primary storage concept system layout is shown on Drawing H-3-56958, Sheets 1 and 2, and the alternate storage concept system layout is shown on Drawing H-3-56960, Sheets 1 and 2.

21.2 CIVIL AND SITE DEVELOPMENT

21.2.1 COLLECTION SYSTEM

The MRS Facility primary storage concept sanitary sewer system collects domestic wastewater from toilets, showers, lavatories, drinking fountains, and floor drains in the R&H Building (Zone 4 areas only) and the support buildings. Sewer lines collect and carry the peak flow of sewage determined by the fixture unit method, as recommended in ASCE Manual 60, Gravity Sanitary Sewer Design and Construction.

Polyvinyl chloride (PVC) pipes are sized for half-full flow or less to ensure future capacity. Design velocities are 2 ft/sec, minimum flowing half full, and 10 ft/sec maximum. A minimum pipe size of 6 in. dia is used to aid cleaning. Manholes are of the flowthrough type, spaced at a maximum distance of 300 ft, center to center. All sewer lines are buried 1 ft below frost depth, or a minimum of 3 ft of cover.

The MRS Facility sanitary sewer system is divided into two parts because of the distances and elevation differences between the buildings. The Inspection Gatehouse is at a lower elevation and is isolated from the rest of the MRS buildings. It is economically unsound to drain this low flow (30-gpm peak) by gravity or to pump it to the Sewage Treatment Facility. The domestic wastewater from the Inspection Gatehouse is disposed of via a septic tank (TK-456) and drain field. Domestic wastewater generated from all other facilities drains to the lift station and is pumped to the Sewage Treatment Facility for treatment.

The alternate storage concept sanitary sewer system layout is similar to the primary concept, less the Cask Manufacturing Facility.

21.2.2 TREATMENT

The Inspection Gatehouse septic tank (TK-456) provides for sedimentation, scum accumulation, anaerobic digestion of organic matter, and storage of sludge. The septic tank effluent is disposed of in a subsurface perforated-pipe leaching field, which permits aerobic-faculative decomposition of organics and seepage of the wastewater. The sludge accumulated in the septic tank is disposed of, as required, by vacuum truck offsite.

The sewage treatment process is the same for the primary and alternate storage concepts. Sanitary sewage treatment is by an extended aeration process package treatment plant, wherein raw sewage enters the comminutor where the sewage solids are cut, sheared, and shredded until they are small enough to be carried through the slots in the rotating drum by the sewage flow. The screened and comminuted raw sewage is fed directly into an aeration tank. The raw sewage is aerated for a minimum of 24 hr. The effluent from the aeration tank enters a clarifier, which provides a minimum of 4 hr retention time.

Effluent from the clarifier overflows to the filter head tank and is further treated by the filter system. The pressure filter effluent is routed through the backwash tank to the chlorine contact tank. The pressure filter backwash cycle is initiated by a pressure differential switch as well as a timer. The backwash water flows to the aeration tank. Pressure filter effluent flows to a chlorine contact tank for disinfection before discharge into the Clinch River. This effluent meets the State of Tennessee and U.S. EPA standards for municipal and domestic wastewater disposal.

The chlorine contact tank provides for 30-min retention and assures positive mixing of the chlorine with the secondary effluent. Primary sedimentation is omitted from the process to simplify the sludge treatment and disposal.

Two air blowers provide air into the aeration chamber and for operating the airlift pumps in the clarifier. Two sludge transfer pumps are provided for transferring the sludge from the clarifier to a sludge holding tank for offsite disposal. The sludge holding tank is aerated to prevent the sludge from becoming septic.

A sodium hypochlorite chlorination system is provided for disinfecting the effluent. The hypochlorite solution is prepared manually on a batch process basis, approximately once a week in the solution tank and fed to the chlorine contact tank through the hypochlorite injection pumps.

The flocculation aid system is designed for continuous operation. Polyelectrolyte solution is prepared manually on a batch process basis in the solution tank and fed to the influent lines of the clarifier and filter to improve suspended solids removal.

21.3 STRUCTURAL

Not applicable to this system.

21.4 ARCHITECTURAL

Not applicable to this system.

21.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this system.

21.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this system.

21.7 MECHANICAL PROCESS

Not applicable to this system.

21.8 INSTRUMENTATION AND CONTROL

21.8.1 UTILITY SYSTEM

Effluent from the sanitary sewer system is monitored for radiation levels before being discharged to the environment. A high alarm is activated in the DCS and locally if an unusual level of radiation is detected, as shown on Drawing H-3-56956.

21.8.2 MAINTENANCE AND CALIBRATION

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation. All of the instruments in this system are maintained and calibrated by direct contact. Signal conditioning and transmission system maintenance are accomplished by replacement of modules or cards, as determined by self-diagnostic or manual troubleshooting methods.

21.9 PIPING

21.9.1 PLUMBING

The sanitary sewer from the various buildings within the MRS Facility extends to a point 5 ft outside the buildings, where a connection is made to the buildings' interior piping systems.

Metallic underground piping is protected against corrosion by protective wrap.

The complete installation is in compliance with the Uniform Plumbing Code and DOE Order 6430.1.

21.9.2 PIPING

Not applicable to this system.

21.10 ELECTRICAL

Not applicable to this system.

21.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

Not applicable to this system.

21.12 FIRE PROTECTION

Not applicable to this system.

SECTION 22

PROCESS SEWER SYSTEM

22.1 INTRODUCTION

Process waste generated from the MRS Facility that is not radioactively contaminated, but contains chemical constituents harmful to the function of the sanitary sewage treatment system, is collected and treated by the process sewer system. The system concept is depicted on Drawings H-3-56966 and H-3-56957. The collection system layout is shown on Drawing H-3-56958, Sheets 1 and 2 for the Primary Storage Concept, and Drawing H-3-56960, Sheets 1 and 2, for the Alternate Storage Concept.

22.2 CIVIL AND SITE DEVELOPMENT

22.2.1 COLLECTION SYSTEM

The MRS Facility Primary Storage Concept process sewer system collects nonoily process wastes, not compatible to the sanitary sewage treatment system, generated from the Receiving and Handling Building (Zone 4 only), the cooling tower, and the support buildings.

The size of process sewer lines is based on a facility with 3,600-MTU throughput peak flows. Fiberglass-reinforced epoxy (FRE) pipes are sized for half-full flow or less to ensure future capacity. Design velocities are 2 ft/sec minimum, flowing half-full, and 10 ft/sec maximum, except that in the limited access area, where flows are small, slopes and pipe sizes are adapted. A minimum pipe size of 6 in. dia is used to aid cleaning. Manholes are of the flowthrough type, spaced at a maximum distance of 300 ft, center to center. All sewer lines are buried 1 ft below frost depth or a mininum of 3 ft of cover.

22.2.2 PROCESS SEWAGE TREATMENT

The Primary Storage Concept sewer lines drain to a lift sump (SMP-490), where the process sewage is neutralized, as necessary, and pumped to the process sewage treatment plant for clarification and filtration to remove the suspended solids and undesirable chemical constituents before disposal to the Clinch River.

The neutralized process sewage is pumped to the flash mix tank for coagulation. The flash mix tank is sized for a minimum of 1-min detention time. The polymer solution (coagulant) is a batch chemical preparation process and will require the polymer solution to be prepared approximately once per week. The flash mix tank effluent overflows to the flocculation tank, wherein the quiescent mixing necessary for flocculation takes place. Flocculation tank detention time is a minimum of 5 min. The flocculation tank effluent is then routed to the inclined plate settler for clarification.

The sludge is removed from the sludge hopper/settler by the air-driven, double-diaphragm sludge withdraw/recycle pumps and pumped to the filter press for dewatering. The sludge pumps are operated by timer or manually, as required.

The dewatered sludge is disposed of at an appropriate offsite landfill, depending upon the chemical content of the sludge. The liquid effluent from the filter press is routed back to the flash mix tank.

Clarifier liquid effluent, which contains less than 20 ppm of suspended solids, overflows to the filter head tank. The pressure filter effluent is routed through the backwash tank to the Clinch River. The filter effluent contains approximately 3 ppm of suspended solids plus trace chemical constituents. The pressure filter backwash cycle is initiated by a pressure differential switch as well as a timer, and the backwash water flows to the neutralization/lift sump. Filter effluent meets the State of Tennessee and U.S. EPA Standards for industrial wastewater disposal.

Process sewage treatment equipment is sized for a facility with 3,600-MTU throughput flows.

The Alternate Storage Concept process sewage treatment is the same as the Primary Concept, less the Cask Manufacturing Facility.

22.3 STRUCTURAL

Not applicable to this system.

22.4 ARCHITECTURAL

Not applicable to this system.

22.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this system.

22.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this system.

22.7 MECHANICAL PROCESS

Drains from areas that are never radioactively contaminated, but that contain chemicals harmful to the function of the sanitary sewer system, are collected by the process sewer system (see Drawing H-3-56966). These drains consist primarily of boiler and cooling tower blowdowns and drains, together with lesser quantities of decon reagent chemical drains and condensate from compressed air systems. These drains are collected throughout the plant, and drain by gravity to a lift sump (SMP-490). The contents of the lift sump are neutralized as necessary with acid or caustic delivered automatically from the process sewer neutralization package (SME-450) located in the sewage treatment facility.

Continuous agitation is provided in the lift sump by a propeller agitator (AG-490) to ensure uniformity of pH control. The neutralized waste is pumped by the process sewer lift pumps (P-490A/B) to the sewage treatment facility for flocculation, clarification, and filtration before discharge to offsite disposal.

22.8 INSTRUMENTATION AND CONTROL

The noncontaminated (utility) drains from the supporting facilities and the R&H Building are collected by the process sewer system. A level transmitter is installed in the process sewer lift sump to monitor and control content level locally or remotely.

Process sewer lift pumps are operated by an ON/OFF remote signal from a DCS level switch. A local manual override ON/OFF switch permits local operation. The mixer is controlled by a local manual ON/OFF switch with an indication light in the DCS. A pH analyzer (probe, transmitter) is installed in the sump to detect the pH level and maintain the neutrality of the liquid by adding acid or caustic.

The neutralization package that supplies diluted acid and caustic is a vendor package consisting of mixing tanks, agitators, and metering pumps, which are operated by a signal from the pH analyzer switch in the DCS.

The 4-20 mA dc signal from the level and pH analyzer transmitters is sent to the DCS via multiplexers centrally located to serve different buildings.

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation.

22.9 PIPING

22.9.1 PLUMBING

Not applicable to this system.

22.9.2 PIPING

The process sewer system from the various buildings within the MRS Facility extends to a point 5 ft outside the buildings, where a connection is made to the buildings' interior piping system.

Reduced-pressure principal backflow preventer is installed to prevent any possibility of contaminating potable water.

Metallic underground piping is protected against corrosion by protective wrap.

The complete installation is in compliance with ANSI B31.1 and DOE Order 6430.1.

22.10 ELECTRICAL

Not applicable to this system.

22.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

Not applicable to this system.

22.12 FIRE PROTECTION

Not applicable to this system.

SECTION 23

FUEL DISTRIBUTION SYSTEMS

23.1 INTRODUCTION

The fuel systems described below are included.

23.1.1 NATURAL GAS

Natural gas is provided in the plant, if available. The gas distribution system is installed in accordance with applicable requirements of NFPA and is used as follows:

(1) Hot water boilers
(2) Steam boilers
(3) Other support functions determined during design

23.1.2 FUEL OIL

Fuel oil is provided in the plant. The fuel oil distribution system is installed in accordance with applicable requirements of NFPA and is used as follows:

- Hot water and steam boilers
- Emergency generation
- Other support functions determined during design

Fuel oil storage is above ground and the storage capacity is equivalent to the supply needed for 45 calendar days of operation.

23.2 CIVIL AND SITE DEVELOPMENT

Not applicable for these systems.

23.3 STRUCTURAL

Not applicable for these systems.

23.4 ARCHITECTURAL

Not applicable for these systems.

23.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to these systems.

23.6 PROCESS (RADWASTE TREATMENT)

Not applicable to these systems.

23.7 MECHANICAL PROCESS

23.7.1 FUEL OIL SYSTEM

A diesel fuel distribution system supplies fuel oil (see Drawing H-3-56963) to the emergency generators, the R&H Building steam boilers, the hot water boilers in the support buildings, the R&H Building diesel-fired door heaters, and the standby engine-driven firewater pump.

Fuel oil is unloaded from the delivery trucks or railcars and pumped at 167 gpm by fuel oil unloading pumps (P-500A or B), through the fuel oil filter (F-500), and into fuel oil storage tanks (TK-501A and B). The fuel oil storage tanks are surrounded by a compacted earth dike, which includes an impervious liner, to contain any leaking fuel. The fuel oil is pumped from the storage tanks, at a rate up to 100 gpm, to the generator fuel oil storage tank (TK-510), the steam boiler day tanks, the hot water boiler day tanks, the firewater pump fuel tank, the door heater day tanks, or any combination of the above.

23.7.2 NATURAL GAS SYSTEM (ALTERNATE FUEL)

Natural gas will be used as an alternate fuel if it is available at the project site. The natural gas system provides fuel for the steam boilers and for the hot water boilers. No equipment is required for the natural gas system - only piping and valves.

23.8 INSTRUMENTATION AND CONTROL

Level transmitters are installed on two fuel oil storage tanks (TK-500A/B) for local/remote indication, alarming, and control. The remote indication and alarming are accomplished by transmitting a 4-20 mA dc signal via multiplexers centrally located to serve several buildings. The unloading pumps are started locally and stopped automatically by a remote signal from the DCS high-level switch. The local manual switch can override the level switch signal.

Local level indicators are provided for each overflow/water drawoff sump to periodically check its content level. From these storage tanks, fuel is pumped to fuel day tanks and a standby generator fuel oil tank by transfer pumps. The pumps are operated automatically from the day tank level switches in the DCS. The pumps can be operated from local START/STOP switches, which override the level switch signal in case of emergency.

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation.

23.9 PIPING

23.9.1 PLUMBING

Not applicable to these systems.

23.9.2 PIPING

The fuel distribution systems to the various buildings within the MRS Facility extend to a point 5 ft outside the buildings, where a connection is made to the buildings' interior piping system. Fuel usage for each building is metered.

Underground piping is protected against corrosion by protective wrap. (For cathodic protection, see Appendix G.)

The complete installation is in compliance with ANSI B31.1.

The fuel gas installation up to the outlet of the MRS Facility main meter outlet is in compliance with ANSI B31.8.

23.10 ELECTRICAL

Not applicable to these systems.

23.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

Not applicable to these systems.

23.12 FIRE PROTECTION

The fuel oil storage tanks are designed in accordance with API 650 and UL142-1981, and are located in accordance with NFPA 30 requirements. The tanks are spaced properly from buildings and each other to preclude the use of automatic fire-suppression systems. All piping, valve, and fitting material is in accordance with NFPA 30 requirements.

SECTION 24

OILY SEWER SYSTEM

24.1 INTRODUCTION

The oily sewer system collects oil from the oil drains onsite for eventual removal and subsequent disposal or recycle.

24.2 CIVIL AND SITE DEVELOPMENT

Not applicable to this system.

24.3 STRUCTURAL

Not applicable to this system.

24.4 ARCHITECTURAL

Not applicable to this system.

24.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

Not applicable to this system.

24.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this system.

24.7 MECHANICAL PROCESS

The function of the oily sewer system (see Drawing H-3-56967) is to collect oil from the oil drains onsite for eventual disposal offsite.

The feed to the oily sewer system consists of off-specification No. 2 fuel oil from the various hot water boiler day tanks and other miscellaneous oil drips. In the Vehicle Maintenance Building, lube and crankcase oil are collected in a portable collection container, and then drained to the collection drum.

Oil is collected from floor drains in collection headers, and flows by gravity to a drum. Three drums collect oil from more than one building. Each drum is periodically checked for level of contents, and is provided with a hose connection for removal of liquid to a vacuum truck for disposal offsite.

24.8 INSTRUMENTATION AND CONTROL

The oil is collected from the floor drains in different buildings, and flows by gravity to collection drums. The liquid is considered free of radioactivity and safe for offsite disposal.

Level transmitters are installed on collection drums for local and remote indication and remote alarming when the drums are full. The remote indication and alarming are accomplished by sending a 4-20 mA dc transmitter signal to the DCS via multiplexers centrally located to serve a number of buildings. The drums are periodically checked for level, and pumped out before they are full. To prevent overflow, the level alarms are to be set to allow enough time to pump out the liquid before the tank is completely full.

Routine maintenance and periodic calibration of instruments are performed to ensure smooth and accurate operation.

24.9 PIPING

24.9.1 PLUMBING

Not applicable to this system.

24.9.2 PIPING

The oily sewer from the various buildings within the MRS Facility extends to a point 5 ft outside the buildings, where a connection is made to the buildings' interior piping systems.

Metallic underground piping is protected against corrosion by protective wrap.

The complete installation is in compliance with ANSI B31.1 and DOE Order 6430.1.

24.10 ELECTRICAL

Not applicable to this system.

24.11 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

Not applicable to this system.

24.12 FIRE PROTECTION

Not applicable to this system.

SECTION 25

SECURITY AND SAFEGUARDS

25.1 INTRODUCTION

The MRS Facility has the capability to receive, inspect, repair, repackage, consolidate (spent fuel only), store and retrieve for subsequent shipment, spent fuel, solidified HLW, and future RHTRU that has been out of the reactor for 10 years. Facilities and equipment are provided to unload, inspect and identify, disassemble, consolidate, package, seal, label, monitor, and store spent fuel assemblies. Fuel rods are consolidated in canisters capable of containing all the fuel rods from either PWR or BWR assemblies.

25.2 PHYSICAL PROTECTION

Physical security is established to provide protection and access controls to deter and assess unauthorized access to or removal of items of security interest and to respond to the following design basis threats:

(1) Sabotage of the facility or nuclear material, resulting in dispersion of radioactivity into the local environment.

(2) Theft of material for release, or threat to release, into the environment elsewhere.

(3) Theft of material for the purpose of retrieving special nuclear materials.

25.2.1 SITE SECURITY

A security fence is provided around the entire developed area of the MRS Facility. The fence provides the boundary to the Limited Area as described in DOE Order 5632, Chapter III (draft) for DOE facilities and the boundary to the Protected Area in accordance with DOE Order 5632.2 and 10 CFR 73.2.g. The Limited Area contains nonprocess structures, such as the Administration Building, Site Services Building, Warehouse, Vehicle Maintenance Building, Fire Station, and utility-related buildings. The Protected Area contains the Receiving and Handling (R&H) Building; the SF, HLW, and RHTRU Storage Facility; the CHTRU Facility; the radioactive shipment lag storage; the off-normal vehicle storage areas; and the Standby Generator Building, which is required to maintain operation of these facilities. All Vital Areas (10 CFR 73.2.h) and Material Access Areas (10 CFR 73.2.j) for the MRS Facility are located within the Protected Area. Security-related facilities are located adjacent to the Limited Area and Protected Area access points, except for the main Security Building, which is in the Limited Area. For the Primary Storage Concept, a Cask Manufacturing Facility is positioned adjacent to the MRS Facility security fence with access to the Protected Area for delivery of sealed storage casks to the R&H Building. The site arrangement for the MRS Facility Conceptual Design is shown on Drawing H-3-56726. A controlled area fence is also provided for the Primary Storage Concept, and is located beyond the Protected Area of the Storage Facility. This 3-strand, barbed-wire fence deters access by the general public to a zone in which the annual permissible direct radiation dose rate is calculated to exceed the permissible limits of 10 CFR 72.67 for continuous occupancy. (See Drawing H-3-56725 for the controlled area boundary.)

The Limited Area is enclosed within a single physical barrier (steel wire-fabric fence), 8 ft in height, topped with brackets for multistrand barbed wire. Except for security-related facilities, buildings are located a minimum of 30 ft from the fence. Protective lighting is provided to permit 24-hr surveillance of the barrier.

The Protected Area is enclosed within two fences (10 CFR 73.2.f) separated by an alarm zone 100 ft in width. Two independent intrusion alarm sensor systems are provided within the alarm zone: a taut wire fence detection system and a buried electromagnetic field sensor system. These systems are backed up by a motion detection system operating through the alarm zone CCTV cameras and the CCTV monitors located in the AMS. An Isolation Zone (10 CFR 73.2.k) is established around the buildings or facilities within the Protected Area and adjacent to the Protected Area fences. Protective lighting is provided to permit 24-hr surveillance of the barriers. A patrol road within the perimeter of the Protected Area facilitates routine surveillance and alarm response. Other roads are provided for transport vehicles, delivery vehicles, and other authorized vehicles. All private vehicles are parked offsite. A single fence separates the Protected Area from the SF, HLW, and RHTRU Storage Facility to limit access to personnel and vehicles authorized to enter the SF, HLW, and RHTRU Storage Facility.

Access to the Protected Area, the R&H Building, and the SF, HLW, and RHTRU Storage Facility is by controlled, manned security points or by an access control system. At the R&H Building, all exterior doors and interior doors into Vital Areas or Material Access Areas are locked and monitored by an alarm system during unoccupied periods.

Security functions are performed by trained personnel operating from five support facilities in the MRS Facility: the Security Building, the Main Gate/Badgehouse, the Inspection Gatehouse, the Protected Area Gatehouse, and the Storage Area Gate Station. These security-related buildings are described in subsequent paragraphs in this section.

Uninterruptible power supply (UPS) system(s) furnish power supply to alarms, essential surveillance and access-control instrumentation and equipment, and emergency lighting systems in case of power loss (commercial and standby). All security alarms, fire alarms, evacuation alarms, or any other alarm requiring a security force response are annunciated at the Protected Area

Gatehouse and at the Security Building. These stations are hardened, controlled access buildings with capabilities to communicate to all security personnel and offsite law enforcement agencies. The design of all security areas and devices complies with NFPA 101 Life Safety Code, Section 5, "Means of Egress."

A closed-circuit television (CCTV) system is provided to assist in security surveillance, personnel safety, and fire protection. Television cameras are installed at the MRS Facility Protected Area perimeter, security-related buildings, gatehouses, gates, Standby Generator Building, and electric substation. Except for cameras, all CCTV equipment used for surveillance is redundant. All cameras used for surveillance are designed for remote operation and control from at least two separate monitoring stations. Functionally identical TV viewing monitors are located in the primary alarm monitoring station (AMS) and in the backup AMS to provide redundancy of security operations. All TV viewing monitors are provided with selective switching capabilities to enable monitoring of the area surveyed by any TV camera in the MRS Facility. All TV cameras are designed to permit removal for maintenance.

25.2.2 SECURITY-RELATED BUILDINGS

25.2.2.A. Security Building

The Security Building is located near the Administration Building and serves as the security headquarters for the MRS Facility. Security surveillance throughout the site is provided from this building, using control alarm and remote surveillance systems. The building is a two-level, reinforced masonry and reinforced concrete structure, with structural steel roof framing. It includes a hardened area in the basement to house the redundant AMS. A hardened weapons storage vault is also provided. In the hardened areas, the walls [including windows, ceiling (roof), and floor] are constructed of bullet-resistant materials meeting the ratings defined in Standard for Safety Standard UL 752 by Underwriters' Laboratories. The power rating for the projectile is the High-Rifle (Table 3-1 of UL 752). This building also contains offices, a conference room, an exercise/training room, a multi-purpose room, toilets and lockers, and enclosed security vehicle parking.

25.2.2.B. Main Gate/Badgehouse

The Main Gate/Badgehouse is located at the primary site entrance point and provides the initial observation and inspection functions for all non-transport vehicles, as well as badge control for all visitors and personnel entering and leaving the site. It is constructed of reinforced masonry walls, slab-on-grade floor, and metal deck roof. The guard booth is constructed of bullet-resistant glass, reinforced concrete walls, and reinforced concrete roof capable of meeting the requirements for the power rating of the High-Rifle projectile in Table 3-1 of UL 752.

Unescorted visitors and employees passing through the Main Gate/Badgehouse, whose destination is the Administration Building, are directed to an exit leading to an exterior fenced area that connects to the entrance to the Administration Building lobby. Employees, escorted visitors, and unescorted visitors, whose destination is one of the other areas of the site, pass through a vestibule and exit doors to the exterior. Most of the remaining site facilities are easily reached on foot, and, in some instances, onsite vehicles may be used.

Private vehicles are parked outside the security area. Only transport vehicles, delivery vehicles, and other authorized vehicles are permitted within the security area after being checked in the vehicle inspection area. Ingress and egress from the inspection area are controlled by lift gates.

25.2.2.C. Inspection Gatehouse

The Inspection Gatehouse provides for the initial observation and inspection functions for all rail and transport vehicles entering the site. The gatehouse and adjacent inspection area are located independent of the Main Gate/Badgehouse and are manned on an as-needed basis by guard and inspection personnel. Incoming transport vehicles and railcars are checked for sabotage, radiation, and shipment documentation. In the inspection area, offsite vehicle tractors and railroad engines are exchanged for onsite units for transfer of the payloads to the Protected Area. Guards will accompany the payload transfer into the Protected Area. The Inspection Gatehouse is constructed of reinforced masonry walls, slab-on-grade floor, and metal deck roof. The hardened guardroom is constructed of materials capable of a bullet-resistant rating for the High-Rifle projectile as shown in Table 3-1 of UL 752.

The Inspection Area is a covered, fenced compound with sliding gates controlling entrance to, and exit from, the Protected Area of the MRS Facility. The roadways in the Inspection Area are split into two distinct areas: one for transport vehicle inspection and the other for railcar inspection. Each area includes a pit for undercarriage inspection.

25.2.2.D. Protected Area Gatehouse

The Protected Area Gatehouse provides for personnel monitoring and inspection of all employees entering and leaving the Protected Area, as well as the control alarm and remote surveillance functions. Only onsite vehicles and other authorized vehicles are permitted in the Protected Area. Vehicles approaching the double-fenced alarm zone come under the surveillance of the Protected Area Gatehouse, and are checked for authority to enter the Protected Area after passing through the alarm zone.

The Protected Area Gatehouse contains two floors: a ground floor and a basement. The hardened guardroom and AMS with its support systems are constructed of materials capable of a bullet-resistant rating for the High-Rifle projectile as shown in Table 3-1 of UL 752. Note that this is the primary AMS system. A redundant AMS system is located in the Security

Building. The ground floor contains a personnel monitoring room, where metal and explosive detectors are used along with X-ray inspection. A hardened access control room is used to supervise passage to and from the Protected Area through electronically controlled turnstiles. The entire basement is hardened because it contains alarm and remote surveillance equipment.

For the Primary Storage concept, an access route is provided for direct access by the sealed storage cask transporter between the Protected Area and the Cask Manufacturing Facility without passing through the Protected Area Gatehouse. Because of the size and function of the transporter, a separate access point through the Protected Area fences is required. A guard will accompany the transporter from the Protected Area, providing the necessary access control card key at the gates, to the Cask Manufacturing Facility. Since materials and personnel at the Cask Manufacturing Facility have direct access to that industrial site, the guard will inspect the waiting cask before it is loaded onto the transporter, and accompany the transporter on its return route into the Protected Area to ensure that physical protection of the Protected Area is maintained.

25.2.2.E. Storage Area Gate Station

The Storage Area Gate Station is one room equipped with radiation detection equipment and a telephone. It is used only by authorized personnel entering or exiting the SF, HLW, and RHTRU Storage Facility, and contains provisions for radiation contamination monitoring and communication with other facilities. It is a single-story, reinforced masonry walled structure with structural steel roof framing.

25.3 SPECIAL NUCLEAR MATERIAL CONTROL AND ACCOUNTABILITY

25.3.1 SPENT FUEL, HLW, AND RHTRU RECEIVING AND PROCESSING

All shipping casks containing spent fuel, HLW, and RHTRU are received by rail or truck at the R&H Building, where the cask is removed from the vehicle and sealed to a shielded process cell entry port for unloading.

Each intact spent-fuel assembly is removed from the cask, identified for inventory, verified against the shipping bill (reactor records), and placed in lag storage, canistered, or moved to the disassembly area. The fuel canisters bear preassigned, unique identification numbers. All consolidated fuel rods from a fuel assembly are placed into the same canister. (Nonfuel-bearing components of the assemblies resulting from consolidation are shredded and placed in numbered drums.) The canister is then placed in a welding chamber, where the air is replaced with an inert atmosphere and the cover is welded onto the canister. The welded canister is leak-tested, decontaminated, removed from the chamber, and checked for contamination.

The canister weld is inspected and the surface temperatures and radiation levels are recorded. The canister is then moved to lag storage; to the loadout port, where it is loaded into an identified sealed storage cask or into a shielded transporter for transfer to a preassigned storage facility location; or to the shipping port area, where it is placed in an identified repository package (if required) and prepared for release from the facility in a preestablished and identifiable shipping cask.

After removal from the shipping cask, containers of consolidated fuel rods, HLW, and RHTRU are identified; verified against the shipping bill (waste generator records); checked for contamination; cleaned and/or overpacked, and relabeled, if necessary; temperature and radiation levels monitored and recorded; and moved to an identified shielded storage cask or into a shielded transporter for transfer to a preassigned storage facility location. If the containers of waste are not to be temporarily stored at the MRS Facility, they are transferred to the shipping port area and prepared for shipping cask loading, including repository packaging, if required.

When offsite shipment of stored spent fuels or radioactive waste is authorized, the procedure is reversed. The identification number of the unloaded waste package is verified at the shielded canyon cell with existing inventory records, surface temperature and radiation levels are monitored and recorded, and the waste canisters are loaded into a repository package (if required) and placed in a shipping cask. Records of the waste packages are duplicated and included with the shipment of the cask offsite.

25.3.2 MATERIAL CONTROL AND INVENTORY

The MRS Facility is designed to accommodate physical inventory procedures required for special nuclear material (SNM) in accordance with 10 CFR 70, Domestic Licensing of Special Nuclear Material, and 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI). A materials control system for SNM inventory provisions is provided, based on state-of-the-art techniques and current regulations.

The capability has been provided for the recording of data; for record retention for all spent fuel, HLW, and TRU wastes; and for periodically performing physical inventories to confirm the presence of accountable material containers. Record retention is provided in the Administration Building and the R&H Building. Initially, inventory records are entered into the administration computer, which provides a daily printout to be stored in the Administration Building. A duplicate copy of this printout is obtained and stored in the R&H Building. Physical inventory can be achieved by returning the cask to the R&H Building or by removing the canister from the drywell, and by transferring the canister(s) to a shielded canyon cell for physical inspection and verification.

The requirement for the capability to control and inventory SNM is an integral feature of the MRS Facility design. To incorporate proper SNM inventory systems in the MRS Facility, Item Control Areas (ICAs) and Unit Process Areas (UPAs) for control and inventory of SNM are established. An ICA is defined by 10 CFR 70.58(a) as a physical area where the quantity of nuclear materials moved in or out can be verified. At the MRS Facility, ICAs are used to define an area for inventory purposes around a facility unit operation or series of unit operations. The UPAs are related to process steps and allow for the traceability of specific materials within an ICA.

Ten ICAs have been designated for the MRS Facility, of which nine are directly related to the handling of the received spent fuel or other remotely handled waste forms. Figure 25-1 shows the nine ICAs and their interrelationship. The definitions of these ICAs are as follows: rail and truck lag storage (ICA-1), for the temporary storage of shipping casks and their transport vehicles until unloading can be scheduled at the R&H Building; off-normal shipment storage (ICA-2), for shipments whose paperwork has been questioned by the personnel at the Inspection Gatehouse or for shipments that will require special handling because of cask size, configuration, or contents; shielded process cell (ICA-3, ICA-4, ICA-5, or ICA-6), for the handling, storage, and preparation of spent fuel for storage or shipment to the repository; shielded canyon cell (ICA-7 or ICA-8), for the canistering and temporary storage of canistered fuel and for the preparation of waste packages (received or MRS-generated, high-activity waste) for onsite storage or shipment offsite; and spent fuel, HLW, and RHTRU storage (ICA-9), for the temporary storage of packaged waste until the repository can schedule receipt. The tenth ICA provides inventory capability of MRS-generated, low-activity waste and has, therefore, been assigned to the CHTRU Facility, where the containers are stored before they are shipped offsite for disposal.

Within the R&H Building, a total of 22 UPAs have been designated relating to six of the ICAs. Table 25-1 lists all ICAs and defines the UPA functions. For each shielded process cell, inventory control is performed at three main hold or process points. Although the size reduction (shredding) function does not handle fission products, it provides the capability of tracing the components of the fuel assembly to complete the inventory process. As fuel rods pass from the shielded process cell into a waiting canister in the shielded canyon cell, inventory control is transferred to the new ICA. Because spent-fuel consolidation is a primary function of the MRS Facility, the number of inventory elements in the process cells is greater than those present in the canyon cells. Likewise, because of the volume reduction achieved by shredding, the quantity of containers (drums) of shredded hardware is less than the number of fuel canisters handled in the canyon cell. The consolidation canisterization process is visually monitored by an operator at the operating console adjacent to the process cell and by a supervisor by means of a CCTV monitor. This visual capability permits the fulfillment of two independent verification signatures, acknowledging the change of inventory records from fuel assembly identification to canister identification. This procedure will also be observed by onsite quality control staff.

The inventory control system for incoming fuel is described in the following example, assuming PWR processed in Shielded Process Cell 1 and transferred by way of Shielded Canyon Cell 5. An incoming spent-fuel rail cask is mated to the process cell (ICA-3) and unloaded remotely. If the disassembly/consolidation equipment is available, three assemblies are verified against

Table 25-1 - R&H Building Unit Process Areas

Item Control Area	Related Unit Process Area(s)
ICA-1, Rail/Truck Lag Storage	None
ICA-2, Off-Normal Shipment Storage	None
ICA-3, Shielded Process Cell 1	UPA-1, In-Process Lag Storage UPA-2, Disassembly/Consolidation of Spent Fuel UPA-3, Nonfuel-bearing component size reduction
ICA-4, Shielded Process Cell 2	UPA-4, In-Process Lag Storage UPA-5, Disassembly/Consolidation of Spent Fuel UPA-6, Nonfuel-bearing component size reduction
ICA-5, Shielded Process Cell 3	UPA-7, In-Process Lag Storage UPA-8, Disassembly/Consolidation of Spent Fuel UPA-9, Nonfuel-bearing component size reduction
ICA-6, Shielded Process Cell 4	UPA-10, In-Process Lag Storage UPA-11, Disassembly/Consolidation of Spent Fuel UPA-12, Nonfuel-bearing component size reduction
ICA-7, Shielded Process Cell 5	UPA-13, Canister loading UPA-14, Lag storage UPA-15, Preparation for shipping UPA-16, Overpack canister loading UPA-17, Outload to storage
ICA-8, Shielded Process Cell 6	UPA-18, Canister loading UPA-19, Lag storage UPA-20, Preparation for shipping UPA-21, Overpack canister loading UPA-22, Outload to storage
ICA-9, Spent Fuel, HLW, and RHTRU Storage	None

the shipping records (previously input into the computer system), the assemblies visually inspected for obvious defects or damage, and placed in the disassembly station (UPA-2) if it was determined that they could be consolidated. The remaining assemblies from the cask are verified and placed in designated locations of in-cell lag storage (UPA-1) to await processing. After disassembly, the related hardware is transferred to UPA-3 for drumming of nozzles and end boxes, and for shredding of the skeleton and grids. The shredded and intact hardware is placed in a drum bearing a discrete number. The fuel rods ar consolidated and pushed into a waiting, numbered canister in the canyon cell (ICA-7, UPA-13). Upon completion of the welding and weld test processes, the clean canister is transferred to a predetermined lag storage location in UPA-14. If the canister is to be temporarily stored at the MRS Facility, the unit moves from UPA-13 to UPA-17 for placement in a waiting, prenumbered sealed storage cask (primary concept) or in the shielded transporter (alternate concept) for delivery to a predetermined storage location onsite. A third option is direct shipment to the repository. In this scenario, the canister is transferred from UPA-13 to UPA-15 for shipping preparation. This preparation may include the loading of the repository package or overpack, again having a preassigned designation, before loading into a waiting, identifiable shipping cask. The remaining UPA-16 in the canyon cell (ICA-7) is provided to allow for overpacking of damaged incoming HLW canisters, which are received directly into ICA-7, or of damaged canisters (off-normal operation) from onsite storage. The overpack process would place a preidentified canister or container into another canister with a discrete identification, thereby retaining traceability of the inventoried package. The drum containing the assembly hardware would be filled in UPA-3 with components from approximately six assemblies before being sealed, decontaminated, and transferred to ICA-7 for further processing. The subsequent processing would include the placing of the numbered drum in a "cage" with four other inventoried drums for transfer to ICA-9 via UPA-17 or to a shipping cask via UPA-15. A retrieved sealed storage cask (from ICA-9) would return to ICA-5 for unloading at UPA-17 and the contents would be transferred to UPA-16, if required, or to UPA-15 for shipment preparation and transportation cask loading.

At each UPA in the above example, the capability is thus provided to trace the movement of the waste forms through the various areas and processes at the MRS Facility. For spent-fuel assemblies that are not to be consolidated, based on shipping records or visual inspection, the UPAs relating to disassembly/consolidation and volume reduction are not used, and the fuel is canistered intact. The procedures relating to the canyon cell remain unchanged. As stated in the example, HLW and RHTRU received from offsite are unloaded directly into a canyon cell for processing.

If during the consolidation process all fuel rods are not extracted from an assembly, a second attempt will be made to pull the remaining rod(s) from the grids. A pull force interlock has been provided that will release the gripper head(s) if the predetermined limit is exceeded. A rod could still remain even after a second attempt. In this instance, an attempt will be made to cut away the grid if the rod is partially extracted. The second option is to place the remaining rod and grid in a second canister with no further attempts to consolidate. If the second operation is selected, the inventory records would reflect the quantity of rods and the associated hardware that have been placed in the auxiliary canister. The records would also indicate that the canister of consolidated fuel was missing the rods from that particular assembly. In the case of BWR, the canister containing the grids and unconsolidated rods may remain unsealed until a second BWR assembly can be added.

Because the condition of the fuel and the determination of consolidation are based on reactor records and visual inspection, a potential exists for breaching fuel rods during consolidation. If an assembly is damaged during the operation, consolidation will be stopped and the assembly canistered intact. An assembly could also be breached to the extent of releasing fuel pellets. The damaged assembly plus the recovered pellets would be canistered separately from the remaining consolidated rods. In either case, the inventory records would reflect the known condition of the fuel at the time of canisterization. If a trend is detected in which the fuel received from a given reactor refuelling operation is being damaged during consolidation, the remaining assemblies from that operation would be canistered intact.

As a result of the various operations in the R&H Building, both high-activity and low-activity radwaste is generated. These wastes include decontamination liquids, spent resins from liquid radwaste treatment, HEPA filters, tools, and other contaminated or potentially contaminated materials. High-activity wastes are handled and packaged in remotely operated areas of the R&H Building. The packages are drums with discrete identifiers; they are transferred to Shielded Canyon Cell 5 (ICA-7), and are handled similarly to the incoming RHTRU or the drums of shredded assembly hardware. Low-activity wastes are packaged in a semiremote (controlled environment enclosures or glove boxes) area into drums bearing individual identifiers. These drums are decontaminated, as required, and transferred to the CHTRU Facility for temporary storage before shipment offsite. New inventory records are established for MRS-generated waste before discharge from their packaging locations. These records will include the identification of the waste form, the package identification, and the surface radiation level of the container.

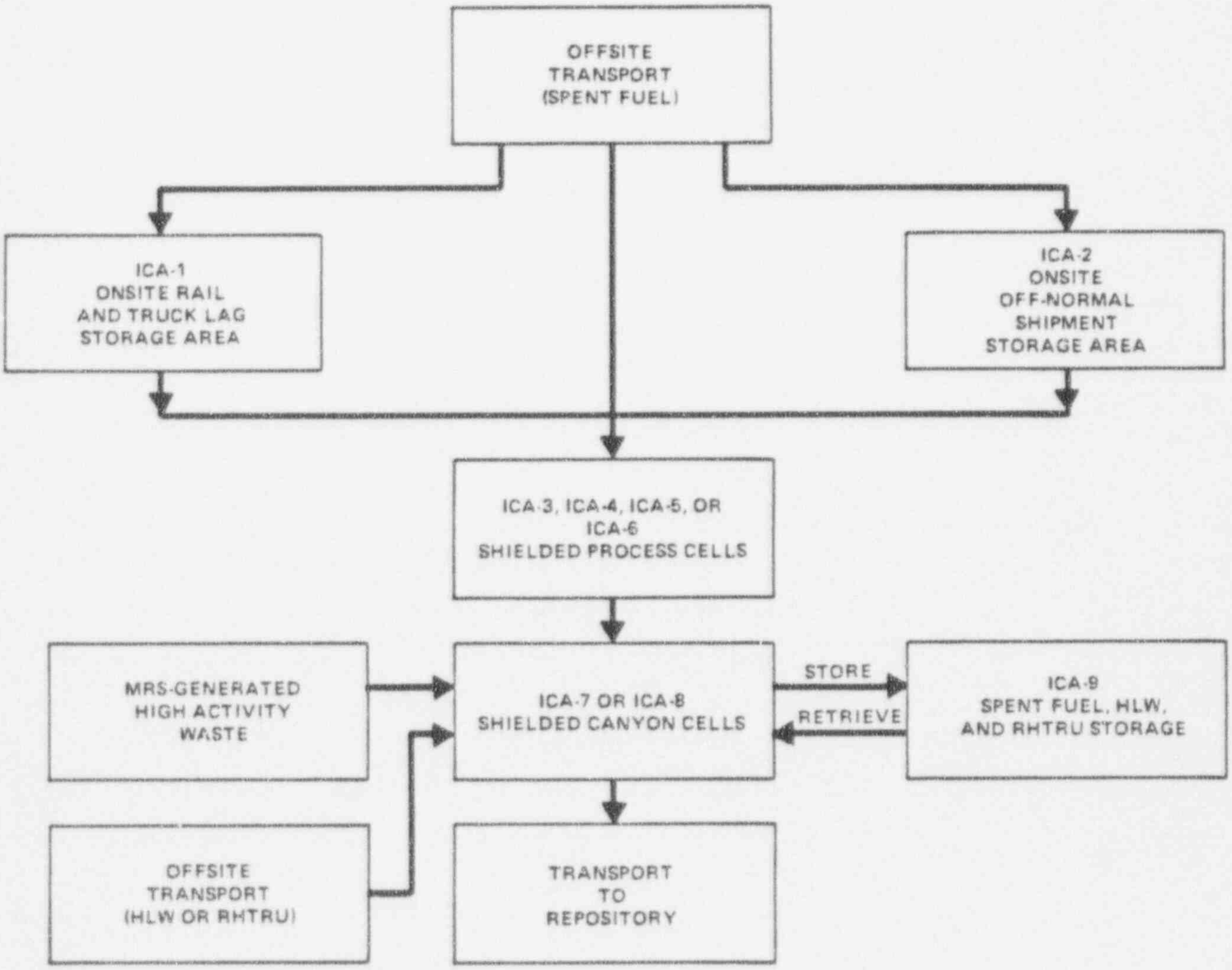


Figure 25-1 - MRS Facility Item Control Areas

SECTION 26

SEISMIC CATEGORY DESIGNATION AND VENTILATION CONFINEMENT ZONES

26.1 DEFINITIONS OF SEISMIC CATEGORY DESIGNATION

The MRS Facility is designed to receive and process spent fuel (SF), high-level waste (HLW), and transuranic (TRU) waste, which contains long half-life toxic radioactive isotopes. Accidental release of radioactivity from the fuel or waste to the environment or direct exposure of operating personnel must be controlled and prevented by building (structural) and equipment design.

Because the SF, HLW, or TRU waste is received and processed in the Receiving and Handling (R&H) Building, major portions of this building are required to be of Category I construction. The Standby Generator Building is also of Category I construction to ensure provision of electrical power for essential and safety-related systems. All other buildings are of Non-Category I construction. Functional areas of the R&H Building and their designated seismic categories are listed in Table 26-1 at the end of this section.

Seismic categories are defined below. (For plans and sections depicting seismic category designations, see Figures 26-1 through 26-6.)

26.1.1 CATEGORY I COMPONENTS, SYSTEMS, AND STRUCTURES

Components, systems, and structures are designated Category I if, during or following an extreme environmental load, including Design Basis Earthquake (DBE), Operating Basis Earthquake (OBE), Design Basis Tornado (DBT), and Design Basis Ashfall, they would be required to perform either of the following safety functions:

(1) Prevent or mitigate the consequences of an uncontrolled release of radioactivity with potential radiological consequences greater than the limits in 10 CFR 20 or DOE Order 5480.1A.

(2) Maintain nuclear criticality safety.

26.1.1.A. Seismic Design

Seismic Category I components, systems, and structures are designed to withstand loadings resulting from either of the following earthquakes:

(1) Design Basis Earthquake: All Category I components, systems, and structures must not suffer a loss of safety functions, as described above, following a DBE. The DBE is identified in DOE Order 6430.1 as the Safe Shutdown Earthquake (SSE).

(2) Operating Basis Earthquake: All Category I components, systems, and structures have the capability for continued operation without undue risk to health and safety following the occurrence of an OBE. The OBE is a higher-probability earthquake than a DBE, and can reasonably be expected to affect the MRS Facility during the operating life of the facility. The maximum ground acceleration of the OBE is generally considered to be one-half of that of the DBE.

The loading combinations and stress limits are as outlined in DOE Order 6430.1, Chapter XXI, Section 7.a.3.d. The maximum ground acceleration is determined from reference site evaluations that consider the regional and local geology and seismology and the characteristics of reference subsurface material. Design response spectra are developed from the evaluation or from NRC Regulatory Guide 1.60. The percentages of damping used in the seismic analysis conform with those in NRC Regulatory Guide 1.61.

26.1.1.B. Design Basis Tornado

Category I components, systems, and structures are designed to withstand a DBT having a tangential speed of 300 mph, a translational speed ranging from 5 to 70 mph, a maximum pressure drop of 3.0 psi, and a rate of pressure change of 2.2 psi/sec. This also takes into account tornado-generated missiles as described in DOE 6430.1, Chapter XXI.

26.1.1.C. Roof Loads

(1) Roof live loads are in accordance with ANSI A58.1, Section 4.

(2) Snow loads are in accordance with ANSI A58.1, Section 7.

(3) Design Basis Ashfall: A volcanic ashfall is considered a potential natural phenomenon. All Category I components, systems, and structures of the MRS Facility are required to meet a design basis ashfall criterion that is site-specific.

26.1.2 NON-CATEGORY I COMPONENTS, SYSTEMS, AND STRUCTURES

Non-Category I components, systems, and structures include those necessary for the normal operation of nuclear waste processing and handling facilities that are not designated as Category I.

26.1.2.A. Wind Loads

These facilities are designed in accordance with ANSI A58.1, Section 6, using the following criteria:

(1) Basic wind speed determined from site history.
(2) Importance Factor III.
(3) Exposure Category C.

26.1.2.B. Earthquake Loads

Earthquake loads are calculated and design is in accordance with the Uniform Building Code (UBC), Chapter 23.

26.1.2.C. Roof Loads

(1) Roof live loads are in accordance with ANSI A58.1, Section 4.

(2) Snow loads are in accordance with ANSI A58.1, Section 7.

26.2 DEFINITION OF VENTILATION CONFINEMENT ZONES

Containment of radioactivity and radiological particulates within the shielded process (hot) cells and shielded canyon cells of the R&H Building is accomplished by structural configuration and by ventilation confinement zones as defined below. The ventilation system is designed to maintain air flows within the building from less to more hazardous areas and to preclude dead air spaces within the building. For plans and sections depicting confinement zoning designations, see Figures 26-1 through 26-6. For a complete listing of areas in each zone, see Section 2.11.1.

26.2.1 ZONE 1 - PROCESS ZONE

Restricted access areas (including the interior of process cells, canyon cells, glove boxes, or process vessels with the highest potential for contamination and radiation) are maintained at a negative pressure relative to Zone 2 areas.

26.2.2 ZONE 2 - RESTRICTED ACCESS ZONE

Service galleries around shielded process and canyon cells; radwaste treatment facilities; cask preparation, decontamination, and unloading areas; decon rooms; and other areas with a potential for contamination are maintained at a negative pressure relative to Zone 3.

26.2.3 ZONE 3 - OPERATING ZONES

Operating galleries, canistered lag storage vaults, process area corridors, and other areas not normally contaminated are maintained at a negative pressure relative to atmosphere.

26.2.4 ZONE 4

Administration areas, receiving, inspection, and shipping areas; incoming and outgoing air control vestibules (ACVs); electrical equipment rooms; supply air fan rooms; chiller rooms; and all other unrestricted access zones are maintained at a slightly positive pressure with respect to atmosphere.

26.2.5 DIFFERENTIAL PRESSURE

Zone differential pressures relative to atmospheric pressure are as follows:

Zone 4: +0.05 to +0.1 in. H_2O
Zone 3: -0.5 to -0.7 in. H_2O
Zone 2: -0.75 to -1.5 in. H_2O
Zone 1: -2.0 to -4.0 in. H_2O

Functional areas of the R&H Building and their designated ventilation confinement zones are listed in Table 26-1.

26.3 BUILDING SUMMARIES

The R&H Building is arranged by process function for a twin straight-line material flow. Buildings and areas are classified as seismic category designations and ventilation confinement zones, both by design and by function, in Table 26-1. The classification indicated under the function columns is a design criteria requirement based on intended use of the space. The classification indicated under the design columns is not only determined by the design criteria, but also by the physical arrangement of the building. In some cases, the functional classification has been upgraded to a higher class because the area of the building concerned is an integral part of the higher class area or physically supports the higher class area.

Table 26-1 - R&H Building Seismic Category Designation and Ventilation Confinement Zones

	Category Designation		Ventilation Confinement Zone	
Area	Function	Design	Function	Design
Administration Area				
Offices, changerooms, shower, and toilet rooms; lunchroom; conference room	N	N	4	4
Receiving and Inspection Facilities				
Incoming air control vestibule Receiving, inspection, and shipping area Outgoing air control vestibule	N	N	4	4

Table 26-1 (Contd)

Area	Category Designation Function	Category Designation Design	Ventilation Confinement Zone Function	Ventilation Confinement Zone Design
Remote Handling Areas				
Shielded process (hot) cells, shielded canyon cells, remote handled equipment maintenance rooms, drum transfer corridor, glove boxes (including spent filter processing enclosures within solid radwaste)	I	I	1	1
Cranes and Crane Maintenance	I	I	2	2
Transfer/Discharge Area				
Loadout and decon rooms	I	I	2	2
Transfer/discharge corridor	I	I	3	3
Shipping loadout room	I	I	2	2
Shipping cask lidding room	I	I	3	3
Shipping cask transfer room	I	I	3	3
Radwaste Area				
High-activity radwaste	I	I	1	1
Low-level solid radwaste	I	I	3[a]	3[a]
Low-level liquid radwaste	I	I	2	2
Analytical Laboratory Facility	I	I	3	3
Control Room				
Supervisor's office, storage, mechanical equipment	I	I	4	4
Health Physics Facility				
Supervisor's office, ready room, personnel decon room, storage and equipment room	N	I	3	3

[a]Except spent filter processing (Zone 1).

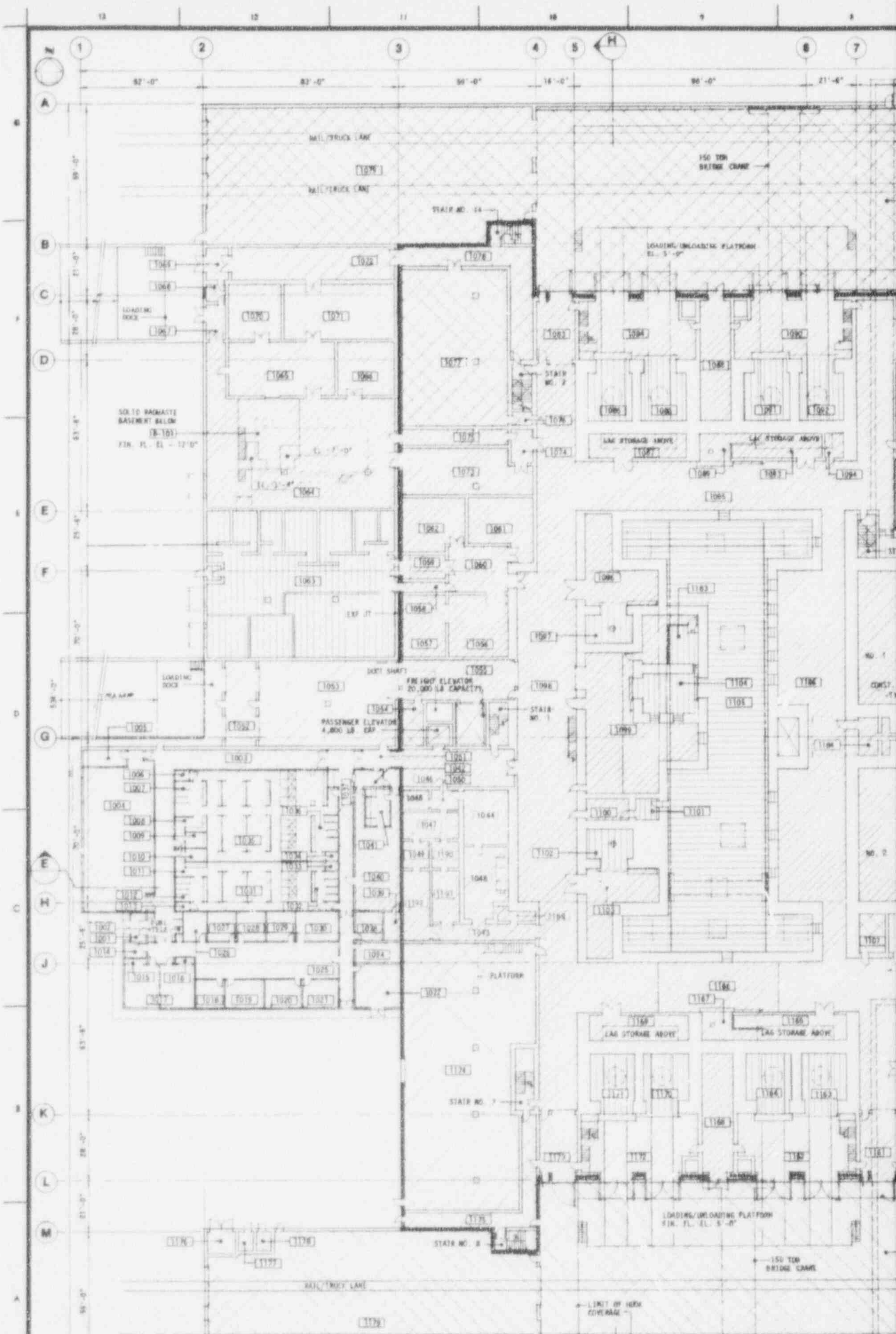
Table 26-1 (Contd)

Area	Category Designation		Ventilation Confinement Zone	
	Function	Design	Function	Design
Other Building Facilities				
Aqueous and chemical decon solution makeup area and deionized water treatment and storage, washdown water area, materials receiving and storage, chiller equipment room	N	I	4	4
Supply fan rooms, compressor room, instrument I/O rooms, battery room, UPS room, corridor	I	I	4	4
Exhaust fan rooms, heat recovery equipment room, manipulator storage and maintenance room, equipment decon, parts and tools storage, operating galleries, service corridors, cask handling and decon rooms, weld/test and decon equipment rooms	I	I	3	3
Boiler room, electrical equipment room	N	N	4	4
Equipment transfer area (third level)	N	N	3	3
Drum/canister transfer rooms, contact handled equipment maintenance room, service gallery, cask unloading rooms, remote handling air filtration rooms, crane equipment service gallery, air locks	I	I	2	2

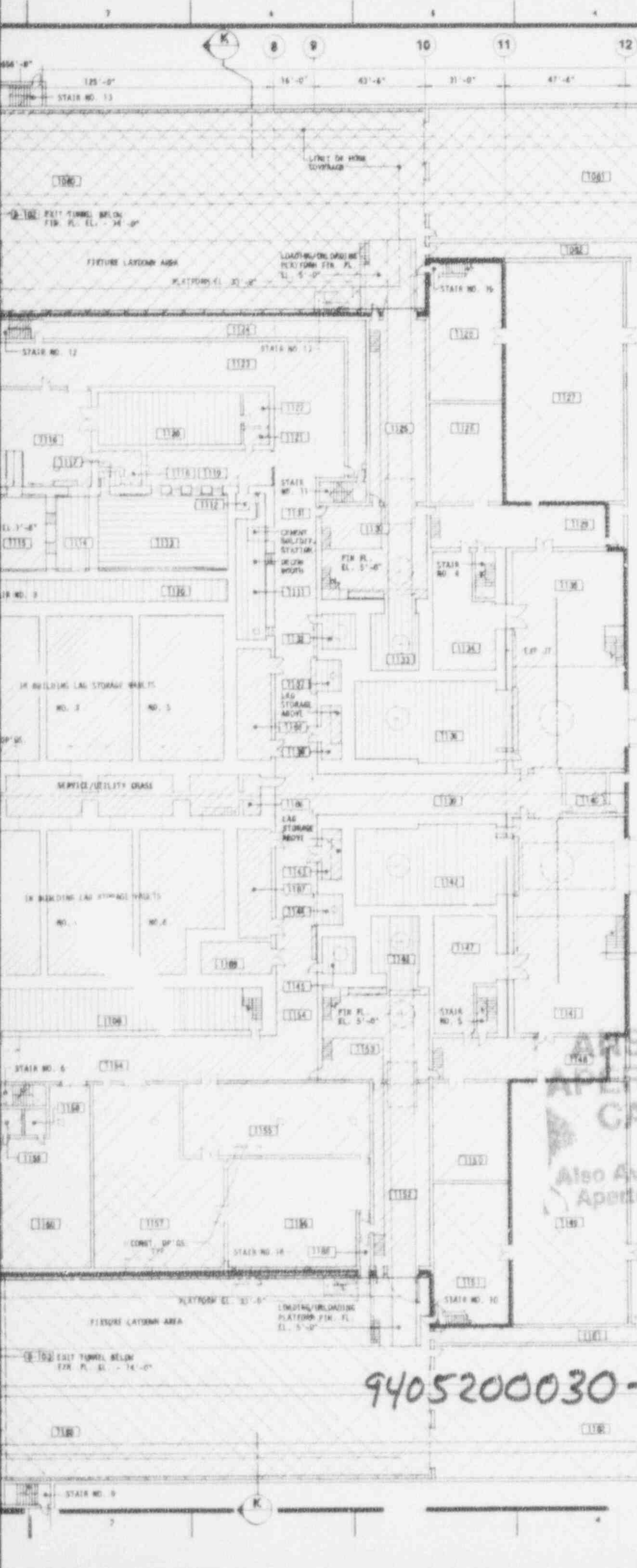
I = Category I

N = Non-Category I

1, 2, 3, 4 = Ventilation Confinement Zones (see Table 2-6)



RAIL/TRUCK LANE
150 TON BRIDGE CRANE
STAIR NO. 14
LOADING/UNLOADING PLATFORM
LOADING DOCK
STAIR NO. 2
SOLID RADWASTE BASEMENT BELOW
FIN. FL. EL - 12'0"
LAG STORAGE ABOVE
DUCT SHAFT
FREIGHT ELEVATOR 20,000 LB CAPACITY
PASSENGER ELEVATOR 4,000 LB. CAP.
STAIR NO. 1
PLATFORM
STAIR NO. 7
STAIR NO. 8
LIMIT OF HOOK COVERAGE



VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

- ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)
- ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.5 IN. H_2O)
- ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)
- ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

- CATEGORY I
- NON-CATEGORY I

ROOM/AREA IDENTIFICATION

B-101 SOLID RADWASTE BASEMENT
B-102 EXIT TUNNEL
B-103 EXIT TUNNEL
1189 SAMPLE STORAGE
1190 REAGENT RM
1191 CHEM & SPT ANALYSIS
1192 COUNTING RM

1001 VESTIBULE
1002 FOYER
1003 CORRIDOR
1004 LUNCH ROOM
1005 STORAGE
1006 JAN. CLOS.
1007 MEN'S TOILET
1008 MEN'S CLOTHING ISSUE
1009 MEN'S COAT RM.
1010 WOMEN'S COAT RM.
1011 WOMEN'S CLOTHING ISSUE
1012 WOMEN'S TOILET
1013 JAN. CL.
1014 TELE. EQUIP.
1015 STOR.
1016 STOR.
1017 CONFERENCE RM.
1018 VISITOR'S OFFICE
1019 MNGMT OFFICE
1020 MNGMT OFFICE
1021 MNGMT OFFICE
1022 CONDENSATE TRANSFER RM.
1023 UNUSED
1024 ELECT. RM.
1025 SECRETARIAL & FILING RM.
1026 DUPLICATION & SUPPLY RM.
1027 OPER. OFFICE
1028 OPER. OFFICE
1029 OPER. OFFICE
1030 STAFF OFFICE
1031 WOMEN'S CHANGE RM.
1032 WOMEN'S TOILET RM.
1033 JAN. CLOS.
1034 JAN. CLOS.
1035 MEN'S CHANGE RM.
1036 MEN'S TOILET RM.
1037 CORRIDOR
1038 H.P. SUPV. OFFICE
1039 H.P. STOR. RM.
1040 HEALTH PHYSICS READY RM.
1041 PERSONNEL DECON RM.
1042 H.P. CHECK STATION
1043 CORRIDOR (ACV)
1044 LOW LEVEL ANALYTICAL LAB.
1045 ANALYTICAL LAB OFFICE
1046 ACV
1047 SUPPLY STORAGE
1048 HIGH LEVEL ANALYTICAL LAB
1049 ANALYZER RM.
1050 ELEVATOR LOBBY ACV
1051 PERSONNEL CORRIDOR
1052 ACV
1053 MATERIALS RECEIVING & STORAGE RM.
1054 INSTR. I/O RM.
1055 FREIGHT CORRIDOR ACV
1056 LAUNDRY
1057 LAUNDRY EQUIP. RM.
1058 CORR.
1059 DECON. RM.
1060 ACV
1061 CLEAN LAUNDRY STOR.
1062 SOILED LAUNDRY STOR.
1063 LOW LEVEL LIQUID RADWASTE
1064 LOW LEVEL SOLID RADWASTE
1065 DRUM INSPECTION & DECON RM.
1066 SOLID RADWASTE MAINTENANCE
1067 ACV
1068 RECEIVING & DISPATCH RM.
1069 ACV
1070 DRUM CURING RM.
1071 FILLED DRUM STORAGE
1072 CORRIDOR
1073 WASTE COLLECTION STOR.
1074 ACV
1075 CORRIDOR
1076 ACV
1077 ELECTRICAL EQUIPMENT RM.
1078 CORRIDOR
1079 INCOMING ACV
1080 RECEIVING, INSPECTION & SHIPPING AREA
1081 OUTGOING ACV
1082 EXIT CORRIDOR
1083 ACV
1084 CASK HANDLING PREP & DECON RM.
1085 CASK UNLOADING RM.
1086 CASK UNLOADING RM.
1087 CLEAN DRUM STOR.
1088 EQUIP. STOR. RM.
1089 CLEAN DRUM TRANSFER STA.
1090 CASK HANDLING PREP & DECON RM.
1091 CASK UNLOADING RM.
1092 CASK UNLOADING RM.
1093 CLEAN DRUM STOR.
1094 ELECT. EQUIP. RM.
1095 OPERATING CORRIDOR
1096 CLEAN CANISTER STORAGE
1097 CLEAN CANISTER TRANSFER RM.
1098 ACCESS CORRIDOR
1099 CONTACT HANDLED EQUIP. MAINT. RM.
1100 H.P. STOR. RM.
1101 AIRLOCK
1102 CLEAN CANISTER TRANSFER RM.
1103 CLEAN CANISTER STORAGE
1104 DECON RM.
1105 REMOTE HANDLED EQUIP. MAINT. RM.
1106 OPERATING CORRIDOR
1107 ELECT. EQUIP. RM.
1108 LAG STORAGE SUMP STATION
1109 STORAGE
1110 LAG STORAGE SUMP STATION
1111 DRUM TRANSFER CORRIDOR
1112 CLEAN DRUM INTRO. VEST.
1113 HIGH ACTIVITY RADWASTE CELL
1114 MAINT. DECON.
1115 OPERATING AREA
1116 CONTACT MAINT. RM.
1117 AIR LOCK
1118 H.P. STOR. RM.
1119 OPERATING RM
1120 HAW EQUIPMENT RM.
1121 ACV
1122 CHEMICAL STORAGE
1123 ACCESS CORRIDOR
1124 EXIT CORRIDOR
1125 SHIPPING CASK TRANSFER RM.
1126 BATTERY RM.
1127 ELECTRICAL RM.
1128 UPS RM.
1129 CORRIDOR
1130 SHIPPING CASK LIDDING RM.
1131 CORRIDOR
1132 STORAGE
1133 SHIPPING LOADOUT RM.
1134 STORAGE RM.
1135 TRANSFER DISCHARGE CORRIDOR ACV
1136 LOADOUT & DECON RM.
1137 CLEAN DRUM/CANISTER TRANSFER STATION
1138 CLEAN DRUM/CANISTER STORAGE
1139 CORRIDOR
1140 ACV
1141 TRANSFER/DISCHARGE CORRIDOR ACV
1142 LOADOUT & DECON RM.
1143 CLEAN DRUM/CANISTER TRANSFER STORAGE
1144 CLEAN DRUM/CANISTER TRANSFER STATION
1145 STORAGE
1146 SHIPPING LOADOUT RM.
1147 STORAGE ROOM
1148 CORRIDOR
1149 ELECTRICAL RM.
1150 BATTERY RM.
1151 UPS RM.
1152 SHIPPING CASK TRANSFER RM
1153 SHIPPING CASK LIDDING RM.
1154 CORRIDOR
1155 COMPRESSOR RM.
1156 WELD/TEST & DECON EQUIP. RM.
1157 AQUEOUS & CHEM. DECON. MAKE-UP
1158 COLD MAINT. OFFICE
1159 COLD MAINT. OFFICE
1160 COLD MAINT. RM.
1161 ACV
1162 CASK HANDLING PREP & DECON RM.
1163 CASK UNLOADING RM.
1164 CASK UNLOADING RM.
1165 CLEAN DRUM STOR.
1166 OPERATING CORRIDOR
1167 CLEAN DRUM TRANSFER RM.
1168 EQUIP. STOR. RM.
1169 CLEAN DRUM STOR.
1170 CASK UNLOADING RM.
1171 CASK UNLOADING RM.
1172 CASK HANDLING PREP & DECON RM.
1173 ACV
1174 CHILLER EQUIP. RM.
1175 EXIT CORRIDOR
1176 ARGON STOR. RM.
1177 HELIUM STORAGE & MANIFOLD
1178 NITROGEN STORAGE & MANIFOLD
1179 INCOMING ACV
1180 RECEIVING INSPECTION & SHIPPING AREA
1181 EXIT CORRIDOR
1182 OUTGOING ACV
1183 MPT GLOVEBOX REPAIR RM
1184 AIRLOCK
1185 CLEAN DRUM/CANISTER STORAGE
1186 AIRLOCK
1187 CLEAN DRUM/CANISTER STORAGE
1188 EXIT CORRIDOR

(CONTINUED ABOVE)

FINISH FLOOR EL. 0'-0" UNLESS NOTED OTHERWISE

GROUND LEVEL PLAN

JQP# NONE

U. S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

MRS FACILITY
RECEIVING & HANDLING BUILDING
SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS
GROUND LEVEL PLAN

NOT REQD | NONE | 77A-200 | 0800

FIGURE 26-1

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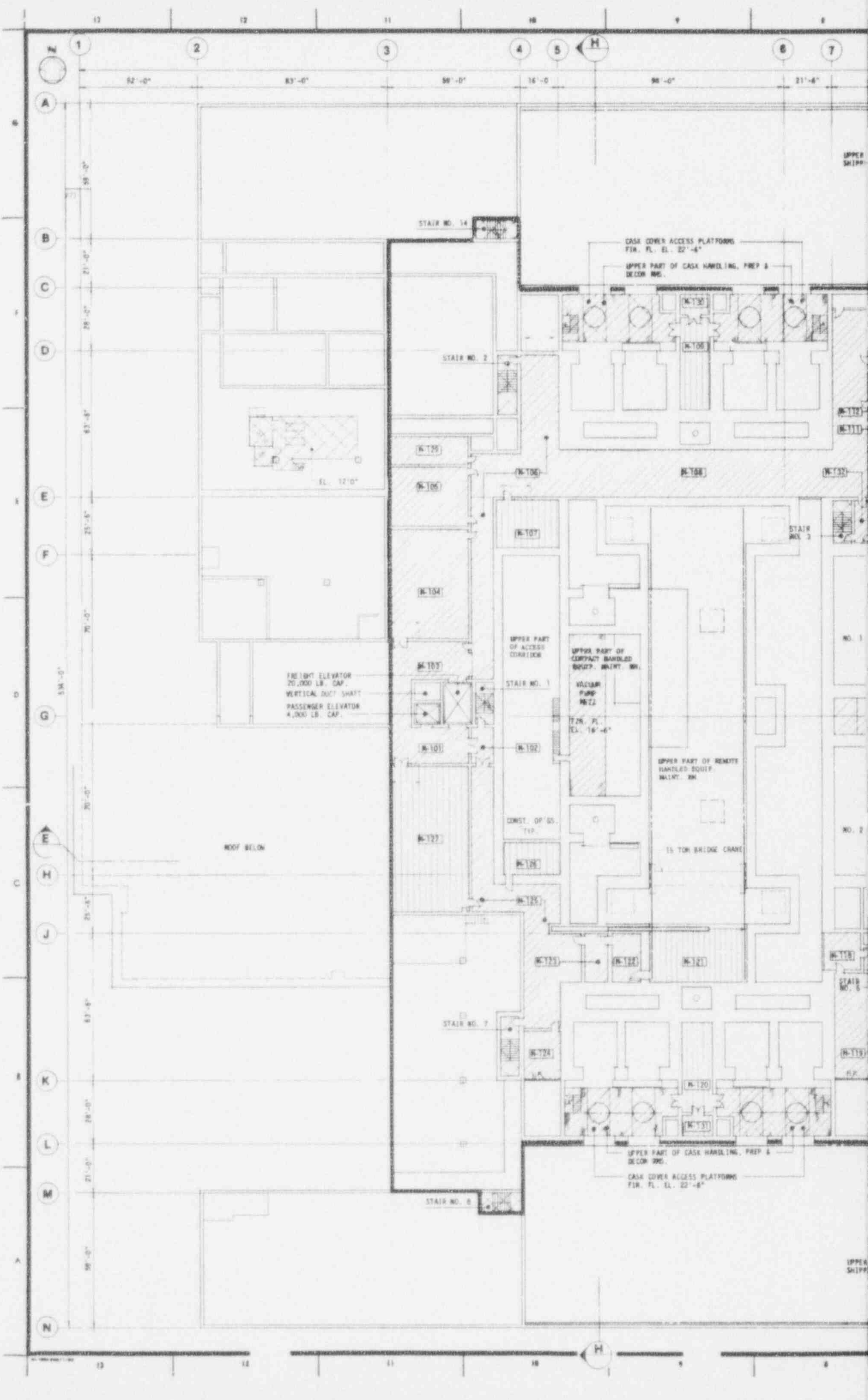
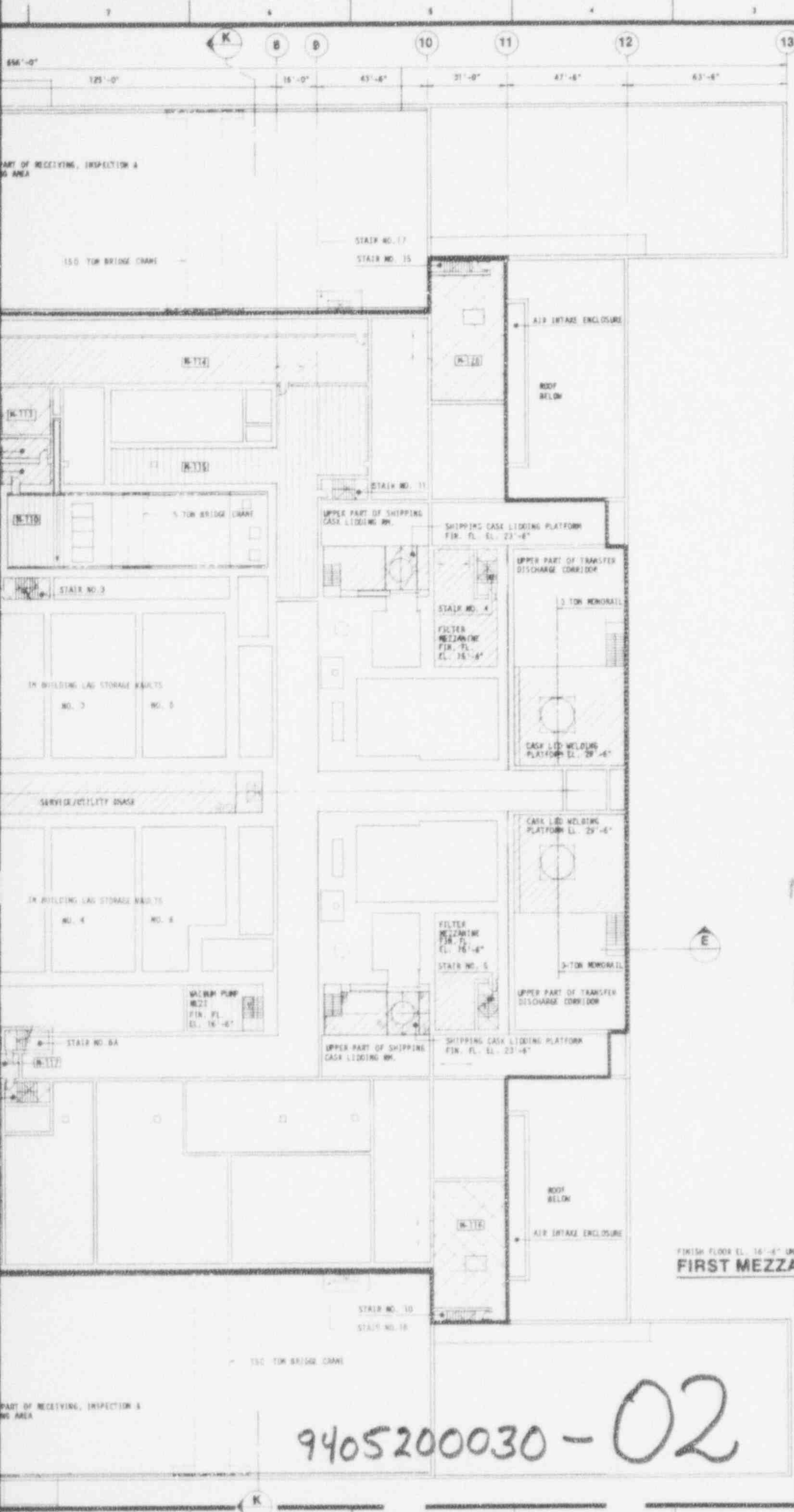
ARSTEC APERTURE CARD
Also Available on Aperture Card



STAIR NO. 14
CASK COVER ACCESS PLATFORMS FIN. FL. EL. 22'-6"
UPPER PART OF CASK HANDLING, PREP & DECON RMS.
STAIR NO. 2
EL. 12'0"
UPPER PART OF ACCESS CORRIDOR
UPPER PART OF CONTACT HANDLED EQUIP. MAINT. RM.
VACUUM PUMP
FREIGHT ELEVATOR 20,000 LB. CAP.
VERTICAL DUCT SHAFT
PASSENGER ELEVATOR 4,000 LB. CAP.
STAIR NO. 1
UPPER PART OF REMOTE HANDLED EQUIP. MAINT. RM.
ROOF BELOW
15 TON BRIDGE CRANE
STAIR NO. 3
STAIR NO. 7
UPPER PART OF CASK HANDLING, PREP & DECON RMS.
CASK COVER ACCESS PLATFORMS FIN. FL. EL. 22'-6"
STAIR NO. 6



FINISH FLOOR EL. 16'-6" UNLESS NOTED OTHERWISE

FIRST MEZZANINE PLAN

VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)

ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.5 IN. H_2O)

ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)

ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

CATEGORY 1

NON-CATEGORY 1

ROOM/AREA IDENTIFICATION

M-101	ELEVATOR LOBBY
M-102	ACV
M-103	FREIGHT CORRIDOR
M-104	LAUNDRY FILTER RM.
M-105	UNASSIGNED SPACE
M-106	CORRIDOR
M-107	FILTER RM. (HEPA)
M-108	CORRIDOR
M-109	EQUIP. STOR. RM.
M-110	CRANE MAINT. RM.
M-111	AIR LOCK
M-112	H.P. STOR. RM.
M-113	ELEC. EQUIP. RM.
M-114	CORRIDOR
M-115	VALVE/FILTER GALLERY
M-116	MECHANICAL EQUIP. RM.
M-117	ACV
M-118	ACCESS RM.
M-119	FILTER RM. (HEPA)
M-120	EQUIP. STOR. RM.
M-121	CRANE MAINT. RM.
M-122	AIR LOCK
M-123	H.P. STOR. RM.
M-124	FILTER RM. (HEPA)
M-125	CORRIDOR
M-126	FILTER RM. (HEPA)
M-127	ANALYTICAL LAB. FILTER RM.
M-128	MECHANICAL EQUIP. RM.
M-129	AIR SAMPLING PUMPING STA. NO. 1
M-130	CONDENSER RM.
M-131	CONDENSER RM.
M-132	ACV

JQP# NONE

U. S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

MRS FACILITY
RECEIVING & HANDLING BUILDING

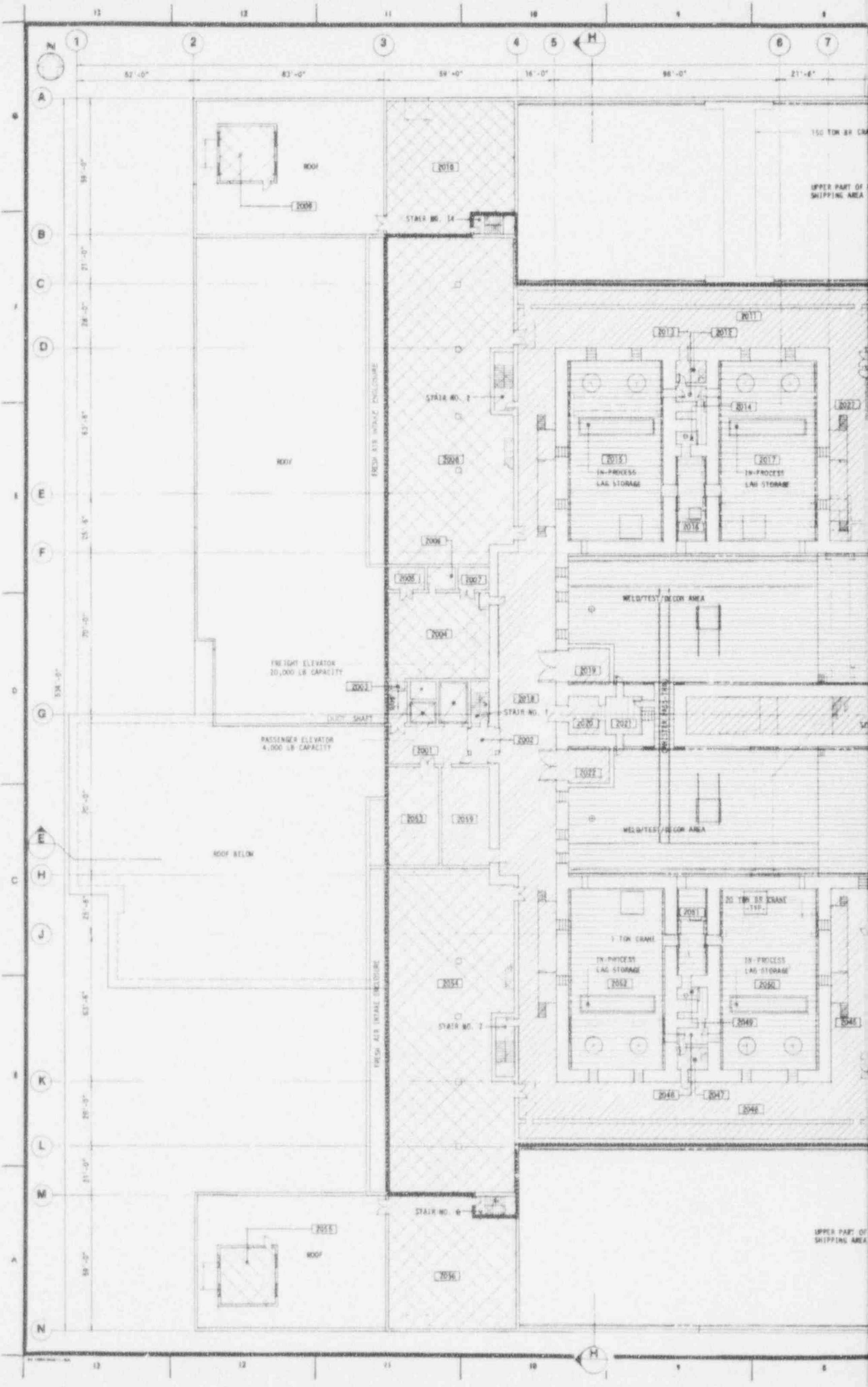
SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS
FIRST MEZZANINE PLAN

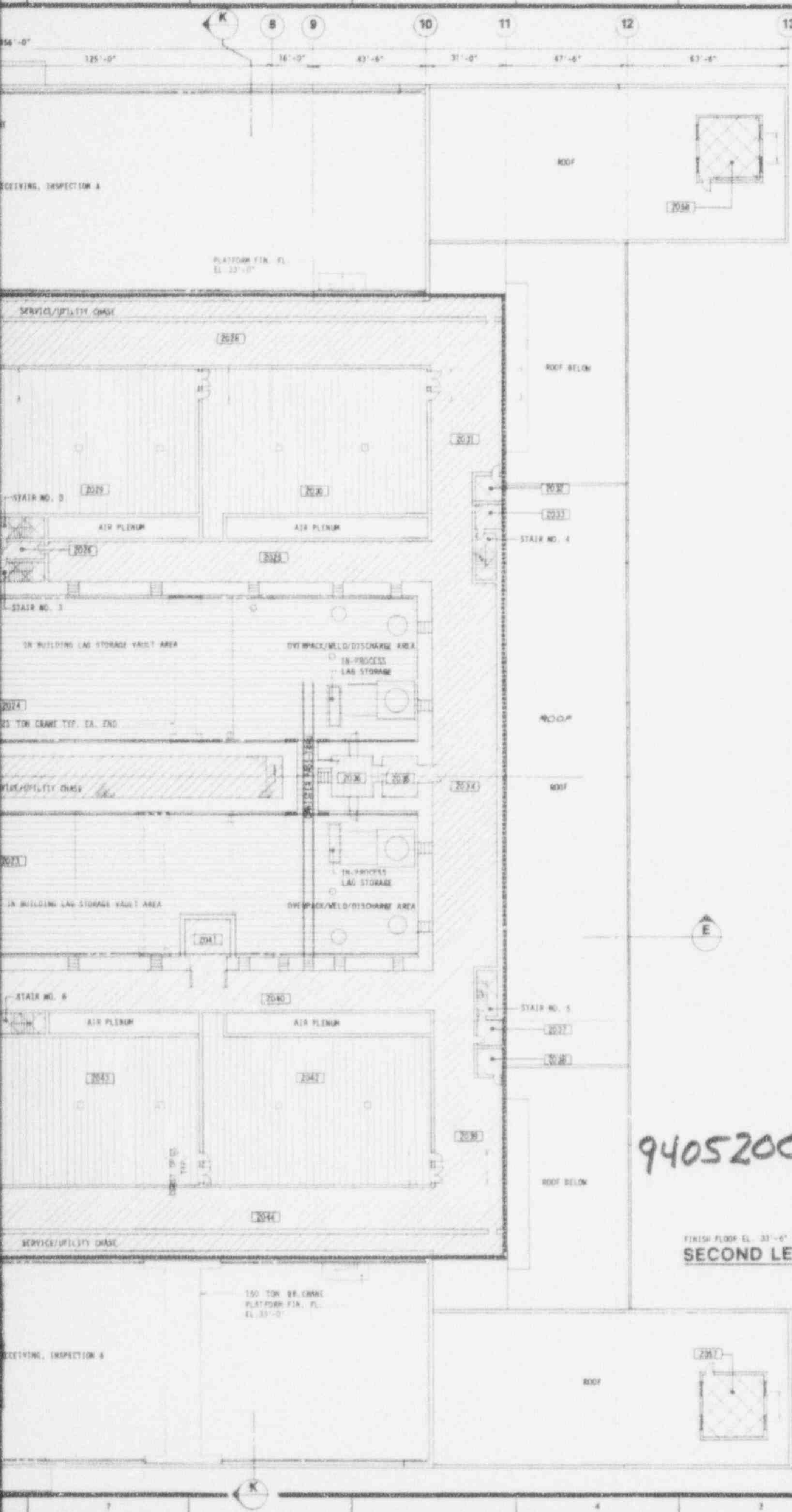
NOT REQD

NONE

77A-200 0800

FIGURE 26-2


STAIR NO. 14
STAIR NO. 2
STAIR NO. 1
STAIR NO. 6
ROOF
ROOF BELOW
FRESH AIR INTAKE ENCLOSURE
FREIGHT ELEVATOR
20,000 LB CAPACITY
PASSENGER ELEVATOR
4,000 LB CAPACITY
DUCT SHAFT
IN-PROCESS
LAG STORAGE
WELD/TEST/DECON AREA
1 TON CRANE
20 TON BT CRANE
UPPER PART OF
SHIPPING AREA
150 TON BR CRANE
2010
2008
2011
2012
2013
2014
2015
2016
2017
2027
2006
2005
2007
2004
2003
2019
2018
2020
2021
2002
2001
2022
2053
2059
2051
2052
2050
2049
2045
2054
2048
2047
2046
2055
2056
82'-0"
83'-0"
59'-0"
16'-0"
96'-0"
21'-6"



VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

- ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)
- ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.5 IN. H_2O)
- ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)
- ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

- CATEGORY I
- NON-CATEGORY I

ROOM/AREA IDENTIFICATION

2001 ELEVATOR LOBBY
2002 ACV
2003 VESTIBULE
2004 CONTROL RM.
2005 STOR. RM.
2006 SUPV. OFFICE
2007 STOR. RM.
2008 SUPPLY FAN RM.
2009 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2010 SUPPLY FAN RM.
2011 OPERATING GALLERY
2012 H.P. STOR. RM.
2013 AIR LOCK
2014 CLEAN DRUM INTRO. RM.
2015 SHIELDED PROCESS CELL NO. 1
2016 DECON CELL
2017 SHIELDED PROCESS CELL NO. 3
2018 OPERATING GALLERY
2019 WELDING STATION
2020 H.P. STOR. RM.
2021 AIR LOCK
2022 WELDING STATION
2023 SHIELDED CANYON CELL NO. 6
2024 SHIELDED CANYON CELL NO. 5
2025 OPERATING GALLERY
2026 ACV
2027 OPERATING GALLERY
2028 ACCESS CORRIDOR
2029 EXHAUST FILTER RM.
2030 EXHAUST FILTER RM.
2031 ACCESS CORRIDOR
2032 ELECT. EQUIP. RM.
2033 ACV
2034 OPERATING GALLERY
2035 H.P. STOR. RM.
2036 AIR LOCK
2037 ACV
2038 ELECT. EQUIP. RM.
2039 ACCESS CORRIDOR
2040 OPERATING GALLERY
2041 WELDING STATION
2042 EXHAUST FILTER RM.
2043 EXHAUST FILTER RM.
2044 ACCESS CORRIDOR
2045 OPERATING GALLERY
2046 OPERATING GALLERY
2047 H.P. STOR. RM.
2048 AIR LOCK
2049 CLEAN DRUM INTRO. RM.
2050 SHIELDED PROCESS CELL NO. 4
2051 DECON CELL
2052 SHIELDED PROCESS CELL NO. 2
2053 MECHANICAL EQUIP. RM. (FOR CONTROL ROOM)
2054 SUPPLY FAN RM.
2055 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2056 SUPPLY FAN RM.
2057 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2058 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2059 MECH. EQUIP. RM. (GLYCOL & H. W. REHEAT PUMPS)

9405200030 - 03

FINISH FLOOR EL. 33'-6" UNLESS NOTED OTHERWISE

SECOND LEVEL PLAN

JOP# NONE

U. S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

Westinghouse Electric Corp. Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING

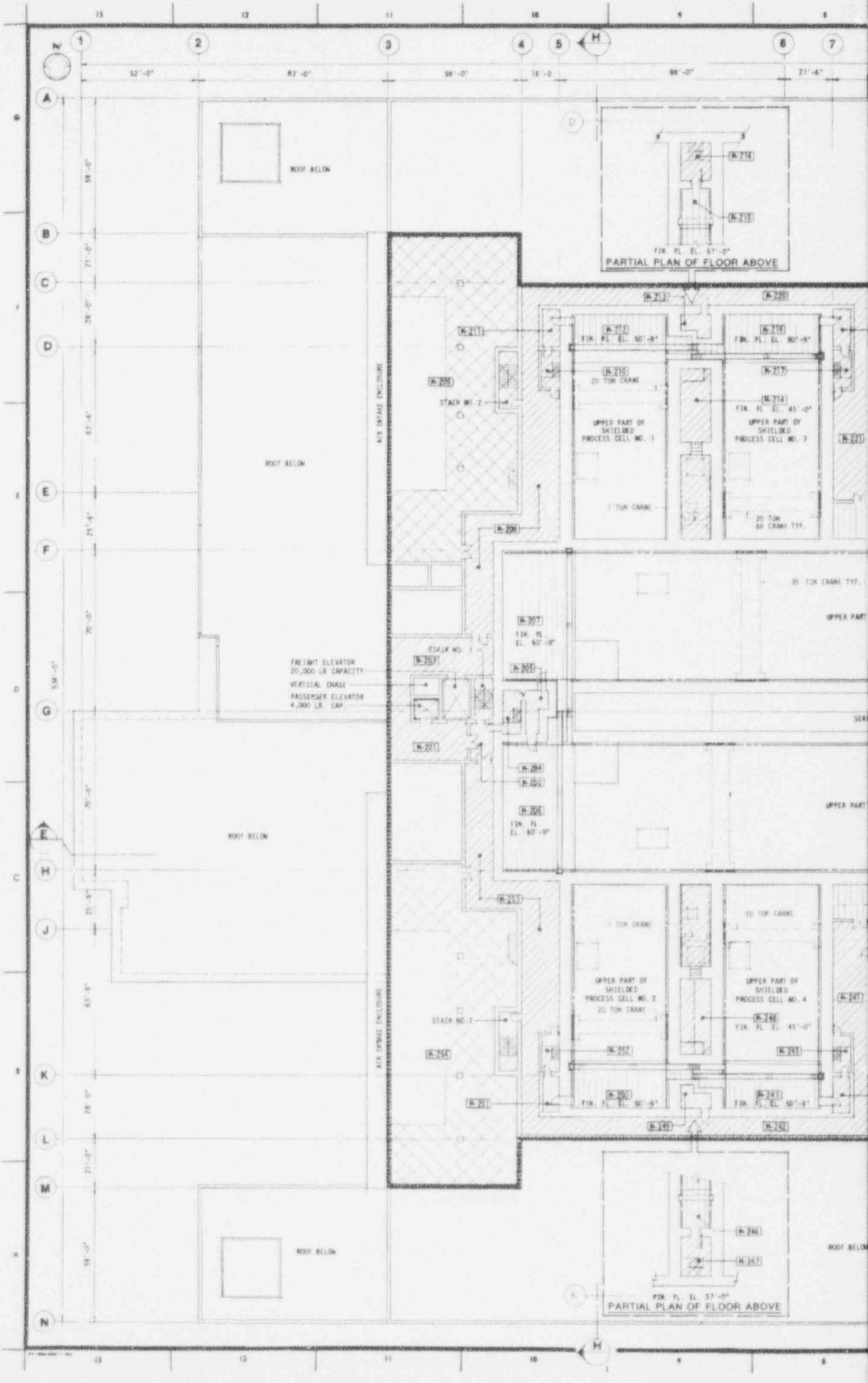
SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS
SECOND LEVEL PLAN

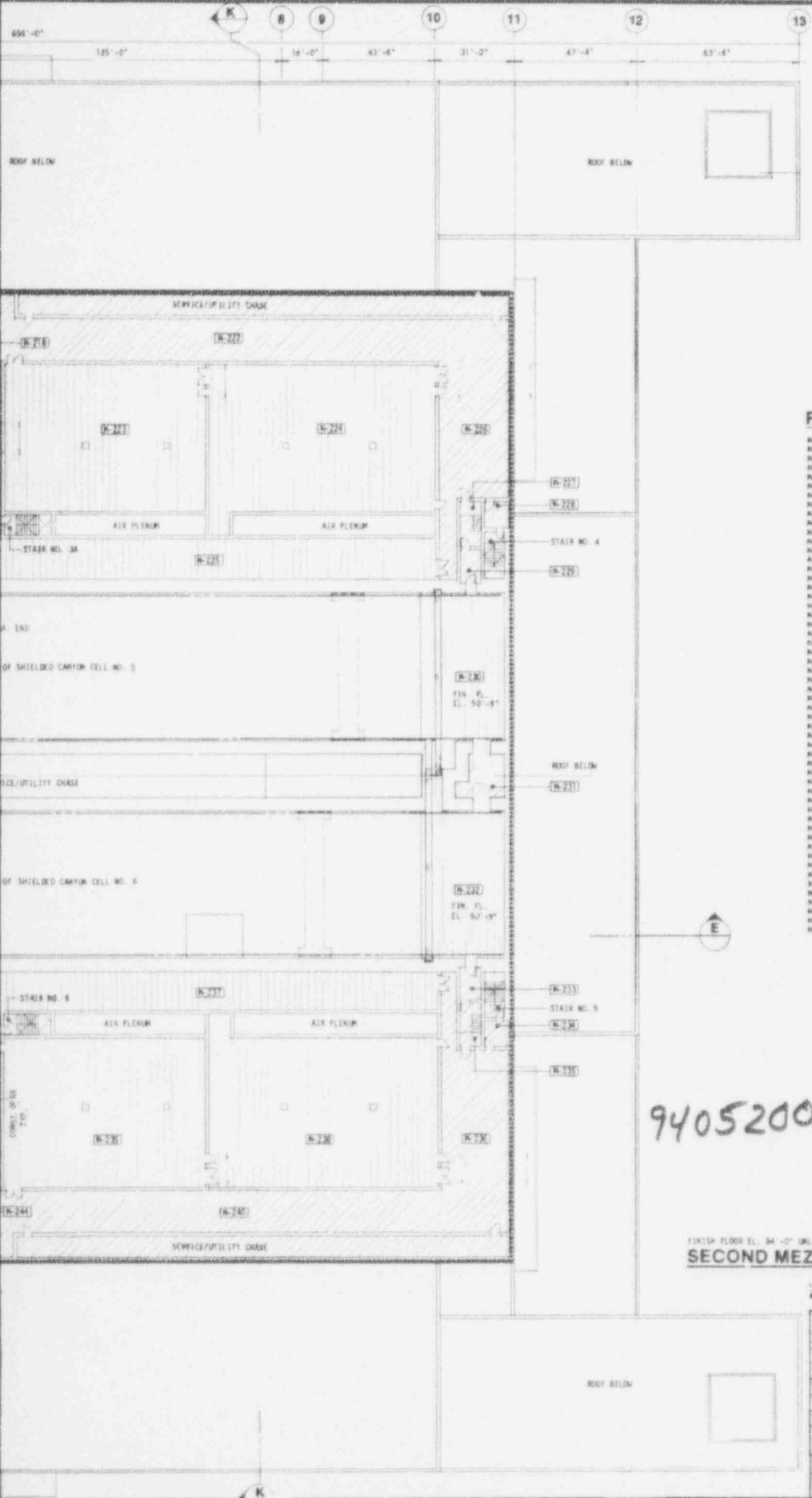
77A-200 0800

CLASSIFIED BY NOT REQD

CLASSIFICATION NONE

FIGURE 26-3


ROOF BELOW
AIR INTAKE ENCLOSURE
STAIR NO. 2
STAIR NO. 1
FREIGHT ELEVATOR
20,000 LB CAPACITY
VERTICAL CHASE
PASSENGER ELEVATOR
4,000 LB. CAP
PARTIAL PLAN OF FLOOR ABOVE
FIN. FL. EL. 57'-0"
UPPER PART OF
SHIELDED
PROCESS CELL NO. 1
UPPER PART OF
SHIELDED
PROCESS CELL NO. 3
UPPER PART OF
SHIELDED
PROCESS CELL NO. 2
UPPER PART OF
SHIELDED
PROCESS CELL NO. 4
20 TON CRANE
1 TON CRANE
35 TON CRANE TYP.
FIN. FL. EL. 50'-9"
FIN. FL. EL. 45'-0"



VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

- ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)
- ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.5 IN. H_2O)
- ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)
- ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

- CATEGORY I
- NON-CATEGORY I

ROOM/AREA IDENTIFICATION

M-201	ELEVATOR LOBBY
M-202	ACV
M-203	FREIGHT CORRIDOR LOBBY
M-204	H.P. STOR. RM.
M-205	AIR LOCK
M-206	CRANE MAINT. RM.
M-207	CRANE MAINT. RM.
M-208	CORRIDOR
M-209	SUPPLY FAN RM.
M-210	H.P. STOR. RM.
M-211	AIR LOCK
M-212	CRANE MAINT. RM.
M-213	ACCESS RM.
M-214	OPERATOR'S AREA
M-215	CRANE MAINT. DECON CELL
M-216	AIR LOCK
M-217	H.P. STOR. RM.
M-218	AIR LOCK
M-219	CRANE MAINT. RM.
M-220	CORRIDOR
M-221	CORRIDOR
M-222	CORRIDOR
M-223	EXHAUST FILTER RM.
M-224	EXHAUST FILTER RM.
M-225	FILTER RM. (HEPA)
M-226	CORRIDOR
M-227	H.P. STOR. RM.
M-228	ACV
M-229	AIR LOCK
M-230	CRANE MAINT. RM.
M-231	EQUIPMENT STOR. RM.
M-232	CRANE MAINT. RM.
M-233	AIR LOCK
M-234	ACV
M-235	H.P. STOR. RM.
M-236	CORRIDOR
M-237	FILTER RM. (HEPA)
M-238	EXHAUST FILTER RM.
M-239	EXHAUST FILTER RM.
M-240	CORRIDOR
M-241	CORRIDOR
M-242	CORRIDOR
M-243	CRANE MAINT. RM.
M-244	AIR LOCK
M-245	H.P. STOR. RM.
M-246	CRANE MAINT/DECON CELL
M-247	AIR LOCK
M-248	OPERATOR'S AREA
M-249	ACCESS RM.
M-250	CRANE MAINT. RM.
M-251	AIR LOCK
M-252	H.P. STOR. RM.
M-253	CORRIDOR
M-254	SUPPLY FAN RM.

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FINISH FLOOR EL. 84'-0" UNLESS NOTED OTHERWISE

SECOND MEZZANINE PLAN

JOP# NONE

U.S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

MRS FACILITY
RECEIVING & HANDLING BUILDING

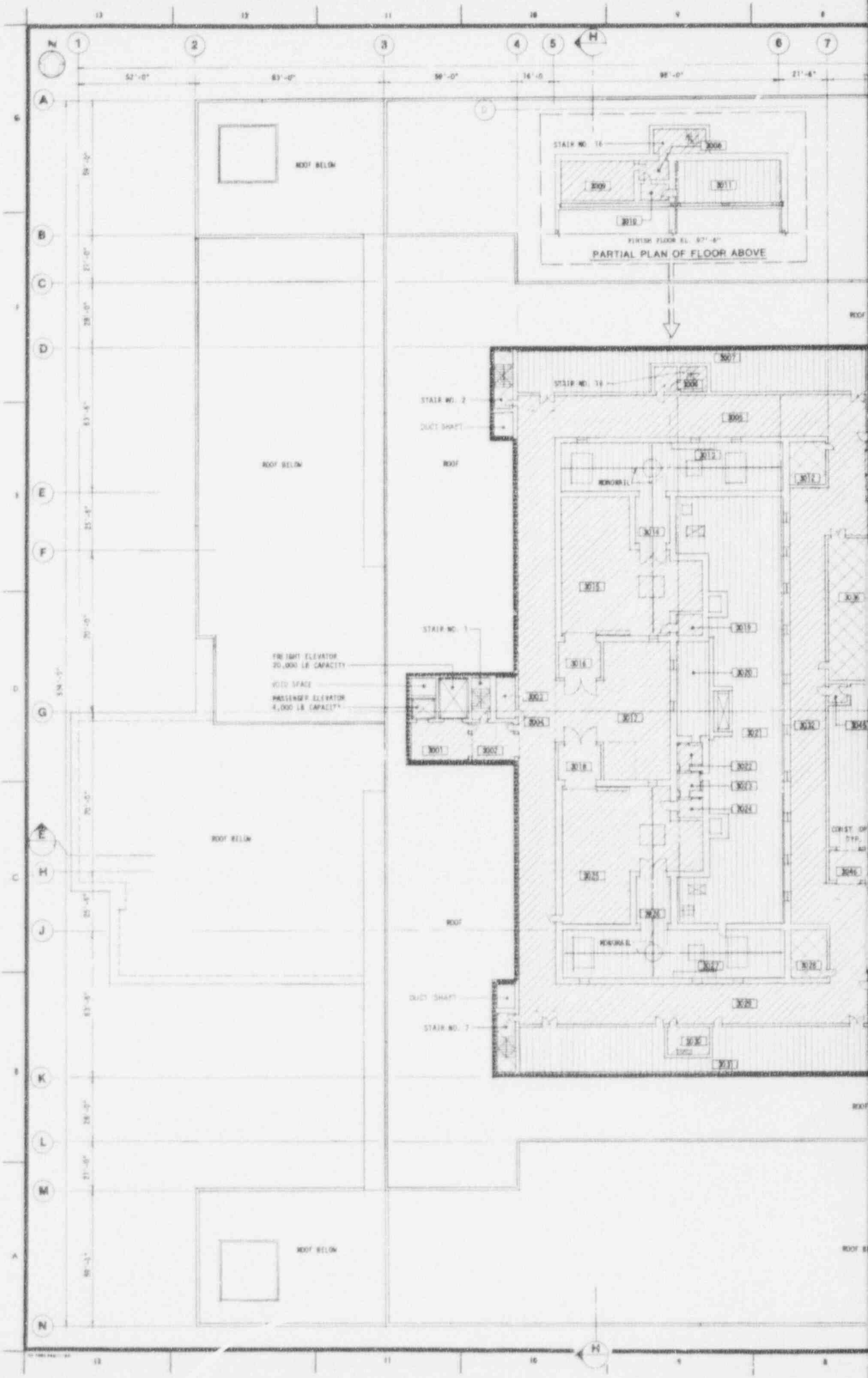
SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS SECOND MEZZANINE PLAN

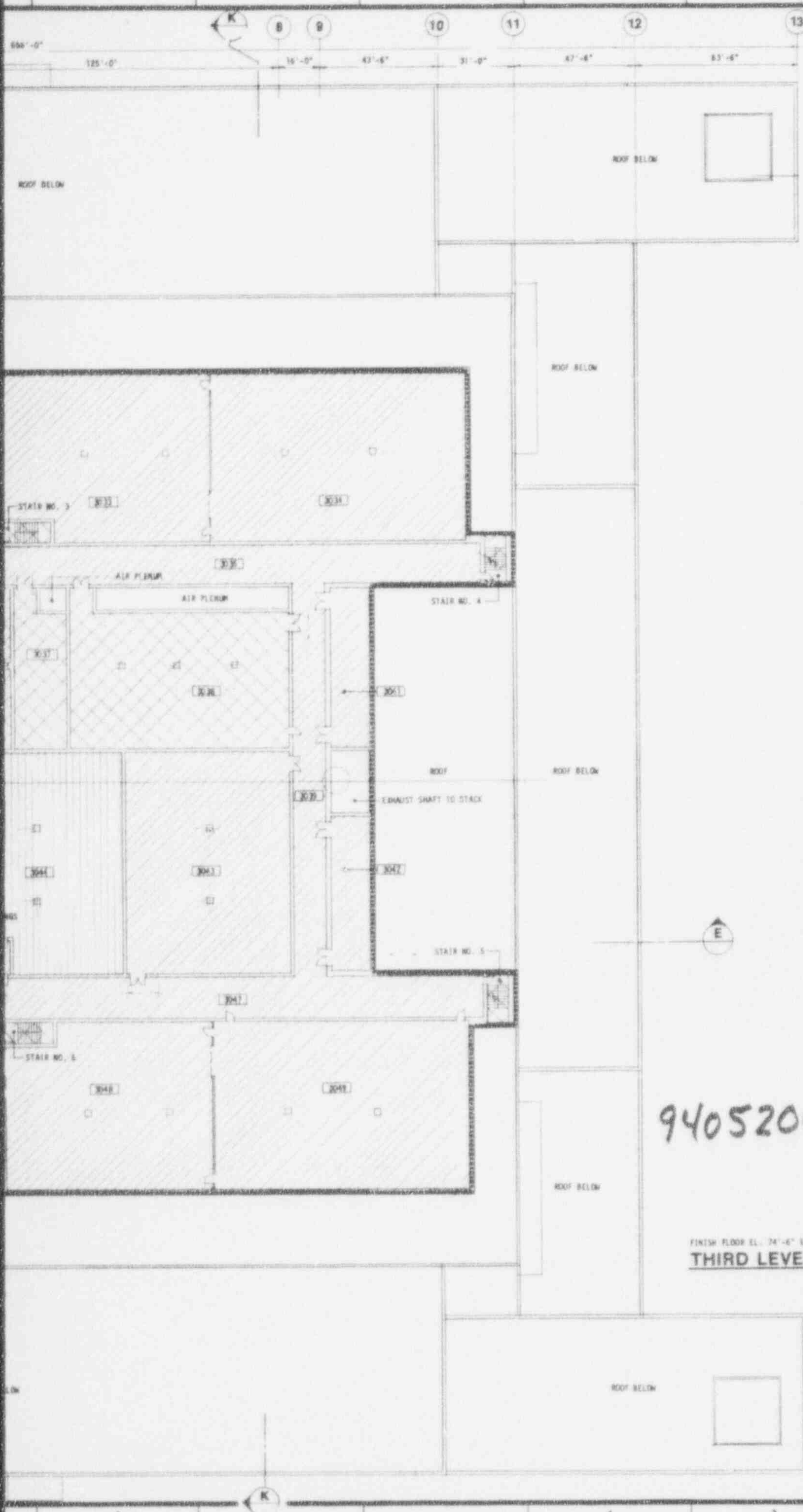
77A-200 0800

NOT REQD

NONE

FIGURE 26-4


PARTIAL PLAN OF FLOOR ABOVE
ROOF BELOW
ROOF
STAIR NO. 2
DUCT SHAFT
STAIR NO. 1
FREIGHT ELEVATOR
20,000 LB CAPACITY
VOID SPACE
PASSENGER ELEVATOR
4,000 LB CAPACITY
MONORAIL
STAIR NO. 7



VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)

ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.5 IN. H_2O)

ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)

ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

CATEGORY I

NON-CATEGORY I

ROOM/AREA IDENTIFICATION

3001	ELEVATOR LOBBY
3002	ACV
3003	STOR. RM.
3004	CORRIDOR
3005	OPERATING CORRIDOR
3006	H.P. STOR. RM.
3007	FILTER ROOM
3008	H.P. STOR. RM.
3009	STOR. & EQUIP. RM.
3010	AIR LOCK
3011	CRANE MAINT. RM.
3012	ELECT. EQUIP. RM.
3013	REMOTE TRANSFER RM.
3014	EQUIP. DECON RM.
3015	MANIPULATOR/CRANE STOR. & MAINT. RM
3016	ACV
3017	OPERATING GALLERY
3018	ACV
3019	COMPACTOR EQUIPMENT RM.
3020	FILTER COMPACTOR RM
3021	REMOTE HANDLING AIR FILTRATION CELL
3022	DRUM INTRO RM.
3023	AIR LOCK
3024	H.P. STOR. RM.
3025	MANIPULATOR/CRANE STOR. & MAINT. RM.
3026	EQUIP. DECON. RM.
3027	REMOTE TRANSFER RM.
3028	ELECT. EQUIP. RM.
3029	OPERATING CORRIDOR
3030	H.P. STOR. RM.
3031	FILTER RM.
3032	OPERATING CORRIDOR
3033	EXHAUST FAN RM.
3034	EXHAUST FAN RM.
3035	CORRIDOR
3036	FILTER STOR. RM.
3037	LAG STOR. GENERATOR RM.
3038	SUPPLY FILTER RM.
3039	CORRIDOR
3040	UNASSIGNED
3041	STOR. RM.
3042	STOR. RM.
3043	EXHAUST FAN RM.
3044	EXHAUST FILTER RM.
3045	ACV
3046	ACV
3047	CORRIDOR
3048	EXHAUST FAN RM.
3049	EXHAUST FAN RM.

9405200030-05

FINISH FLOOR EL. 74'-6" UNLESS NOTED OTHERWISE

THIRD LEVEL PLAN

JQP# NONE

U. S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

MRS FACILITY
RECEIVING & HANDLING BUILDING

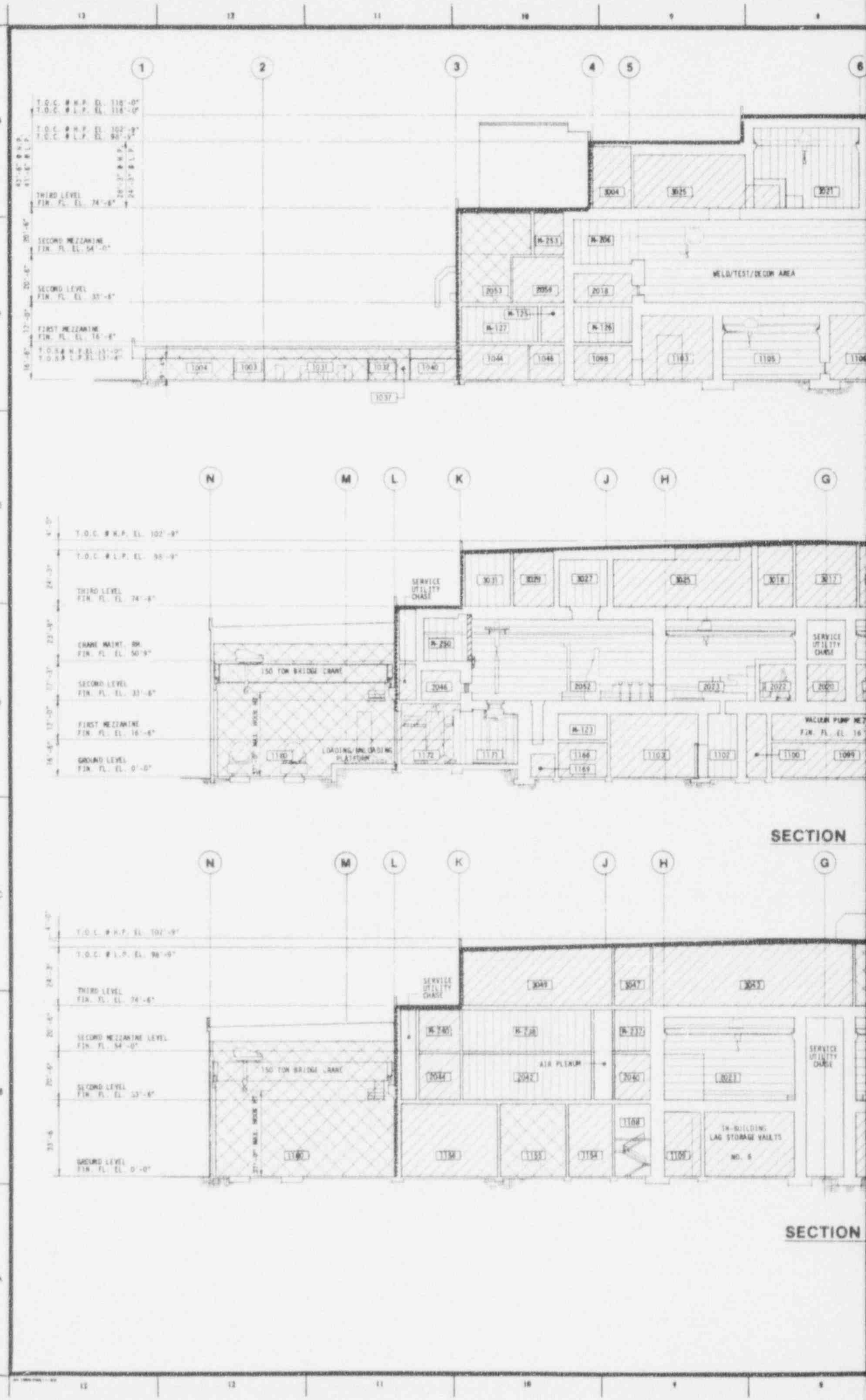
SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS THIRD LEVEL PLAN

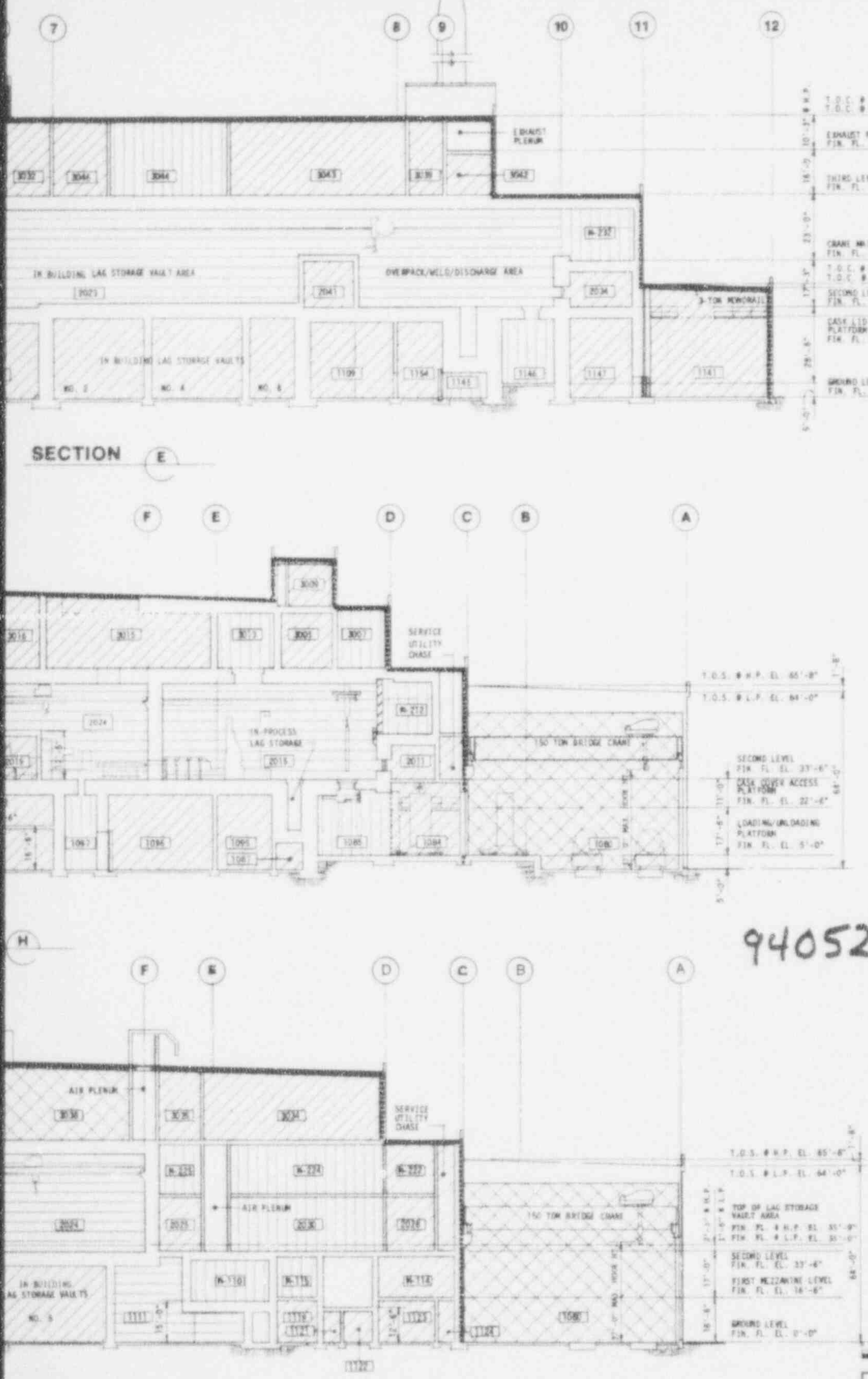
77A-200 0800

NOT RS.

CLASSIFICATION NONE

FIGURE 26-5


WELD/TEST/DECON AREA
THIRD LEVEL FIN. FL. EL. 74'-6"
SECOND MEZZANINE FIN. FL. EL. 54'-0"
SECOND LEVEL FIN. FL. EL. 33'-6"
FIRST MEZZANINE FIN. FL. EL. 16'-6"
GROUND LEVEL FIN. FL. EL. 0'-0"
CRANE MAINT. RM.
150 TON BRIDGE CRANE
LOADING/UNLOADING PLATFORM
SERVICE UTILITY CHASE
AIR PLENUM
IN-BUILDING LAG STORAGE VAULTS NO. 5
SECTION
SECTION



ANSTEC APERTURE CARD

Also Available on Aperture Card

9405200030 - 06

VENTILATION CONFINEMENT ZONES

(DIFFERENTIAL PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE)

ZONE 1 - PROCESS ZONE (-2.0 TO -4.0 IN. H_2O)

ZONE 2 - RESTRICTED ACCESS ZONE (-0.75 TO 1.* IN. H_2O)

ZONE 3 - OPERATING ZONES (-0.5 TO -0.7 IN. H_2O)

ZONE 4 - (+ 0.05 TO + 0.1 IN. H_2O)

SEISMIC CATEGORY DESIGNATIONS

CATEGORY I

NON-CATEGORY I

JQP# NONE

U.S. Department Of Energy
Richland Operations Office

PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

Westinghouse Electric Corp. Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING

SEISMIC CATEGORY AND VENTILATION CONFINEMENT ZONING DESIGNATIONS TYPICAL SECTIONS

77A-200 0801

NOT REQD

NONE

FIGURE 26-6

REVISIONS

REFERENCE DRAWINGS

DRAWING STATUS

NEXT USED ON

SECTION 27

SAFETY EVALUATION

A safety evaluation of the proposed MRS Facility was developed to provide assurance that the design meets the requirements of 10 CFR 72 and will not cause an undue risk to the health and safety of the public during normal or off-normal operations. This evaluation is presented in Volume II of the Design Report (Regulatory Assessment Document).

27.1 APPROACH

The Regulatory Assessment Document (RAD) was developed consistent with the conceptual level of design and with the use of site-specific characteristics. To avoid the implication that a Safety Analysis Report (SAR) was produced, the RAD is formatted as a direct response to the sections and paragraphs of 10 CFR 72. However, the data requested for an SAR, as delineated in Section 72.15(a), are provided to the extent possible for the Conceptual Design. Because various portions of 10 CFR 72 are not related to this design phase, responses to these topics are not provided. A table of applicability is provided in the RAD introduction.

27.2 STRUCTURES, SYSTEMS, AND COMPONENTS IMPORTANT TO SAFETY

In accordance with the requirements of 10 CFR 72, the structures, systems and components important to safety have been determined and the rationale for their selection presented in Subpart C of the RAD as a response to Section 72.72.b.

27.3 ACCIDENT ANALYSIS

Various off-normal events and design basis accidents for the MRS Facility are presented in the RAD with a listing of the potential consequence(s) to both operating personnel and the general public. The tables for design events considered in the evaluation are presented in Appendix A of the RAD. The contents of the tables delineate a range of credible events in each category, but are not to be interpreted as describing all possible events in the MRS Facility.

The accident analysis events are grouped in accordance with the event definitions of ANSI/ANS 57.9, referenced in Regulatory Guide 3.48, Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage). The design event categories and definitions are:

(1) Design Event I: Design Event I consists of that set of events that are expected to occur regularly or frequently in the course of normal operation of the ISFSI.

(2) Design Event II: Design Event II consists of that set of events that, although not occurring regularly, can be expected to occur with moderate frequency or on the order of once during a calendar year of ISFSI operation.

(3) Design Event III: Design Event III consists of that set of infrequent events that could reasonably be expected to occur during the lifetime of the ISFSI.

(4) Design Event IV: Design Event IV consists of the events that are postulated because their consequences may result in the maximum potential impact on the immediate environs. Their consideration establishes a conservative design basis for certain systems with Important Confinement Features. Typically this set of events will consist of plant specific design events as defined in design phenomena.

The MRS Facility conceptual design was evaluated during design development using engineering judgement. Credible events in Design Event Categories II, III, and IV were identified that may result in an off-normal exposure to radioactivity or hazardous material by operating personnel and/or the general public prior to taking credit for design features which may mitigate or prevent the event. The event category was designated based on potential frequency or event probability. The Design Event I category is, by definition, normal operational events, and these are described only in the body of the Regulatory Assessment Document. The off-normal event identification was performed relative to functional areas or systems, as defined in ANSI/ANS 57.9.

In accordance with the level of detail for conceptual design, a range of major credible events in each category was delineated; however, this analysis is not to be interpreted as describing all possible events in the MRS Facility. Multiple or sequential events and events resulting from decommissioning were not addressed in this analysis. Calculations were performed for selected events from Categories III and IV to ensure that the current design dose not exceed acceptable limits at the site boundary, as defined in 10 CFR 72.68. The events that were calculated are believed to present the worst-case radiological exposure for operating personnel and/or the general public.

SECTION 28

INDUSTRIAL HEALTH AND SAFETY

28.1 INTRODUCTION

All buildings, systems, and equipment in the MRS Facility are designed to comply with all pertinent OSHA standards and comply with the intent of state and local safety standards. The design complies with the latest edition of the following codes and standards, specifications, and orders.

28.1.1 CODES AND STANDARDS

(1) AEC-ERDA RDT Standards for F8-6T - Hoisting and Rigging of Critical Components and Related Equipment

(2) Air Moving and Conditioning Association, Inc. (AMCA)

(3) American National Standards Institute

- ANSI B2.1-1968, Pipe Thread
- ANSI B16.1-1975, Cast-Iron Pipe Flanges and Flanged Fittings
- ANSI B16.3-1977, Malleable Iron Screwed Fittings, 150 and 300 lb
- ANSI B16.4-1977, Cast-Iron Threaded Fittings
- ANSI B16.5-1981, Steel Pipe Flanges, Flanged Valves and Fittings Standard Weight
- ANSI B16.9-1981a, Factory-Made Wrought Steel Butt-Welding Fittings
- ANSI B16.11-1980, Forged Steel Fittings, Socket-Welding and Threaded
- ANSI B30, DOE Hoisting and Rigging Manual
- ANSI B31.1-1980, Power Piping
- ANSI B36.10-1979, Wrought Steel and Wrought Iron Pipe
- ANSI B36.19-1976, Stainless Steel Pipe
- ANSI A58.1, Minimum Design Loads for Buildings and Other Structures
- ANSI/ANS 57.9-1984, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)
- ANSI/ANS 55.1-1979, Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants
- ANSI/ANS 55.6-1979, Liquid Radioactive Waste Processing System for Light Water Cooled Reactor Plants
- ANSI Z358.1-1981, Standard for Emergency Eyewash and Shower Equipment
- ANSI/ASME NQA-1-1983, Quality Assurance Program Requirements for Nuclear Facilities
- ANSI Z88.2-1980, Practices for Respiratory Protection

(4) Factory Mutual Corporation (FM)

- Approval Guide - 1982
- Loss Prevention Data Sheets - 1982 (Rev)

(5) International Conference of Building Officials (ICBO)

- UBC - 1982, Chapter 23 and 38 - Uniform Building Code
- UBC - 1982, Uniform Fire Code
- UPC - 1982, Uniform Plumbing Code

(6) National Fire Protection Association (NFPA)

- NFPA 10-1981, Portable Fire Extinguishers
- NFPA 12A-1980, Halon 1301 Fire Extinguishing Systems
- NFPA 13-1983, Sprinkler System Installation
- NFPA 14-1983, Standpipe and Hose Systems
- NFPA 17-1980, Dry Chemical Extinguishing Systems
- NFPA 24-1981, Private Fire Service Mains and Their Appurtenances
- NFPA 70-1981, National Electric Code
- NFPA 71-1982, Signaling Systems - Central Station
- NFPA 72A-1979, Signaling Systems - Local Protective
- NFPA 72D-1979, Signaling Systems - Proprietary
- NFPA 72E-1982, Automatic Fire Detectors
- NFPA 80-1981, Fire Doors and Windows
- NFPA 90A-1981, Air Conditioning and Ventilation System
- NFPA 101-1981, Life Safety Code
- NFPA 251-1979, Fire Test of Building Construction and Materials
- NFPA 1961-1979, Fire Hose
- NFPA 1963-1979, Screw Threads and Gaskets for Fire Hose Connections
- NFPA 30-1981, Flammable and Combustible Liquids Code
- NFPA 58-1983, Storage and Handling Liquefied Petroleum Gases
- NFPA 20-1983, Fire Pumps, Centrifugal

(7) Underwriters' Laboratories, Inc. (UL)

Fire Protection Equipment Directory

(8) National Electric Manufacturers' Association (NEMA) Standards

(9) American Society of Mechanical Engineers (ASME)

ASME Boiler and Pressure Vessel Code, 1980

- Section I, Power Boilers
- Section II, Parts A, B, and C - Material Specifications
- Section V, Nondestructive Examination
- Section VIII, Pressure Vessels
- Section IX, Welding and Brazing Qualifications

(10) Nuclear Regulatory Commission (NRC) Regulatory Guides

- 8.15, Acceptable Programs for Respiratory Protection
- NUREG-0041, Manual of Respiratory Protection Against Airborne Radioactive Materials

(11) Mine Safety and Health Administration (MSHA) Standards for Respirator Testing

(12) Compressed Gas Association (CGA) 1966 Commodity Specification for Air, Specification G7.1

(13) National Institute of Occupational Safety and Health (NIOSH)

28.1.2 SPECIFICATIONS

(1) American Society for Testing and Materials (ASTM)

- ASTM A53-1982, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

- ASTM A120-1976 (1981), Welded and Seamless Steel Pipe for Ordinary Users, Specification for Black and Hot-Dipped, Zinc-Coated (Galvanized)

- ASTM A182-1982a, Forged or Rolled Alloy-Steel Pipe Flanged, Forged Fittings and Valves

- ASTM A234-1982a, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

- ASTM A312-1982, Seamless and Welded Austenitic Stainless Steel Pipe

- ASTM A403-1982a, Wrought Austenitic Stainless Steel Pipe Fittings

- ASTM E119-1983, Fire Tests of Building Construction Materials

(2) American Welding Society (AWS)

AWS D10.9-1980, Standard for Building Service Piping

(3) American Water Works Association (AWWA)

- AWWA-C104-1980, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

- AWWA-C150-1981, Standard Laying Conditions for Ductile Iron Pipe

- AWWA-C203-1978, Coal Tar Protective Coatings and Linings for Steel Water Pipelines; Enamel and Tape Hot Applied

- AWWA-C506-1978, Standard for Backflow Prevention Devices

- AWWA-C601-1981, Standard for Disinfecting Water Mains

(4) Crane Manufacturer's Association of America (CMAA), Specification No. 70

28.1.3 DOE ORDERS

(1) DOE 4320.1, Site Development and Facility Utilization Planning

(2) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(3) DOE 5480.4, Environmental Protection, Safety and Health Protection Program for DOE Operations

(4) DOE 5700.6, Quality Assurance

(5) DOE 6430.1, General Design Criteria

28.1.4 FEDERAL, STATE, AND LOCAL STANDARDS

(1) Title 10 CFR 20, Standards for Protection Against Radiation

(2) Title 29 CFR 1910, 1981 (revised), Occupational Safety and Health Administration (OSHA)

(3) Title 30 CFR 11, Respiratory Protective Devices, Tests for Permissibility

(4) Title 49 CFR 178, Department of Transportation, Shipping Container Specification Regulations

(5) Other federal, state, and local standards, permits, and licenses

28.2 SAFETY REQUIREMENTS

Special safety features for this facility are listed below.

28.2.1 SAFETY SHOWERS AND EYEWASH STATIONS

Safety showers and eyewash stations are provided in areas where personnel are exposed to chemicals, radiation, and other industrial hazards. They are connected to the potable cold water system. Drainage for these facilities is connected to the process sewer system or radioactive waste system, depending on the potential hazard of the waste solution.

28.2.2. ULTRAVIOLET PROTECTION

Curtains are provided around welding stations for eye protection from ultraviolet rays.

28.2.3 DUST

Dust-collection systems are provided for the plastics, glass, and carpentry shops.

28.2.4 SOUND

Noise levels are limited to less than 70 dbA in areas of continuous occupancy and to 85 dbA for 8-hr exposure in other personnel access areas.

28.2.5 WALKING SURFACES

Floors subject to wetting are treated with nonskid materials or otherwise constructed with nonskid materials.

28.2.6 EMERGENCY LIGHTING

Emergency standby lighting is provided to illuminate indoor exitways from facilities in case of electric power outage. Standby lighting includes yard (exterior) lighting.

28.2.7 SYSTEM OR CONTROL MALFUNCTIONS

A "fail-safe" philosophy has been adopted in the design of the facilities. Failure or malfunction of any single system or single component will not initiate a failure that can result in injury to personnel or damage to the surrounding environment.

28.2.8 FIRST AID

Facilities are provided for plant emergency and industrial first aid. Space has been provided for a heliport for emergency medical air evacuation from the facility.

28.2.9 CRANES

Cranes are accessible for inspection and maintenance.

28.2.10 CHEMICALS

Process reagents and decontamination solutions (such as acids and caustics, metal salt solutions, oxidizing solutions, and others) are stored and handled in accordance with federal, state, and local standards.

28.2.11 VENTILATION

The R&H Building is divided into ventilation zones, based on relative potential for exposure of personnel to airborne radionuclides. Exhaust systems are provided at all critical areas within the building.

28.2.12 STORAGE

Storage facilities are provided in the area of use for all reagents, chemicals, protective clothing, first-aid and safety supplies, and breathing equipment.

28.2.13 BREATHING AIR

Breathing air is differentiated by the type of connections from the plant air system and other gas systems to prevent connecting to the wrong system, and is protected from irradiated and nonirradiated contaminants.

28.2.14 GROUNDING

All buildings are grounded to a site grounding grid. All instruments are attached to a separate grounding loop that is connected at a single point to the site grounding grid.

28.2.15 VACUUM SYSTEMS

Vacuum systems serving contaminated zones are HEPA filtered before discharge. The filters are located upstream of the vacuum pump.

28.2.16 SANITATION

Sanitary facilities are provided in accordance with DOE Order 5480.1, Chapter XII, OSHA Standards, the UBC, and UPC.

28.2.17 PERSONNEL PROTECTION

Piping, vessels, and equipment have external insulation applied for the protection of personnel from injury where operating temperatures exceed 125°F. The extent of this safety insulation is a minimum of 7 ft above and 3 ft away from accessible areas.

Thermal insulation meets the requirements of NFPA 90A and is 100% asbestos-free.

Insulation has a flame spread rating not exceeding 25 when tested in accordance with ASTM E84 and fuel contributed and smoke developed under 50 when tested in accordance with ASTM E662.

Spray shields are provided over flanges and valves on pipelines conveying hazardous solutions or vapors.

Rotating machinery is provided with protective guards to meet OSHA standards.

28.3 FIRE PROTECTION

28.3.1 FIRE STATION

A fire station provides complete facilities to house firefighting equipment, paramedic/ambulance personnel and equipment, fire-protection personnel (on call), and limited combined cooking, dining, exercise, and training facilities. The main apparatus room is flanked by the remaining facilities at both ends, thus providing ready access to the firefighting apparatus from any point in the building. The apparatus is parked side-by-side in a single row, providing direct access to the exterior for each unit.

28.3.2 FIRE ALARM AND DETECTION SYSTEM

A local fire alarm system is provided for the fire station. The alarm annunciator panel is located in the dispatch room. The system includes smoke detectors, fire sensors, manual fire alarm stations, and a local and audible alarm. The dispatch room also contains the central fire alarm computer and event/recorder/printer for the plantwide fire alarm system. The fire alarm computer is UL-listed, and is connected to equipment in the redundant alarm-monitoring stations. A repeater system is located in the security building. All fire alarm systems are designed in accordance with NFPA 72A, Local Protective Signaling System; NFPA 72D, Proprietary Protective Signaling System; and NFPA 72E, Automatic Fire Detectors. All fire alarm systems and equipment are UL-listed and/or FM-approved, and are installed and located in accordance with NFPA 101, Life Safety Code. All fire alarm systems are connected to the radio dispatch room at the fire station and at the security building.

28.3.3 RADIO

A fixed-base and mobile radio system is provided to support communications between the fire station and mobile firefighting equipment personnel.

28.3.4 FIREWATER SUPPLY

Water is provided by the water filtration plant, located on the Clinch River, which serves the Oak Ridge Gaseous Diffusion Plant (ORGDP). After treatment, the water is pumped to the MRS Facility water storage tank, sized to accommodate both the facility process use and maximum credible firewater demand. The water is distributed to all facilities via an underground system. The distribution system provides sanitary process and fire-protection water for all facilities at the site. The distribution pressure is a minimum of 100 psi under normal operating conditions. The water system is looped and sectioned, with valves installed at appropriate locations to provide system reliability and flexibility. Fire hydrants are located throughout the site.

28.3.5 WET-PIPE SPRINKLER SYSTEM

An automatic wet-pipe sprinkler system is provided in buildings throughout the facility, except in electrical equipment rooms and areas protected by Halon 1301 or dry-pipe sprinkler systems. Each system is designed in accordance with NFPA 13, and is complete, including piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls.

Fire Department connections are provided for the installed sprinkler systems to have a secondary water supply.

28.3.6 DRY-PIPE SPRINKLER SYSTEM

The dry-pipe system design is similar to that of the wet-pipe system described above, except that the piping system contains air or nitrogen under pressure, the release of which permits the water pressure to open the dry-pipe valve.

28.3.7 HALON 1301 SYSTEM

Areas of high value or of high program importance (e.g., computer areas/ control rooms, electrical equipment rooms, and remote surveillance room) are provided with a total-flooding Halon 1301 system. The system consists of fixed piping manifolded racks, cylinders, detectors, circuits, alarms, and controls designed to provide detection, alarm, and extinguishment of fire in accordance with NFPA 12A.

28.3.7 DRY CHEMICAL SYSTEM

Dry chemical systems are provided in areas subject to flammable-liquid fires.

28.3.9 PORTABLE FIRE EXTINGUISHERS

Portable extinguishers are part of the site fire-protection system. Portable fire extinguishers are sized, located, and installed throughout the facility in accordance with NFPA 10.

28.3.10 BOTTLED GAS STORAGE

Fire-resistant bottled gas storage facilities, with separate compartments for flammable and oxidizing gases, are provided. Other safety features include explosionproof fixtures and outside manifolds.

28.3.11 HVAC - FIRE DAMPERS

Fire dampers and back-draft dampers are provided in ventilation ducts at appropriate locations.

28.3.12 FLAMMABLE-MATERIAL AREAS

The paint shop and solvent storage facilities are separated from other facilities. Explosionproof fixtures are used at these locations.

SECTION 29

NUCLEAR CRITICALITY AND SAFETY

Criticality is a potential problem in the MRS Facility because of the fissionable material in the spent fuel rods. The handling of these rods will be confined to the process cells and canyon cells in the R&H Building. Analysis has shown that moderator must be present in optimum amounts for a criticality event. Thus, by design, no moderator is present in these cells during normal operation. This will be ensured by using spool pieces in the decon solution lines to prevent the inadvertent introduction of decon solution into the cells. The lag storage pits are designed with curbs to supply additional protection against the entry of decon solution. Also, the spent fuel assemblies will be removed from the process cell before any decon work is attempted. As an additional safeguard, the quantity of decon liquid per batch is limited so that, if the liquid were directed into the lag storage pit with fuel assemblies present, the liquid level would be well below the fueled portion of the stored assemblies.

29.1 LAG STORAGE CRITICALITY SAFETY

The nominal configuration of spent fuel in the lag storage pits is significantly subcritical. This reactivity margin would be reduced if fuel with lower than expected burnup is stored in the pits. However, it will still be safely subcritical. Since more than two independent failures are required to introduce moderator during operation, a criticality event is not possible.

29.2 CRITICALITY DURING CONSOLIDATION

During consolidation, the fuel rod array is reconfigured from an open, square pitch to a close-packed triangular pitch. During reconfiguration, there is a change in the k_{eff} of the array; however, the nominal configurations are subcritical and there is no chance for the addition of a moderator, so criticality is not possible during consolidation.

29.3 CRITICALITY AFTER CONSOLIDATION

The consolidated fuel rods have a less reactive geometry than that of the original fuel assembly. Furthermore, the canisters are designed to maintain the consolidated fuel geometry during and after a seismic event, so the reactivity will remain low. Once the canisters are sealed, in the welding station, there will be no chance for a moderator to enter the canister, although reflection may be a problem. However, no water will be present in the shielded process cell during normal operation, so there is little chance for significant reflection and no criticality event can be expected to occur.

29.4 PROCESS CELL DECON CRITICALITY

If there is a breach in fuel-rod cladding, the process cell contamination will contain spent-fuel particulates. The high-activity decon liquids produced during cell decontamination will be sent to the high-activity radwaste cell. The liquid radwaste system component designs were analyzed for criticality safety, and were determined to be safe for all possible configurations and combinations of events.

29.5 STORAGE UNITS

The storage units for the MRS Facility have been designed to preclude any criticality incidents.

29.5.1 CONCRETE CASKS

The sealed storage casks have a greater potential for criticality than the drywells because they hold 12 canisters of intact or consolidated spent fuel (up to 36 PWR or 84 BWR assemblies worth of fuel rods). Calculations indicate that dry intact or consolidated storage configurations will remain subcritical. Because of the decay heat from the spent fuel, the temperature in the interior of the sealed storage casks will be well above the boiling point of water at atmospheric pressure. For this reason, no liquid water will be present in the cask and only small amounts of water vapor will be present in the air. The preliminary analytic results for this case indicate that the cask is safely subcritical, even with postulated flooding of one canister.

An assessment of the criticality potential for storage of high-level waste and RHTRU or nonfuel-bearing components indicates that cask storage of these wastes will always be subcritical, based on the amount of fissile material.

29.5.2 DRYWELLS

The drywell will normally be free of water. Presence of water represents an accident condition.

Past analyses of intact spent-fuel assemblies, stored individually in canisters in water-filled drywells, have shown this storage configuration to be subcritical. For the storage of consolidated spent fuel, previous analyses have shown that this geometry (consolidated rods) is less reactive than is the intact fuel assembly.

SECTION 30

RADIATION PROTECTION AND SHIELDING

The MRS Facility design provides radiation protection for its operating personnel by using As Low As Reasonably Achievable (ALARA) principles in the facility design and by the use of sufficient radiation shielding.

30.1 ALARA CONSIDERATIONS

There has been an ongoing effort to ensure that radiation exposure to MRS Facility operating personnel will be ALARA. This effort takes two forms:

(1) The Nuclear Analysis Group promoted ALARA awareness with lectures on ALARA and with the ALARA Shielding Guide (Ref. 1) to provide design principles that help designers to meet ALARA requirements.

(2) An interdisciplinary ALARA Committee reviewed the design and design concepts with the designers for each engineering discipline. The reviews focused attention on the design areas and operational procedures with the greatest potential for reducing radiation exposure. The design alternatives were explored and evaluated for the impact on ALARA and on plant cost. Both the formal ALARA Committee and the design emphasis on ALARA are ongoing efforts.

30.2 RADIATION SOURCES

The dominant radiation sources in the MRS Facility will be the spent-fuel assemblies, the high-level waste (HLW), and the high-activity waste/remote handled transuranic waste (HAW/RHTRU).

Contamination sources will originate in the process cells from the activated crud and the fuel assemblies, activated fuel assembly structural metal from the laser cutting operations, and particulate spent fuel from failed fuel rods.

There will be trace amounts of radioactive contamination in the spent-fuel transport casks.

30.2.1 SPENT-FUEL ASSEMBLY AND ACTIVATED HARDWARE SOURCES

The spent-fuel assemblies, HLW, and HAW/RHTRU will be handled in the process cells. The sources in these materials determine the shielding for the process cells; the cask loading and unloading equipment and compartments; and the storage casks and drywells. The nominal spent-fuel burnup is 33,000 megawatt days per metric ton of uranium (MWD/MTU) with 10 yr decay time. However, the facility is designed to handle spent fuel with a burnup of

55,000 MWD/MTU and 10 yr decay time. The gamma source terms for this fuel (55,000 MWD/MTU) and for the activated structural fuel assembly metal parts are given in Table 30-1 at the end of this section. These source terms were calculated with the ORIGEN-II computer program (Ref. 2).

The surface gamma dose rates and neutron emission rates for the various waste packages stored in the MRS Facility are included in Table 30-2 from the Conceptual Design Report (Ref. 3).

30.2.2 RADIOACTIVE CONTAMINATION SOURCES

The contamination sources in the process cells will be significant as they are deposited on the in-cell equipment, in the HVAC filters and in the facility decontamination (decon) systems and components.

The incoming spent-fuel assemblies will have surface deposits of crud that will be abraded from the fuel during the handling and consolidation operations. It is estimated that these operations will produce 196 grams of crud per day per cell as a fine particulate powder in the PWR cells and 210 g/day per cell in the BWR cells.

The fuel assembly thimbles will be cut with a laser beam to facilitate the disassembly before the fuel rod consolidation. It is estimated that, for PWR fuel assemblies, this operation will produce 12 g/day per cell of vaporized metal. For BWR assemblies, the estimated vaporized metal production rate is 140 g/day per cell.

It is expected that there will be failed fuel rods in the incoming spent-fuel elements with some additional fuel-rod cladding breakage during the handling and fuel-rod consolidation operations. The total failed fuel is estimated as 1% with 0.1% of that amount deposited in the hot cell, equipment, and HVAC systems. This amounts to 30 g/day per cell for PWR fuel and 20 g/day per cell for BWR fuel.

The gamma source terms per gram of crud, laser-vaporized metal, and spent-fuel fission products are given in Table 30-3 for PWR fuel assemblies. In use, these source terms would be scaled by the amount of each material that accumulated in the compartment, system, or component of interest.

30.2.3 SPENT-FUEL TRANSPORT CASK CONTAMINATION

The average contamination on a spent-fuel transport cask is 9 Ci with the composition in Part A of Table 30-4. The gamma source spectrum for 1 curie of this contamination is given in Part B of Table 30-4. This contamination will be removed in the cask decon station and will be included in the liquid radwaste system radiation sources.

30.3 <u>SHIELDING</u>

Reduction of radiation exposure is one of the major design objectives of the MRS Facility design. As such, the facility design and equipment layout have included the design considerations for operation, maintenance, and replacement to meet the ALARA design criteria in radiation exposure. Sufficient shielding is provided to permit operation without exposing personnel to unacceptable radiation levels. Remote maintenance is used as needed to reduce personnel exposure and minimize facility downtime. The spent-fuel handling consolidation and packaging are conducted in heavily shielded process cells, whereas the equipment maintenance and decon are done in adjacent, heavily shielded compartments.

30.3.1 METHOD OF ANALYSIS

The shielding analyses require radiation source distributions in both energy and space in addition to the geometry and material distribution of the models. The analysis programs are widely used and accepted in the nuclear industry.

30.3.1.A Source Terms

The radiation source terms are listed in Table 30-1 on a per-unit basis, i.e., per fuel assembly or per gram. In the shielding analysis, the number of units for a given component can be entered as a scale factor in the analysis program. For spent-fuel assemblies and associated hardware, the scale factors are readily available.

The mass accumulation of the contaminants in the process cells, on the process cell equipment, and within the HVAC system was obtained from the relative distribution rate among the components, the transfer of material between components, and the appropriate changeout rate or decon frequency. The resulting contamination burdens on hot cell components are given in Table 30-5. Within the HVAC system, the filter efficiencies and the relative distribution between the filters and the HVAC duct walls were also factored into the calculations.

The equipment and facility decon frequency and the amounts of decon fluid are given in Tables 30-6 and 30-7. This information was combined with the component contamination burdens from Table 30-5, with the dilution within the liquid radwaste system, and the concentration by the evaporator to determine the source strengths for the liquid and solid radwaste areas.

30.3.1.B Radiation Analysis

The gamma radiation shielding analyses were done by using the QAD-P5A point kernel radiation analysis program (Ref. 5). The ANISN-ORNL one-dimensional radiation transport program (Ref. 6) was used for the neutron shielding analysis, primarily in the process cells.

In these analyses, the geometries were simplified whenever possible with compensating conservatism. This approach was used only where the simplification did not have an adverse impact on the results.

30.3.2 RADIATION ZONING

The radiation zoning followed the suggested zoning in the ALARA reduction document DOE/EV 1830-T5 (Ref. 7). The radiation zoning for the MRS Facility is given in Table 30-8. (For plans and sections depicting ALARA area radiation zoning designations, see Figures 30-1 through 30-6.)

30.3.3 SHIELDING DESIGN

The MRS Facility consists of a three-story building with a first-floor mezzanine and a second-floor mezzanine. The shielding discussions will consider the facility on a floor-by-floor basis.

30.3.3.A Ground-Level Shielding

The first level is a ground level and includes the vehicle receipt and washdown areas, the cask loading and unloading areas, the liquid radwaste area, the solid radwaste area, and the equipment maintenance areas.

(1) Vehicle Receipt and Washdown Area

The vehicle washdown water may or may not contain radioactive contamination. It is expected that some of the shipments will have low-level contamination. The washdown water in those cases will be a liquid radwaste source, but will not require shielding because of the low level of contamination. Low-level contamination is defined for this application as radioactive contamination that produces less than 10 mrem/hr contact dose rate.

(2) Cask Unloading Areas

The spent-fuel assemblies will arrive in any of a number of shipping casks with varying dimensions. This makes the design of a shielded cask/facility mating fixture quite difficult. The cask unloading area walls are 5 ft-6 in. of concrete where they are continuations of the process cell outer walls, and are 4 ft of concrete between the unloading cells. The cell doors are 3 ft-6 in. of concrete.

(3) Cask Loadout Areas

The cask loadout area walls have the same dimensions as the unloading station, with 5 ft-6 in. concrete walls extended from the second-floor process cells, and 4 ft of concrete between the loadout areas. The doors are equivalent to 1 ft-6 in. of concrete shielding.

(4) Liquid Radwaste Area

The radiation sources in the liquid radwaste area will come from the decon operations summarized in Tables 30-6 and 30-7. These are handled on a case-by-case basis to determine the radiation source strength, dilution in decon solution, and then the source geometrics. The high-activity decon liquids containing the greatest amount of radioactive contaminants will be collected in a holding tank in the high-activity radwaste cell. This liquid will be batch-processed through an evaporator, with the evaporator bottoms being mixed with concrete in a drum and disposed of as high-activity waste. The low-activity decon liquids will go to a separate holding tank, where they will be processed in the same manner as the high-activity liquid.

(a) High-Activity Liquid (HAL) Radwaste

The HAL evaporator will reduce the HAL waste volume by about 234:1. The HAL waste system components are located in a shielded cell that has 3-ft-thick concrete walls and in which all tasks are done remotely.

(b) Low-Activity Liquid (LAL) Radwaste

The LAL evaporator will reduce the LAL waste volume by about 63:1. The LAL waste system components do not need shielding and can be contact handled. The LAL comes from such operations as cask decon and contaminated laundry washing.

(5) Low-Level Solid Radwaste Area

The low-level radwaste is received in this area and mixed with concrete in 55-gal drums. The low-level waste will include CHTRU, such as the second- and third-stage HEPA filters, and includes the evaporator bottoms slurry from the low-level decon liquid in the liquid radwaste area. The components in this area will require little or no shielding.

(6) Equipment Maintenance Areas

These areas include the remote handled equipment maintenance room, the contact handled equipment maintenance room, and the glove-box repair room.

The remote handled equipment maintenance room wall shielding requirements are determined by the radiation sources in the contaminated hot cell equipment. This is 4 ft of concrete shielding. Some of the walls are continuations of the process cell walls, and are 5 ft-6 in. of concrete. The maintenance cell ceiling is determined by the process cell requirements, and is 5 ft-6 in. of concrete.

The contact handled equipment maintenance room wall thicknesses are determined by the remote handled maintenance room requirements, and are 4 ft of concrete. The ceiling thickness is determined by the process cell floor thickness, and is 5 ft-6 in. of concrete.

30.3.3.B First Floor Mezzanine Shielding

The shielded areas at this level are extensions of the ground-level shielded areas.

30.3.3.C Second Level Shielding

The hot cells and their associated canister welding stations are the principal shielded areas on the second level. The shielding requirements are 5 ft-6 in. of concrete.

The canister welding stations occupy a corner of the canyon cells and, as the name implies, contain equipment to weld the lid onto the consolidated fuel canisters. The walls between the welding stations and the canyon cells are 18 in. of concrete and 6 in. of steel. The outside wall of the welding station is 2 ft-6 in. of concrete, as is the roof.

30.3.3.D Second Floor Mezzanine Shielding

The second floor mezzanine level contains the upper parts of the hot cells and the crane maintenance rooms at the upper ends of the hot cells.

The crane maintenance rooms extend past the hot cells. The shielding requirements are 4 ft of concrete for the walls and the roof. The door between the maintenance cells and the hot cells is 15 in. of steel and 12 in. of borated polyethylene.

30.3.3.E Third Level Shielding

The remote handling air filtration cells are the only area on the third floor that requires shielding. The radiation sources are those in the first-stage HEPA filters. The shielding requirements are 3 ft of concrete.

30.3.3.F Penetration Shielding

The shielding penetrations have been designed to incorporate steps or doglegs to eliminate any direct line-of-sight paths through the shields. As the design evolves, the specific geometrics will be analyzed to better define the shielding requirements.

30.3.3.G Shielding Uncertainties

The largest uncertainties associated with the shielding analysis are in defining the radioactive contamination sources in the HVAC filters, on the hot cell equipment, and in the liquid radwaste system. This comes from a lack of data on the magnitudes of the contamination and its probable distribution. The analysis to date has shown that the crud sources are dominant in most areas, thus reducing the relative impact of the uncertainties in the magnitude of laser-vaporized metal sources and the spent-fuel fission production sources.

The behaviors of the laser-vaporized metal and, specifically, how tightly it adheres to other surfaces can have a major impact in decontaminating both facilities and equipment.

The radiation sources in the spent-fuel assemblies and in the associated, activated hardware are known reasonably well and the remaining uncertainty would have only a minor impact on the shielding.

30.3.4 STORAGE UNITS

Radiation protection for workers and the general public is provided by each of the storage units. The two storage casks use the concrete and steel (concrete casks) or the steel, lead, and water jacket (transportable casks) surrounding the stored waste containers to attenuate radiation to acceptable levels. The drywell uses the surrounding soil and the steel and concrete provided above the waste containers to attenuate radiation.

For each storage unit, the presence of radiation-protection materials is ensured under normal and accident conditions by design measures. For the concrete casks, the concrete surrounding the sides and below the waste containers is cast in place and held together by reinforcing rod. The steel and concrete shield plug above the waste is removable, and is held in place by the seal-welded cask cover. The cask is designed to take drop loads (from its own drop or from tornado missile loads) and to maintain radiation protection. For the transportable storage casks, the lead and water-jacket shielding materials are enclosed in steel-lined compartments. Loss of water from missile impact can be remedied by repair and replacement of the water, using temporary shielding, or the cask can be emptied and replaced. For drywells, a reinforced concrete pad at the ground surface and the grout layer around the liner prevent gross soil erosion around the liner and liner axial lifting under flood conditions. The steel shield plug above the waste containers is seated in the liner and held in place by the seal-welded drywell cover.

Penetrations through the shielding materials are designed to limit radiation streaming. Instrumentation tubes and gas sampling tubes have 90-deg bends with bend radii sufficient to avoid constricting the gas flow.

30.3.5 TRANSPORTATION

The two casks use their integral shielding material to provide radiation protection during waste container transfer to the storage facility. The drywells make use of specially designed transfer shields to transport the waste containers to the storage facility. The transfer shields are designed to ensure that radiation protection is provided during waste container loading, transport, waste container emplacement, and shield plug emplacement in the drywells. The shielding materials (lead and Bisco NS-3) are contained in steel-lined compartments. The movable shield doors, provided to allow top loading and bottom unloading of the shield, have electrical interlocks to prevent inadvertent opening or closing. These also have mechanical override features to allow manual actuation in case of electrical power loss. The winch and grapple for the shield also have electrical interlocks and manual actuation features to prevent inadvertent container waste release or to allow transfer shield movement with the drywell or transfer shield in an unsafe configuration.

30.4 HEALTH PHYSICS

The health physics functions in the MRS Facility include monitoring and recording personnel radiation exposure; monitoring for personnel radioactive contamination; routine monitoring of facilities radiation levels and level trends; and routine monitoring for the spread of radioactive contamination in the facility. This will include monitoring to evaluate and reduce the environmental impact of the MRS Facility. The duties of health physics personnel include applying correcting actions to maintain personnel exposure at acceptable levels and overseeing both personnel and facilities decontamination.

The health physics offices and supply room on the first level provide a base of operations and supplies. The analytical laboratory facility provides the analytic equipment necessary for data measurement and recording.

The plant layout is designed to restrict and contain radioactive contamination. This is done with the HVAC system, regulating the air flow from decon areas to contaminated areas, and by maintaining the hot cell air pressure below local ambient. The equipment flow is regulated by placing contingent areas between contaminated areas. These contingent areas are provided with radiation monitors to detect contaminants and with personnel and facility decon facilities for cleanup.

Area radiation monitors will track radiation levels in the facility; process samples will provide information on radiation sources in the system. Swipes will be used to determine area contamination, and personnel radiation badges will record personnel radiation exposure.

30.5 RADIOLOGICAL ACCIDENTS

A number of accidents in the MRS Facility (Ref. 8) were reviewed. Table 30-9 lists the accidents with radiological consequences after preventive measures were taken. These accidents are classified as either minor or major.

Subsequently, a list of equipment malfunctions was received from WEC. These were reviewed and are included in Table 30-9, Part C. Not all of these malfunctions have potential radiological consequences.

30.5.1 MAJOR ACCIDENTS

The major accidents (Part A of Table 30-9) all occur in the shielded process, shielded canyon, and maintenance cells. The accident with a dropped fuel assembly in the cask handling and unloading area is included because the cask will not be opened and fuel assemblies engaged until after the cask is mated to the hot cell.

30.5.1.A. Spent-Fuel Spillage

The accidents involving dropped fuel assemblies are grouped with the consolidation equipment malfunction with respect to severity. In all cases, it is assumed that the noble gas burden in one fuel assembly is released.

The spillage of spent fuel and activated structural metal, including cladding, contributes to contamination in the hot cell, but is assumed to be contained safely. No criticality problems are possible.

30.5.1.B. Cloth/Paper Fire, Zirconium Fire

Zirconium would come from the laser cutting machines. The fires would redistribute contamination in the cell, but no cell breach is postulated and the contamination would be contained. The fire could destroy a filter and contaminate the HEPA filters. Again, the contamination would be contained.

30.5.1.C. Cell Penetration Breach

This would result in a beam of high-intensity radiation through the breach. Analysis shows a dose rate of about 4,000 Rem/hr at 4 ft from a single fuel assembly. The radiation level should not exceed this. Only if there is an HVAC shutdown would there be any chance of contamination spreading through the breach.

30.5.2 MINOR ACCIDENTS

30.5.2.A. Cask Gas Release

This accident in the loadout and decon area would release fission product gas to the plant HVAC system. An upper-limit release is estimated as about 10% of the total in one fuel assembly. There could also be some local contamination.

30.5.2.B. Contamination

With one exception, the balance of the minor accidents would result in local contamination. These would need to be cleaned up, but should be contained in the plant. The exception, surface water in a drywell, has been determined to be criticality safe.

30.5.3 EQUIPMENT MALFUNCTIONS

There is some redundancy in these malfunctions as compared to those in Parts A and B of Table 30-9.

30.5.3.A. Spent-Fuel Spillage

For the cask impulse loads (Items 15 and 16), the cask will remain intact and any fuel rod damage will be contained. The noble gas released will be vented to the MRS Facility HVAC system when the cask is opened for inspection. The other events that involve cladding breach, FP release, and FP gas release occur in the hot cell. In these cases, the noble gas released will not exceed the burden in one fuel assembly. The spillage of spent fuel and activated structural materials will contribute to contamination in the hot cell, but will be safely contained. No criticality problems are possible.

30.5.3.B. Contamination Barrier Failure

The contamination barrier is part of the equipment mating the incoming transport cask to the hot cell unloading ports. A failure (Item 17) could result in contamination spreading to the cask unloading area. It would be somewhat mitigated by the air flow through the breach into the hot cell. Local cleanup would be needed.

30.5.3.C. Load Drop in Hot Cell

Item 18 addresses a drop of a suspended load, such as a shipping cask cover, intake port cover, lag storage port cover, or maintenance hatch cover. These items will be lifted to clear the associated component and stored adjacent to the part or pit. There could be mechanical damage, but no radiation release is expected.

30.5.3.D. Welding Equipment - Canister Rotation Malfunction

This equipment rotates the canister end-for-end from the loading station to the welding station. A malfunction (Item 23) could result in a process delay, but no radiological consequences are expected.

30.5.3.E. Secondary Waste Drum Equipment or Shredder Malfunction

These events (Items 25 through 28) take place in the process cell or adjacent decon cell. They could involve spillage of activated structural metal scrap. This occurs in heavily shielded areas that will contain the contamination from normal operation as well as from any of these items.

30.5.4 RADIOLOGICAL CONSEQUENCES

The majority of these events result in contamination that is confined to heavily shielded areas, such as the hot cell, with no radiological impact. Some events will result in local contamination that will be confined to the facility and cleaned up with a small impact.

The noble gases released from fuel rod ruptures will be exhausted from the plant stack, and can spread beyond the facility boundary. The dose at the site boundary from the release of the Kr-85 in one PWR spent-fuel assembly has been calculated (Ref. 9) as about 4 x 10^{-4} Rem. Because this is three decades lower than the 0.5-Rem dose limit specified in DOE Order 5480.1A, Chapter XI, Attachment I for unlikely events (Ref. 11), it presents no significant radiological hazard. The release of any credible fraction of the Kr-85 in a transport cask, resulting from Events 15 and 16 in Table 30-9, would also be several decades below the 0.5-Rem dose limit.

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9. Silveria, D.J., to Jackson, D.D., "MRS Accident Dose Calculations for AF," PNL Memo DJS: 197-84, Dec. 17, 1984.

10. Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation, 10 CFR 72.

11. DOE Order 5480.1A, Chapter XI, "Environmental Protection, Safety, and Health Protection Program for DOE Operations," Aug. 13, 1981.

Table 30-1 - PWR Spent Fuel Assembly
Gamma Source Terms[a]

Group		Gamma Source Spectrum (γ/sec - Assembly)		
No.	Mean Energy $\bar{E}$ (MeV)	Spent Fuel[b]	Skeleton[c]	Hull[d]
1	0.05	2.085 E+15[e]	3.891 + 11	2.683 + 12
2	0.0575	2.798 E+14	3.116 + 11	3.626 + 10
3	0.085	1.680 E+14	1.226 + 11	1.506 + 10
4	0.125	1.706 E+14	4.813 + 10	1.629 + 10
5	0.225	1.373 E+14	3.125 + 10	1.602 + 11
6	0.375	6.445 E+13	9.825 + 10	9.454 + 11
7	0.575	2.526 E+15	1.210 + 10	1.215 + 12
8	0.850	2.514 E+14	7.228 + 10	4.077 + 09
9	1.250	2.392 E+14	1.049 + 14	7.283 + 12
10	1.750	2.820 E+12	5.507 + 02	5.536 + 03
11	2.250	3.747 E+10	5.562 + 08	3.860 + 07
12	2.750	3.071 E+09	1.721 + 06	1.194 + 05
13	3.500	3.834 E+08		
14	5.000	1.875 E+07		
15	7.000	2.162 E+06		
16	10.00	2.947 E+05		

[a] 55,000 MWD/MTU exposure, 10 yr decay.
[b] Initial uranium loading 0.462 MT/assembly.
[c] 26.5 kg/assembly.
[d] 100.5 kg/assembly.
[e] For 2.085 + 15 read 2.085 x 10^{15}.

Table 30-2 - Heat Generation and Radiation Intensity of Packages Stored at an MRS Facility

Package	Gamma Surface Dose Rate (R/hr)	Neutron Emission Rate (n/sec)	Heat Generation (W)
PWR assembly[a]	2×10^4	2×10^8	550
Consolidated PWR (2:1)	5×10^4	4×10^8	1,100
BWR assembly[b]	1×10^4	1×10^8	180
Consolidated BWR (5:1)	5×10^4	4×10^8	900
HLW canister (1' d x 10' to 15' 1)[c]	1×10^5	5×10^8	2,200 to 3,300[d]
HLW canister[e] (2.5' d x 15' 1)	1×10^5	1×10^9	f
Hulls canister[g]	1×10^3	5×10^6	---
Hardware canister[h]	3×10^4	---	---
Base case HLW canister[i]	3×10^3	TBD	220

[a] 0.462 MT initial U; 33,000 MWD/MTU; 10 yr out of reactor.

[b] 0.186 MT initial U; 28,000 MWD/MTU; 10 yr out of reactor.

[c] 2.28 MT initial U processed (60% PWR - 40% BWR); 10 yr out of reactor.

[d] Based on a heat-generation rate of 220 W per foot of length.

[e] 12.77 MT initial U processed (60% PWR - 40% BWR); 10 yr out of reactor.

[f] Storage concept limited. To be determined by design for each storage concept.

[g] Hulls from 4.4 MTU, 0.5% loss; 10 yr out of reactor.

[h] Hardware from 10.7 MTU; 10 yr out of reactor.

[i] HLW in vitrified glass logs; 3×10^3 R/hr is the maximum surface dose rate accepted at the MRS Facility.

Table 30-3 - Gamma Radiation Source Terms in Crud, Laser-Vaporized Metal, and Spent Fuel

Group		Gamma Source Term (γ /sec gram)		
No.	Mean Energy $\bar{E}$ (MeV)	Crud	Laser-Vaporized Metal	Spent Fuel Fission Products
1	0.05		1.114 + 6	1.040 + 8
2	0.0575		8.915 + 4	3.190 + 7
3	0.085		3.519 + 4	1.769 + 6
4	0.125		1.328 + 4	1.475 + 6
5	0.225		8.944 + 3	1.169 + 6
6	0.375		2.812 + 4	7.332 + 4
7	0.575		3.46 + 4	2.030 + 3
8	0.85	2.031 + 4	2.07 + 4	2.882 + 3
9	1.25	8.956 + 7	2.991 + 7	1.170 + 3
10	1.75		1.528 - 4	3.901 + 2
11	2.25		1.592 + 2	1.716 + 2
12	2.75		4.927 - 1	9.397 + 2
13	3.5			8.914 + 1

Table 30-4 - Transport Cask Contamination

A. Composition

Radionuclide	Fractional Activity
Co-60	1.09E-4
Ni-63	1.28E-4
Sr-90	2.38E-1
Tc-99	1.80E-4
Ru-106	4.82E-4
Sb-125	6.04E-3
Te-125m	1.45E-3
I-129	9.35E-6
Cs-134	2.70E-2
Cs-137	7.26E-1
C3-144	4.32E-4
U-235	1.04E-8
U-238	6.28E-8
Pu-238	2.59E-8
Pu-239	2.35E-5
Pu-240	5.91E-6
Pu-241	3.89E-4
Am-241	2.34E-6

B. Gamma Source Terms per Curie Activity

Group No.	Mean Energy $\bar{E}$ (MeV)	Source Term (γ/sec)
1	0.05	1.30 + 10
2	0.0575	1.51 + 9
3	0.85	8.71 + 8
4	0.125	5.47 + 8
5	0.225	6.91 + 8
6	0.375	3.53 + 8
7	0.575	2.76 + 10
8	0.85	8.94 + 8
9	1.25	7.88 + 7
10	1.75	1.19 + 6
11	2.52	1.37 + 5
12	2.75	3.71 + 3
13	3.5	4.72 + 2

Table 30-5 - Hot Cell Component Contamination

Component	Contaminant	Decon Frequency	Buildup Rate 1 BWR Cell (g/day)	Buildup Rate 1 PWR Cell (g/day)	Decon Load BWR (g)	Decon Load PWR (g)
Process cell surfaces	Crud	5 yr	6.9	6.5	12,592.5	11,862.5
	LM[a]	5 yr	23.24	1.0	42,413.0	1,825.0
	FP[b]	5 yr	4.0	6.0	7,300.0	10,950.0
Consolidation equipment	Crud	1 yr	21.0	19.6	7,665.0	7,154.0
	LM	1 yr	9.24	0.4	3,372.6	146.0
	FP	1 yr	0.74	1.11	270.1	405.2
Consolidation equipment filter[c]	Crud	1 mo	152.8	142.6	4,584.0	4,278.0
	LM	1 mo	14.0	0.6	420.0	18.0
	FP	1 mo	6.23	9.34	186.9	280.2
Laser-cutting equipment	Crud	1 yr	1.8	1.7	657.0	620.5
	LM	1 yr	70.0	3.0	25,550.0	1,095.0
	FP	1 yr	1.0	1.5	365.0	547.5
Other equipment[d]	Crud	1 yr	3.6	3.3	1,314.0	1,204.5
	LM	1 yr	23.52	1.0	8,584.8	365.0
	FP	1 yr	2.0	3.0	730.0	1,095.0

[a]LM = laser-vaporized metal.
[b]FP = spent-fuel fission products.
[c]80% of crud retained on consolidation equipment filter.
[d]Five major components, total. The components are the clamping module, robot, fuel grapple, horizontal gripper module, and vertical gripper module.

Table 30-6 - Decontamination of High-Activity Radiation Areas and Equipment

Radiation Area	Frequency[a]	Technique	Liquid Application Rate	Area (sq ft)
Process cells	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	15,192
Maintenance cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	38,352
High-activity radwaste cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	7,392
Remote equipment decontaminating room	All surfaces: semiannually	Remote: high-pressure rinse. Contact: as required.	1.0 gal/sq ft	1,760
Remote handling air filtration cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	51,213
Filter compaction area of remote handling air filtration cell	All surfaces: annually	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	1,680
Crane maintenance room	All surfaces: annually	Contact: dry vacuum, foam, wet vacuum, high-pressure rinse.	0.5 gal/sq ft	60,048 (13 rooms)
Process cell ventilation ducts between nontestable and testable HEPA filters	Internal surfaces: 5 yr	Remote: self-propelled spray hose.	1.0 gal/sq ft	8,550
Drum decontaminating cells	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft	Each cell different size

[a]Actual decontamination will be on an as-required basis. Frequencies given are for calculation purposes only.

Table 30-6 (Contd)

Radiation Area	Frequency[a]	Technique	Liquid Application Rate	Area (sq ft)
Canyon cell	All surfaces: 5 yr	1. Floor near canister upender equipment: Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft	6,020
		2. Other surfaces: Contact: vacuum, mop, and rinse.	1.0 gal/100 sq ft	54,452
Cranes (in crane maintenance cells)	All surfaces: monthly	Contact: mops, rags, high-pressure rinse.	60 gal/decon	
Crane hooks and power mast wrist	All surfaces: monthly	Remote: high-pressure rinse.	10 gal/decon	
Compaction equipment in remote air filtration cell	Annually	Remote: high-pressure rinse. Contact: electro-polisher, as required.	1 gal/sq ft	500
Sealed storage canisters	3,253 canisters/yr	Remote: Freon.[b]	-	
In-cell equipment components	Every 2 wk	Remote: high-pressure rinse, electropolisher, or Freon spray, as required.	1 gal/sq ft	Each component different size
Secondary waste drums	1,582 drums/yr	Remote: Freon.[b]	-	
HAW filter drums	676 drums/yr	Remote: Freon.[b]	-	
Solid radwaste drums (assume 50% contaminated)	17 drums/yr	Remote: high-pressure rinse.	20 gal/drum	
Manipulators (70, once every 2 wk)	1,820 decons/yr	Remote: Freon.[b]	-	
Tool decontamination	As needed	Remote: Freon or electropolisher, as required.	-	

[b]Water-soluble contaminants are not expected.

Table 30-7 - Decontamination of Low-Level Radiation Areas and Equipment

Radiation Area	Frequency[a]	Technique	Liquid Application Rate	Area (sq ft)
Cask handling and decon	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	21,424
Loadout and decon rooms	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	13,524
Contact repair room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	5,800
Weld, test, and decon equipment room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	9,956
Low-level radwaste (solid and liquid)	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	41,796
Decon rooms (contact handled)	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	All rooms different sizes
Laundry room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	2,236
Analyzer room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	1,100
Analytical laboratory	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft	5,524
Equipment				
Solid radwaste drums (assume 50% contaminated)	267 drums/yr	High-pressure rinse	20 gal/drum	
Remote air filtration cell crane	Monthly	Mop and rinse	60 gal/decon	
Shipping casks	680 casks/yr (30%)	Wipe and rinse	4 gal/cask	

Table 30-8 - MRS Facility Radiation Zones

Room No.	Operation Description	Area Radiation Zoning Designation[a]	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	1. GROUND LEVEL			
1001 to 1037	Administration Area	1	0.125	40
1038	Health physics supervisor's office	2	0.125	40
1039	Health physics storage room	2	0.125	40
1040	Health physics ready room	2	0.125	40
1041	Personnel decon room	3	0.25	30
1042	Health physics dosimetry room	2	0.125	40
1043	Corridor (ACV)	2	0.125	40
1044	Low-level analytical laboratory	3	0.25	30
1045	Analytical room	3	0.25	30
1046	ACV	2	0.125	40
1047	Storage	2	0.125	40
1048	High-level analytical laboratory	3	0.25	30
1049	Analyzer room	3	0.25	30
1050	ACV	2	0.125	40
1051	Personnel corridor	2	0.125	40
1052	ACV	1	0.125	40
1053	Materials receiving and storage room	1	0.125	40
1054	Instrumentation I/O room	1	0.125	40
1055	ACV	2	0.125	40
1056	Laundry	3	0.25	30
1057	Laundry equipment room	3	0.25	30
1058	Corridor	2	0.125	40
1059	Decontamination room	4	0.75	20
1060	ACV	2	0.125	40
1061	Clean laundry storage	2	0.125	40
1062	Soiled laundry storage	3	0.25	30
1063	Low-level liquid radwaste	3	0.25	30
1064	Solid radwaste	3	0.25	30
1065	Drum inspection and decon room	3	0.25	30
1066	Solid radwaste maintenace	3	0.25	30
1067	ACV	2	0.125	40

[a]Zones
1: Uncontrolled area
2: Contingent area
3: General operation and laboratory
4: Process operation area
5: Intermittent operation area
6: Remote operation area
7: Isolation area

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	1. GROUND LEVEL (Contd)			
1068	Receiving and dispatch room	2	0.125	40
1069	ACV	2	0.125	40
1070	Drum curing room	3	0.25	30
1071	Filled drum storage	3	0.25	30
1072	Corridor	2	0.125	40
1073	Waste collection storage	3	0.25	30
1074	ACV	2	0.125	40
1075	Corridor	2	0.125	40
1076	ACV	2	0.125	40
1077	Electrical equipment room	2	0.125	40
1078	Corridor	2	0.125	40
1079	Incoming ACV (receipt and washdown area)	4	0.75	20
1080	Receiving, inspection, and shipping area	4	0.75	20
1081	Outgoing ACV (vehicle exit area)	2	0.125	40
1082	Exit corridor	2	0.125	40
1083	ACV	2	0.125	40
1084	Cask handling, preparation, and decon room	4	0.75	20
1085	Cask unloading room	4, 7[a]	0.75	20
1086	Cask unloading room	4, 7[a]	0.75	20
1087	Clean drum storage	2	0.125	40
1088	Equipment storage room	2	0.125	40
1089	Clean drum transfer station	2, 7[b]	0.125	40
1090	Cask handling, preparation, and decon room	4	0.75	20
1091	Cask unloading room	4, 7[a]	0.75	20
1092	Cask unloading room	4, 7[a]	0.75	20
1093	Clean drum storage	2	0.125	40
1094	Electrical equipment room	2	0.125	40
1095	Operating corridor	2	0.125	40
1096	Clean canister storage	2	0.125	40
1097	Clean canister transfer room	2, 7[b]	0.125	40
1098	Access corridor	2	0.125	40

[a]Zone 4 except during cask loading or unloading; then isolation area.

[b]Zone 2 except during drum or canister transfer; then isolation area.

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	1. GROUND LEVEL (Contd)			
1099	Contact handled equipment maintenance room	5	2.5	30
1100	Health physics storage room	3	0.25	30
1101	Air lock	4	0.75	20
1102	Clean canister transfer room	2, 7[b]	0.125	40
1103	Clean canister storage	2	0.125	40
1104	Decon room	6	10	2
1105	Remote handled equipment maintenance room	7	-	-
1106	Operating corridor	2	0.125	40
1107	Electrical equipment room	2	0.125	40
1108	Lag storage sump pump room	2	0.125	40
1109	Storage	2	0.125	40
1110	Lag storage sump station	2	0.125	40
1111	Drum transfer corridor	7	-	-
1112	Clean drum intro. vest.	3	0.25	30
1113	High-activity radwaste cell	7	-	-
1114	Maintenance decon	5	2.5	10
1115	Operated area	2	0.125	40
1116	Contact maintenance room	5	2.5	10
1117	Air lock	4	0.75	20
1118	Health physics storage room	3	0.25	30
1119	Operating room	2	0.125	40
1120	Hands-on operating room	2	0.125	40
1121	ACV	2	0.125	40
1122	Chemical storage	2	0.125	40
1123	Access corridor	2	0.125	40
1124	Exit corridor	2	0.125	40
1125	Shipping cask transfer room	4	0.75	20
1126	Battery room	2	0.125	40
1127	Electrical room	2	0.125	40
1128	UPS room	2	0.125	40
1129	Corridor	2	0.125	40
1130	Shipping cask lidding room	4	0.75	20
1131	Corridor	2	0.125	40

[b]Zone 2 except during drum or canister transfer; then isolation area.

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	1. GROUND LEVEL (Contd)			
1132	Storage	2	0.125	40
1133	Shipping cask loadout room	4, 7[a]	0.75	20
1134	Storage room	2	0.125	40
1135	Transfer/discharge corridor	4	0.75	20
1136	Loadout and decon room	4, 7[a]	0.75	20
1137	Clean drum/canister transfer station	2, 7[b]	0.125	40
1138	Clean drum/canister storage	2	0.125	40
1139	Corridor	2	0.125	40
1140	ACV	2	0.125	40
1141	Transfer/discharge corridor	4	0.75	20
1142	Loadout and decon room	4, 7[a]	0.75	20
1143	Clean drum/canister transfer storage	2	0.125	40
1144	Clean drum/[illegible]er transfer station	2, 7[b]	0.125	40
1145	Storage	2	0.125	40
1146	Shipping lo[illegible]out room	4, 7[a]	0.75	20
1147	Storage room	2	0.125	40
1148	Corridor	2	0.125	40
1149	Electrical room	2	0.125	40
1150	Battery room	2	0.125	40
1151	UPS room	2	0.125	40
1152	Shipping cask transfer room	4	0.75	20
1153	Shipping cask loading room	4	0.75	20
1154	Corridor	2	0.125	40
1155	Compressor room	2	0.125	40
1156	Weld/test and decon equipment room	2	0.125	40
1157	Aqueous and chemical decon makeup	2	0.125	40
1158	Cold maintenance office	2	0.125	40
1159	Cold maintenance office	2	0.125	40
1160	Cold maintenance room	2	0.125	40
1161	ACV	2	0.125	40
1162	Cask handling, preparation, and decon room	4	0.75	20

[a]Zone 4 except during cask loading or unloading; then isolation area.

[b]Zone 2 except during drum or canister transfer; then isolation area.

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	1. GROUND LEVEL (Contd)			
1163	Cask unloading room	4, 7[a]	0.75	20
1164	Cask unloading room	4, 7[a]	0.75	20
1165	Clean drum storage	2	0.125	40
1166	Operating corridor	2	0.125	40
1167	Clean drum transfer room	2, 7[b]	0.125	40
1168	Equipment storage room	2	0.125	40
1169	Clean drum storage	2	0.125	40
1170	Cask unloading room	4, 7[a]	0.75	20
1171	Cask unloading room	4, 7[a]	0.75	20
1172	Cask handling, preparation, and decon room	4	0.75	20
1173	ACV	2	0.125	40
1174	Chiller equipment room	2	0.125	40
1175	Exit corridor	2	0.125	40
1176	Argon storage room	2	0.125	40
1177	Helium manifold	2	0.125	40
1178	Nitrogen manifold	2	0.125	40
1179	Incoming ACV (receipt and washdown area)	4	0.75	20
1180	Receiving, inspection, and shipping area	4	0.75	20
1181	Exit corridor	2	0.125	40
1182	Outgoing ACV (vehicle exit area)	2	0.125	40
	2. FIRST MEZZANINE LEVEL			
M-101	Elevator lobby	2	0.125	40
M-102	ACV	2	0.125	40
M-103	Freight corridor	2	0.125	40
M-104	Laundry filter room	3	0.25	30
M-105	Unassigned space	2	0.125	40
M-106	Corridor	2	0.125	40
M-107	Filter room	2	0.125	40
M-108	Corridor	2	0.125	40
M-109	Equipment storage room	2	0.125	40
M-110	Crane maintenance room	5	2.5	10
M-111	Air lock	4	0.75	20

[a]Zone 4 except during cask loading or unloading; then isolation area.

[b]Zone 2 except during drum or canister transfer; then isolation area.

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	2. FIRST MEZZANINE LEVEL (Contd)			
M-112	Health physics storage room	3	0.25	30
M-113	Electrical equipment room	2	0.125	40
M-114	Corridor	2	0.125	40
M-115	Valve/filter gallery	2	0.125	40
M-116	Mechanical equipment room	2	0.125	40
M-117	ACV	2	0.125	40
M-118	Access room	2	0.125	40
M-119	Filter room	2	0.125	40
M-120	Equipment storage room	2	0.125	40
M-121	Crane maintenance room	5	2.5	10
M-122	Air lock	4	0.75	20
M-123	Health physics storage room	3	0.25	30
M-124	Filter room	2	0.125	40
M-125	Corridor	2	0.125	40
M-126	Filter room	2	0.125	40
M-127	Analytical laboratory filter room	3	0.25	30
	3. SECOND LEVEL			
2001	Elevator lobby	2	0.125	40
2002	ACV	2	0.125	40
2003	Storage room	2	0.125	40
2004	Control room	2	0.125	40
2005	Storage room	2	0.125	40
2006	Supervisor's office	2	0.125	40
2007	Storage room	2	0.125	40
2008	Supply fan room	2	0.125	40
2009	Mechanical equipment penthouse	2	0.125	40
2010	Mechanical equipment room	2	0.125	40
2011	Operating gallery	2	0.125	40
2012	Health physics storage room	3	0.25	30
2013	Air lock	4	0.75	20
2014	Clean drum intro. room	7	-	-
2015	Shielded Process Cell No. 1	7	-	-
2016	Decon cell	7	-	-
2017	Shielded Process Cell No. 3	7	-	-
2018	Operating gallery	2	0.125	40
2019	Welding station	5	2.5	10
2020	Health physics storage room	3	0.25	30
2021	Air lock	4	0.75	20
2022	Welding station	5	2.5	10

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	3. SECOND LEVEL (Contd)			
2023	Shielded Canyon Cell No. 6	7	-	-
2024	Shielded Canyon Cell No. 5	7	-	-
2025	Operating gallery	2	0.125	40
2026	ACV	2	0.125	40
2027	Operating gallery	2	0.125	40
2028	Access corridor	2	0.125	40
2029	Exhaust filter room	2	0.125	40
2030	Exhaust filter room	2	0.125	40
2031	Access corridor	2	0.125	40
2032	Electrical equipment room	2	0.125	40
2033	ACV	2	0.125	40
2034	Operating gallery	2	0.125	40
2035	Health physics storage room	3	0.25	30
2036	Air lock	4	0.75	20
2037	ACV	2	0.125	40
2038	Electrical equipment room	2	0.125	40
2039	Access corridor	2	0.125	40
2040	Operating gallery	2	0.125	40
2041	Welding station	5	2.5	10
2042	Exhaust filter room	2	0.125	40
2043	Exhaust filter room	2	0.125	40
2044	Access corridor	2	0.125	40
2045	Operating gallery	2	0.125	40
2046	Operating gallery	2	0.125	40
2047	Health physics storage room	3	0.25	30
2048	Air lock	4	0.75	20
2049	Clean drum intro. room	7	-	-
2050	Shielded Process Cell No. 4	7	-	-
2051	Decon cell	7	-	-
2052	Shielded Process Cell No. 2	7	-	-
2053	Mechanical equipment room	2	0.125	40
2054	Supply fan room	2	0.125	40
2055	Mechanical equipment penthouse	2	0.125	40
2056	Mechanical equipment room	2	0.125	40
2057	Mechanical equipment penthouse	2	0.125	40
2058	Mechanical equipment penthouse	2	0.125	40
2059	Mechanical equipment room	2	0.125	40

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	4. SECOND MEZZANINE LEVEL			
M-201	Elevator lobby	2	0.125	40
M-202	ACV	2	0.125	40
M-203	Freight corridor	2	0.125	40
M-204	Health physics storage room	3	0.25	30
M-205	Air lock	4	0.75	20
M-206	Crane maintenance room	5	2.5	10
M-207	Crane maintenance room	5	2.5	10
M-208	Corridor	2	0.125	40
M-209	Supply fan room	2	0.125	40
M-210	Health physics storage room	3	0.25	30
M-211	Air lock	4	0.75	20
M-212	Crane maintenance room	5	2.5	10
M-213	Access room	4	0.75	20
M-214	Operator's area	2	0.125	40
M-215	Crane maintenance decon cell	5	2.5	10
M-216	Air lock	4	0.75	20
M-217	Health physics storage room	3	0.25	30
M-218	Air lock	4	0.75	20
M-219	Crane maintenance room	5	2.5	10
M-220	Corridor	2	0.125	40
M-221	Corridor	2	0.125	40
M-222	Corridor	2	0.125	40
M-223	Exhaust filter room	2	0.125	40
M-224	Exhaust filter room	2	0.125	40
M-225	Filter room	2	0.125	40
M-226	Corridor	2	0.125	40
M-227	Health physics storage room	3	0.25	30
M-228	ACV	2	0.125	40
M-229	Air lock	4	0.75	20
M-230	Crane maintenance room	5	2.5	10
M-231	Equipment storage room	4	0.75	20
M-232	Crane maintenance room	5	2.5	10
M-233	Air lock	4	0.75	20
M-234	ACV	2	0.125	40
M-235	Health physics storage room	3	0.25	30
M-236	Corridor	2	0.125	40
M-237	Filter room	2	0.125	40
M-238	Exhaust filter room	2	0.125	40
M-239	Exhaust filter room	2	0.125	40
M-240	Corridor	2	0.125	40
M-241	Corridor	2	0.125	40

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	4. SECOND MEZZANINE LEVEL (Contd)			
M-242	Corridor	2	0.125	40
M-243	Crane maintenance room	5	2.5	10
M-244	Air lock	4	0.75	20
M-245	Health physics storage room	3	0.25	30
M-246	Crane maintenance/decon cell	5	2.5	10
M-247	Air lock	4	0.75	20
M-248	Operator's area	2	0.125	40
M-249	Access room	4	0.75	20
M-250	Crane maintenance room	5	2.5	10
M-251	Air lock	4	0.75	20
M-252	Health physics storage room	3	0.25	30
M-253	Corridor	2	0.125	40
M-254	Supply fan room	2	0.125	40
	5. THIRD LEVEL			
3001	Elevator lobby	2	0.125	40
3002	ACV	2	0.125	40
3003	Storage room	2	0.125	40
3004	Corridor	2	0.125	40
3005	Operating corridor	2	0.125	40
3006	Health physics storage room	2	0.125	40
3007	Filter room	2	0.125	40
3008	Health physics storage room	3	0.25	30
3009	Storage and equipment room	2	0.125	40
3010	Air lock	4	0.75	20
3011	Crane maintenance room	5	2.5	10
3012	Electrical equipment room	2	0.125	40
3013	Remote transfer room	6	10	2
3014	Equipment decon room	6	10	2
3015	Manipulator/crane storage and maintenance room	3	0.25	30
3016	ACV	2	0.125	40
3017	Operating gallery	2	0.125	40
3018	ACV	2	0.125	40
3019	Compactor equipment room	2	0.125	40
3020	Filter compactor room	7	-	-
3021	Remote air handling filtration cell	7	-	-
3022	Drum intro. room	6	10	2
3023	Air lock	4	0.75	20

Table 30-8 (Contd)

Room No.	Operation Description	Area Radiation Zoning Designation	Maximum Steady-State Design Dose Rate (mrem/hr)	Area Occupancy (hr/wk)
	5. THIRD LEVEL (Contd)			
3024	Health physics storage room	3	0.25	30
3025	Manipulator/crane storage and maintenance room	3	0.25	30
3026	Equipment decon room	6	10	2
3027	Remote transfer room	7	-	-
3028	Electrical equipment room	2	0.125	40
3029	Operating corridor	2	0.125	40
3030	Health physics storage room	2	0.125	40
3031	Filter room	2	0.125	40
3032	Operating corridor	2	0.125	40
3033	Exhaust fan room	2	0.125	40
3034	Exhaust fan room	2	0.125	40
3035	Corridor	2	0.125	40
3036	Filter storage room	2	0.125	40
3037	Lag storage generator room	2	0.125	40
3038	Supply filter room	2	0.125	40
3039	Corridor	2	0.125	40
3040	Unassigned	2	0.125	40
3041	Storage room	2	0.125	40
3042	Storage room	2	0.125	40
3043	Exhaust fan room	2	0.125	40
3044	Exhaust filter room	2	0.125	40
3045	ACV	2	0.125	40
3046	ACV	2	0.125	40
3047	Corridor	2	0.125	40
3048	Exhaust fan room	2	0.125	40
3049	Exhaust fan room	2	0.125	40

Table 30-9 - Accidents With Radiological Consequences

Item No.	Accident	Location	Consequences: Clad Breach	Rad Exposure	FP Release	FP Gas Release	Spread Contamination	Other - Specify
A.	Major Accidents							
1	Cloth/paper/zirconium fire	Process and maintenance hot cell					X	
2	Drop fuel assembly	Cask handling and unloading (mated to hot cell)	X			X	X	
3	Drop fuel assembly	Hot cell	X			X	X	
4	Consolidation equipment malfunction	Hot cell	X			X	X	
5	Cell penetration breach	Process and maintenance hot cells		X				
B.	Minor Postulated Events							
6	Cloth/paper/hydrualic fluid fire	Liquid and solid radwaste					X	
7	Cask gas release	Loadout and decon				X		
8	Vessel failure	Liquid and solid radwaste					X	
9	Evaporator failure	Liquid radwaste					X	
10	Pump failure	Liquid and solid radwaste		X			X	
11	Piping failure	Liquid and solid radwaste		X			X	

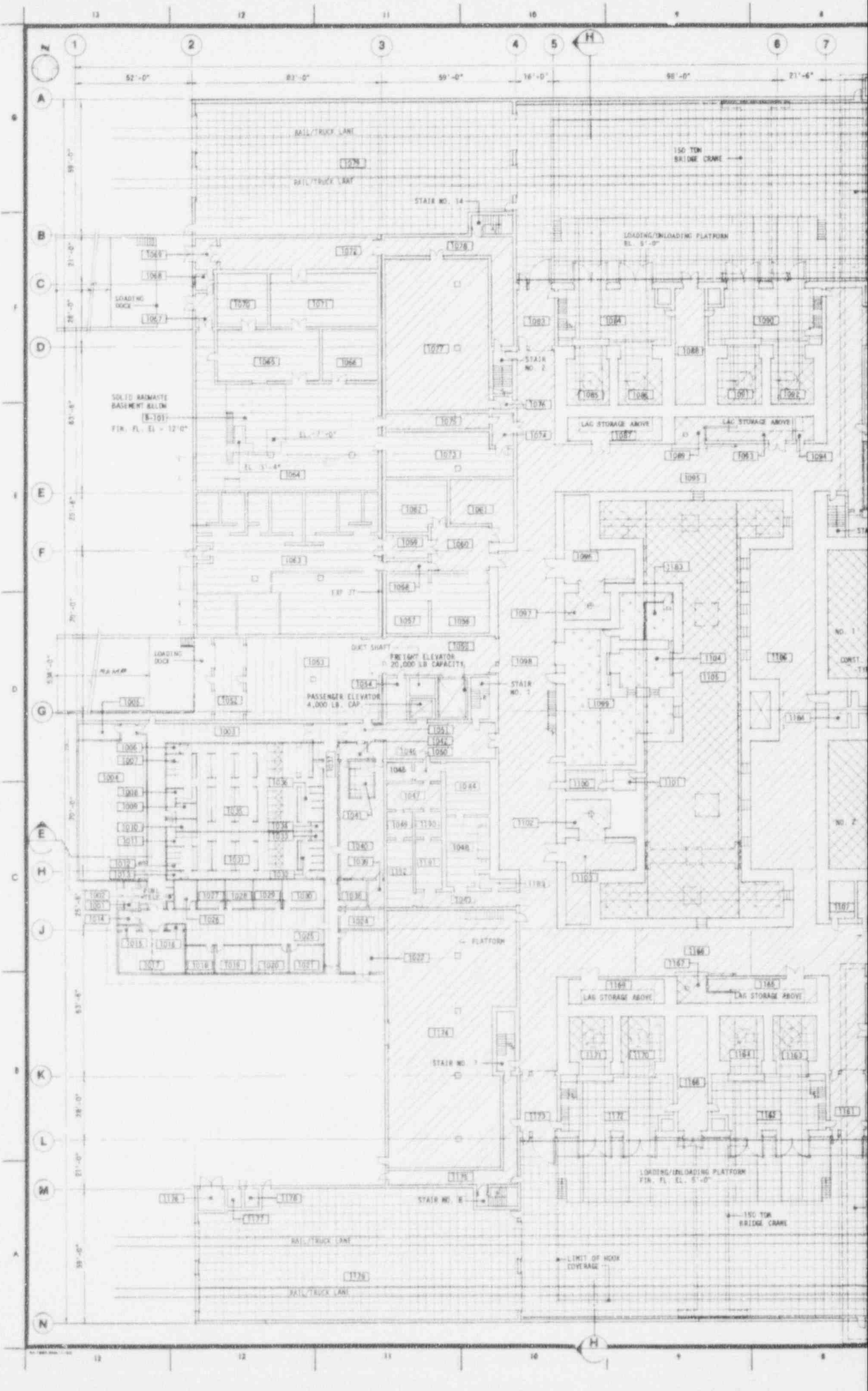
Table 30-9 (Contd)

Item No.	Accident	Location	Consequences: Clad Breach	Rad Exposure	FP Release	FP Gas Release	Spread Contamination	Other - Specify
12	Plastic bag rupture	Solid radwaste		X			X	
13	Surface water in drywell	Drywell storage						Criticality
14	Drum drop	Storage area					X	
C.	Equipment Failures							
15	Shipping cask drop from unloading crane	Receiving and inspection area	X		X	X	X	
16	External loads on shipping cask	During shipment and at MRS Facility	X		X	X	X	
17	Contamination barrier failure	Cask unloading area					X	
18	Suspended load falls off shielded process cell (hot cell) crane	Hot cell						Mechanical damage
19	Suspended shielded process cell crane load impacts shielded process cell equipment	Hot cell	X		X	X	X	
20	Waste form dropped from crane during handling	Hot cell	X		X	X	X	
21	Consolidation equipment malfunction (six different failures)	Hot cell	X		X	X	X	See Item 4.

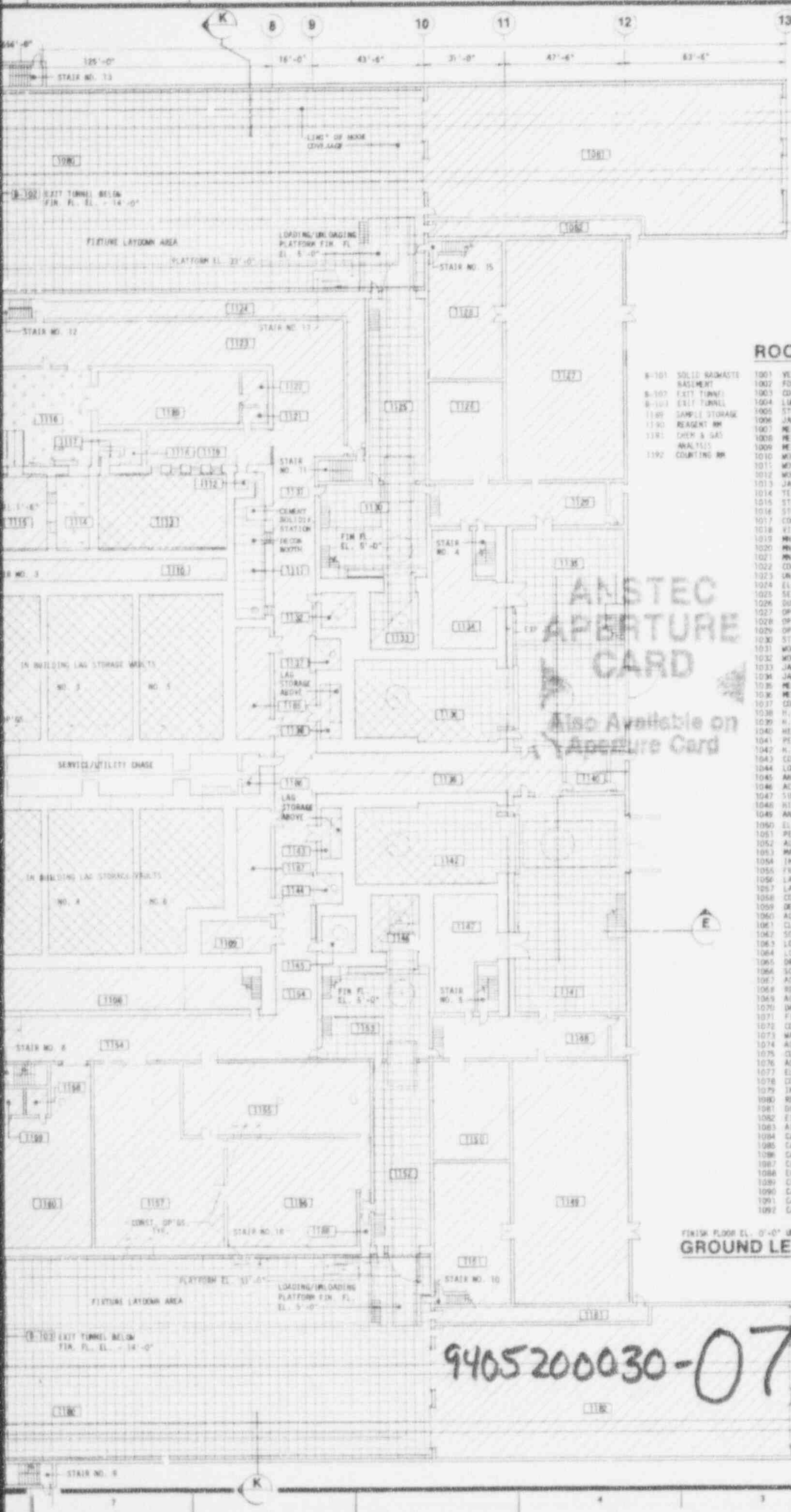
PARSONS

Table 30-9 (Contd)

Item No.	Accident	Location	Consequences					
			Clad Breach	Rad Exposure	FP Release	FP Gas Release	Spread Contamination	Other - Specify
22	Fuel rod bundle will not enter canister	Hot cell	X		X	X	X	
23	Welding equipment - canister rotation malfunction	Hot cell						Process delay
24	Welding equipment - incomplete canister weld	Hot cell	X		X	X	X	
25	Secondary waste drum equipment malfunction (two failures)						X	
26	Clogged shredder feed chutes	Process cell					X	
27	Clogged shredder	Process cell					X	
28	Clogged shredder discharge chutes	Process cell					X	



RAIL/TRUCK LANE
150 TON BRIDGE CRANE
STAIR NO. 14
LOADING/UNLOADING PLATFORM EL. 5'-0"
LOADING DOCK
SOLID RADWASTE BASEMENT BELOW
FIN. FL. EL - 12'0"
STAIR NO. 2
LAG STORAGE ABOVE
DUCT SHAFT
FREIGHT ELEVATOR 20,000 LB CAPACITY
PASSENGER ELEVATOR 4,000 LB. CAP.
STAIR NO. 1
PLATFORM
STAIR NO. 7
STAIR NO. 8
LOADING/UNLOADING PLATFORM FIN. FL. EL. 5'-0"
LIMIT OF HOOK COVERAGE



ALARA	AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
1	UNCONTROLLED AREAS	0.125
2	CONTINGENT AREAS	0.125
3	GENERAL OPERATION & LABORATORY AREAS	0.25
4	PROCESS OPERATION AREAS	0.75
5	INTERMITTENT OPERATION AREAS	2.5
6	REMOTE OPERATION AREAS	10
7	ISOLATION AREAS	

ROOM/AREA IDENTIFICATION

B-101 SOLID RADWASTE BASEMENT
B-102 EXIT TUNNEL
B-103 EXIT TUNNEL
1189 SAMPLE STORAGE
1190 REAGENT RM
1191 CHEM & GAS ANALYSIS
1192 COUNTING RM

1001 VESTIBULE
1002 FOYER
1003 CORRIDOR
1004 LUNCH ROOM
1005 STORAGE
1006 JAN. CLOS.
1007 MEN'S TOILET
1008 MEN'S CLOTHING ISSUE
1009 MEN'S COAT RM.
1010 WOMEN'S COAT RM.
1011 WOMEN'S CLOTHING ISSUE
1012 WOMEN'S TOILET
1013 JAN. CL.
1014 TELE. EQUIP.
1015 STOR.
1016 STOR.
1017 CONFERENCE RM.
1018 VISITOR'S OFFICE
1019 MNGMT OFFICE
1020 MNGMT OFFICE
1021 MNGMT OFFICE
1022 CONDENSATE TRANSFER RM.
1023 UNUSED
1024 ELECT. RM.
1025 SECRETARIAL & FILING RM.
1026 DUPLICATION & SUPPLY RM.
1027 OPER. OFFICE
1028 OPER. OFFICE
1029 OPER. OFFICE
1030 STAFF OFFICE
1031 WOMEN'S CHANGE RM.
1032 WOMEN'S TOILET RM.
1033 JAN. CLOS.
1034 JAN. CLOS.
1035 MEN'S CHANGE RM.
1036 MEN'S TOILET RM.
1037 CORRIDOR
1038 H.P. SUPV. OFFICE
1039 H.P. STOR. RM.
1040 HEALTH PHYSICS READY RM.
1041 PERSONNEL DECON RM.
1042 H.P. CHECK STATION
1043 CORRIDOR [ACV]
1044 LOW LEVEL ANALYTICAL LAB.
1045 ANALYTICAL LAB OFFICE
1046 ACV
1047 SUPPLY STORAGE
1048 HIGH LEVEL ANALYTICAL LAB
1049 ANALYZER RM.
1050 ELEVATOR LOBBY ACV
1051 PERSONNEL CORRIDOR
1052 ACV
1053 MATERIALS RECEIVING & STORAGE RM.
1054 INSTR. I/O RM.
1055 FREIGHT CORRIDOR ACV
1056 LAUNDRY
1057 LAUNDRY EQUIP. RM.
1058 CORR.
1059 DECON. RM.
1060 ACV
1061 CLEAN LAUNDRY STOR.
1062 SOILED LAUNDRY STOR.
1063 LOW LEVEL LIQUID RADWASTE
1064 LOW LEVEL SOLID RADWASTE
1065 DRUM INSPECTION & DECON RM.
1066 SOLID RADWASTE MAINTENANCE
1067 ACV
1068 RECEIVING & DISPATCH RM
1069 ACV
1070 DRUM CURING RM.
1071 FILLED DRUM STORAGE
1072 CORRIDOR
1073 WASTE COLLECTION STOR.
1074 ACV
1075 CORRIDOR
1076 ACV
1077 ELECTRICAL EQUIPMENT RM.
1078 CORRIDOR
1079 INCOMING ACV
1080 RECEIVING, INSPECTION & SHIPPING AREA
1081 OUTGOING ACV
1082 EXIT COP?IDOR
1083 ACV
1084 CASK HANDLING PREP & DECON RM.
1085 CASK UNLOADING RM.
1086 CASK UNLOADING RM.
1087 CLEAN DRUM STOR.
1088 EQUIP. STOR. RM.
1089 CLEAN DRUM TRANSFER STA.
1090 CASK HANDLING PREP & DECON RM.
1091 CASK UNLOADING RM.
1092 CASK UNLOADING RM.
1093 CLEAN DRUM STOR.
1094 ELECT. EQUIP. RM.
1095 OPERATING CORRIDOR
1096 CLEAN CANISTER STORAGE
1097 CLEAN CANISTER TRANSFER RM.
1098 ACCESS CORRIDOR
1099 CONTACT HANDLED EQUIP. MAINT. RM.
1100 H.P. STOR. RM.
1101 AIRLOCK
1102 CLEAN CANISTER TRANSFER RM.
1103 CLEAN CANISTER STORAGE
1104 DECON RM
1105 REMOTE HANDLED EQUIP. MAINT. RM.
1106 OPERATING CORRIDOR
1107 ELECT. EQUIP. RM.
1108 LAG STORAGE SUMP STATION
1109 STORAGE
1110 LAG STORAGE SUMP STATION
1111 DRUM TRANSFER CORR?DOR
1112 CLEAN DRUM INTRO. VEST.
1113 HIGH ACTIVITY RADWASTE CELL
1114 MAINT. DECON.
1115 OPERATING AREA
1116 CONTACT MAINT. RM.
1117 AIR LOCK
1118 H.P. STOR. RM.
1119 OPERATING RM
1120 HAW EQUIPMENT RM.
1121 ACV
1122 CHEMICAL STORAGE
1123 ACCESS CORRIDOR
1124 EXIT CORRIDOR
1125 SHIPPING CASK TRANSFER RM.
1126 BATTERY RM.
1127 ELECTRICAL RM.
1128 UPS RM.
1129 CORRIDOR
1130 SHIPPING CASK LIDDING RM.
1131 CORRIDOR
1132 STORAGE
1133 SHIPPING LOADOUT RM.
1134 STORAGE RM.
1135 TRANSFER DISCHARGE CORRIDOR ACV
1136 LOADOUT & DECON RM.
1137 CLEAN DRUM/CANISTER TRANSFER STATION
1138 CLEAN DRUM/CANISTER STORAGE
1139 CORRIDOR
1140 ACV
1141 TRANSFER/DISCHARGE CORRIDOR ACV
1142 LOADOUT & DECON RM.
1143 CLEAN DRUM/CANISTER TRANSFER STORAGE
1144 CLEAN DRUM/CANISTER TRANSFER STATION
1145 STORAGE
1146 SHIPPING LOADOUT RM.
1147 STORAGE ROOM
1148 CORRIDOR
1149 ELECTRICAL RM.
1150 BATTERY RM.
1151 UPS RM.
1152 SHIPPING CASK TRANSFER RM.
1153 SHIPPING CASK LIDDING RM.
1154 CORRIDOR
1155 COMPRESSOR RM.
1156 WELD/TEST & DECON EQUIP. RM.
1157 AQUEOUS & CHEM. DECON. MAKE-UP
1158 COLD MAINT. OFFICE
1159 COLD MAINT. OFFICE
1160 COLD MAINT. RM.
1161 ACV
1162 CASK HANDLING PREP & DECON RM.
1163 CASK UNLOADING RM.
1164 CASK UNLOADING RM.
1165 CLEAN DRUM STOR.
1166 OPERATING CORRIDOR
1167 CLEAN DRUM TRANSFER RM.
1168 EQUIP. STOR. RM.
1169 CLEAN DRUM STOR.
1170 CASK UNLOADING RM.
1171 CASK UNLOADING RM.
1172 CASK HANDLING PREP & DECON RM.
1173 ACV
1174 CHILLER EQUIP. RM.
1175 EXIT CORRIDOR
1176 ARGON STOR. RM.
1177 HELIUM STORAGE & MANIFOLD
1178 NITROGEN STORAGE & MANIFOLD
1179 INCOMING ACV
1180 RECEIVING INSPECTION & SHIPPING AREA
1181 EXIT CORRIDOR
1182 OUTGOING ACV
1183 HOT GLOVEBOX REPAIR RM
1184 AIRLOCK
1185 CLEAN DRUM/CANISTER STORAGE
1186 AIRLOCK
1187 CLEAN DRUM/CANISTER STORAGE
1188 EXIT CORRIDOR

[CONTINUED ABOVE]

FINISH FLOOR EL. 0'-0" UNLESS NOTED OTHERWISE

GROUND LEVEL PLAN

JQP# NONE

9405200030-07

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PACIFIC NORTHWEST LABORATORY
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THE RALPH M. PARSONS COMPANY of DELAWARE

MRS FACILITY
RECEIVING & HANDLING BUILDING

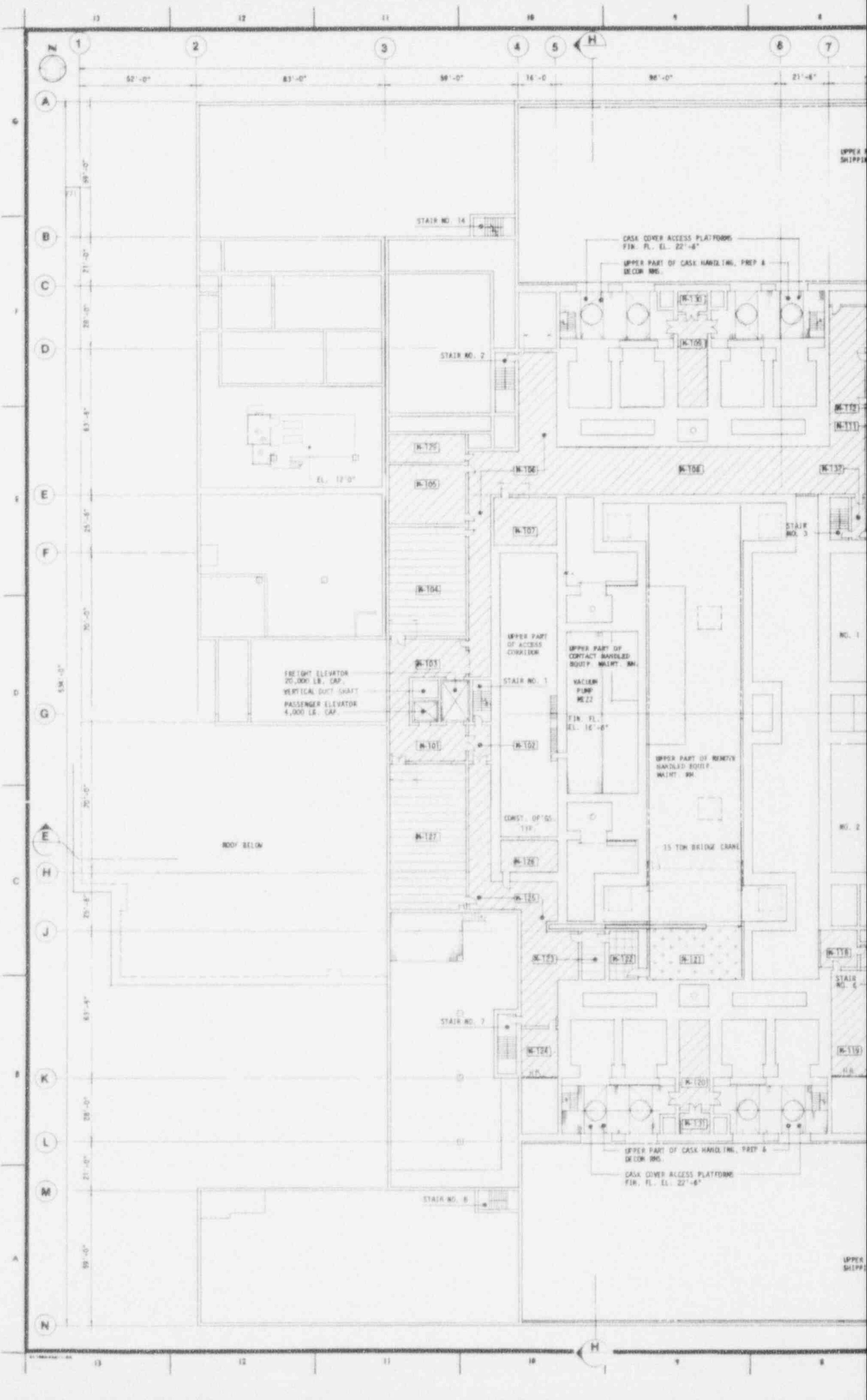
ALARA AREA RADIATION
ZONING DESIGNATIONS
GROUND LEVEL PLAN

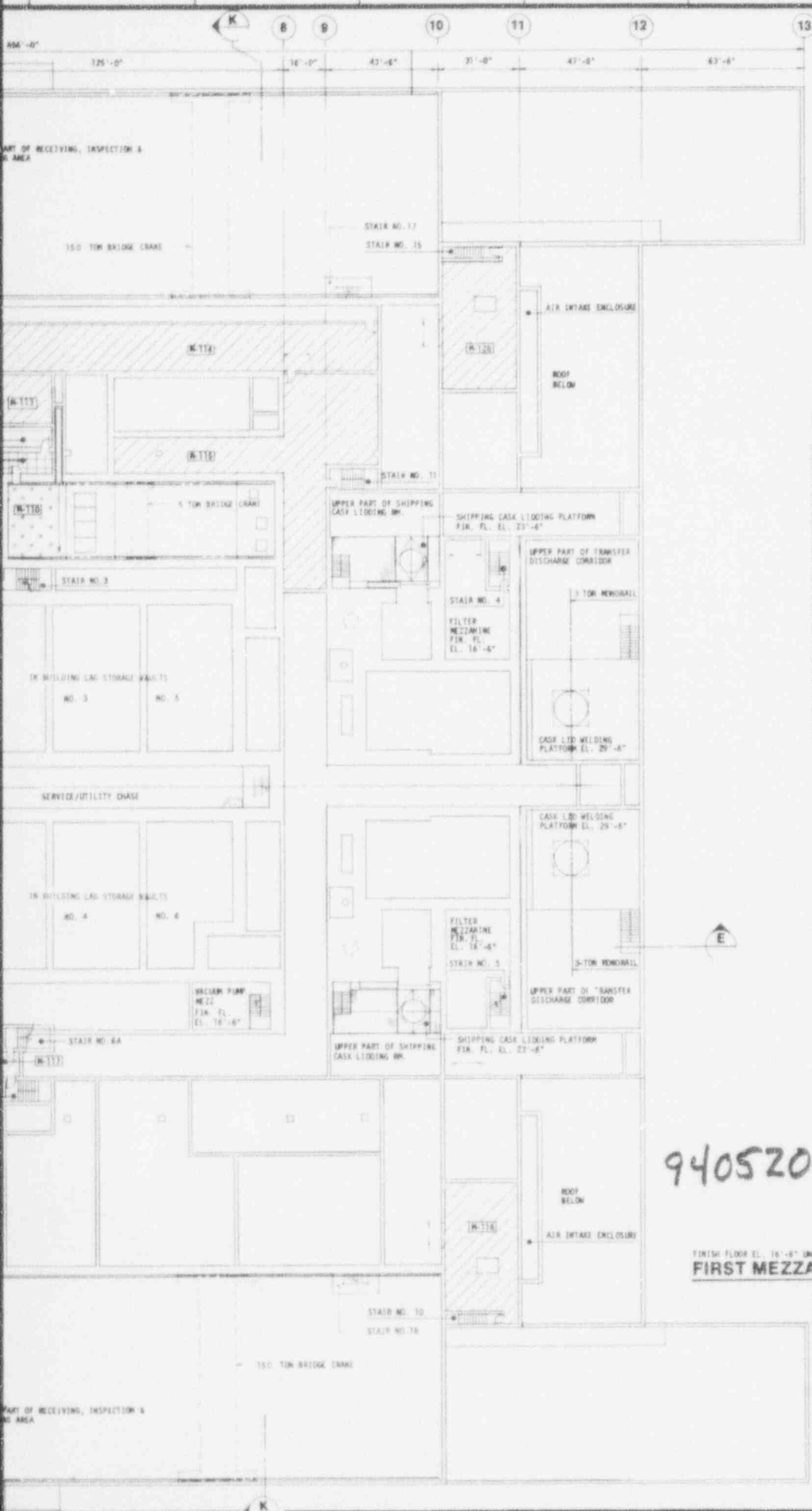
77A-200 0800

NOT REQD

NONE

FIGURE 30-1


52'-0"
83'-0"
58'-0"
16'-0
98'-0"
21'-6"
STAIR NO. 14
CASK COVER ACCESS PLATFORMS
FIN. FL. EL. 22'-6"
UPPER PART OF CASK HANDLING, PREP &
DECON RMS.
STAIR NO. 2
EL. 12'0"
STAIR
NO. 3
UPPER PART
OF ACCESS
CORRIDOR
UPPER PART OF
CONTACT HANDLED
EQUIP. MAINT. RM.
VACUUM
PUMP
MEZZ
FIN. FL.
EL. 16'-6"
FREIGHT ELEVATOR
20,000 LB. CAP.
VERTICAL DUCT SHAFT
PASSENGER ELEVATOR
4,000 LB. CAP.
STAIR NO. 1
UPPER PART OF REMOTE
HANDLED EQUIP.
MAINT. RM.
CONST. OP'GS.
TYP.
ROOF BELOW
15 TON BRIDGE CRANE
NO. 1
NO. 2
STAIR NO. 7
UPPER PART OF CASK HANDLING, PREP &
DECON RMS.
CASK COVER ACCESS PLATFORMS
FIN. FL. EL. 22'-6"
STAIR NO. 8



ALARA		AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
	1	UNCONTROLLED AREAS	0.125
	2	CONTINGENT AREAS	0.125
	3	GENERAL OPERATION & LABORATORY AREAS	0.25
	4	PROCESS OPERATION AREAS	0.75
	5	INTERMITTENT OPERATION AREAS	2.5
	6	REMOTE OPERATION AREAS	10
	7	ISOLATION AREAS	

ROOM/AREA IDENTIFICATION

M-101 ELEVATOR LOBBY
M-102 ACV
M-103 FREIGHT CORRIDOR
M-104 LAUNDRY FILTER RM.
M-105 UNASSIGNED SPACE
M-106 CORRIDOR
M-107 FILTER RM. (HEPA)
M-108 CORRIDOR
M-109 EQUIP. STOR. RM.
M-110 CRANE MAINT. RM.
M-111 AIR LOCK
M-112 H.P. STOR. RM.
M-113 ELEC. EQUIP. RM.
M-114 CORRIDOR
M-115 VALVE/FILTER GALLERY
M-116 MECHANICAL EQUIP. RM.
M-117 ACV
M-118 ACCESS RM.
M-119 FILTER RM. (HEPA)
M-120 EQUIP. STOR. RM.
M-121 CRANE MAINT. RM.
M-122 AIR LOCK
M-123 H.P. STOR. RM.
M-124 FILTER RM. (HEPA)
M-125 CORRIDOR
M-126 FILTER RM. (HEPA)
M-127 ANALYTICAL LAB. FILTER RM.
M-128 MECHANICAL EQUIP. RM.
M-129 AIR SAMPLING PUMPING STA. NO. 1
M-130 CONDENSER RM.
M-131 CONDENSER RM.
M-132 ACV

FINISH FLOOR EL. 16'-6" UNLESS NOTED OTHERWISE

FIRST MEZZANINE PLAN

JOP# NONE

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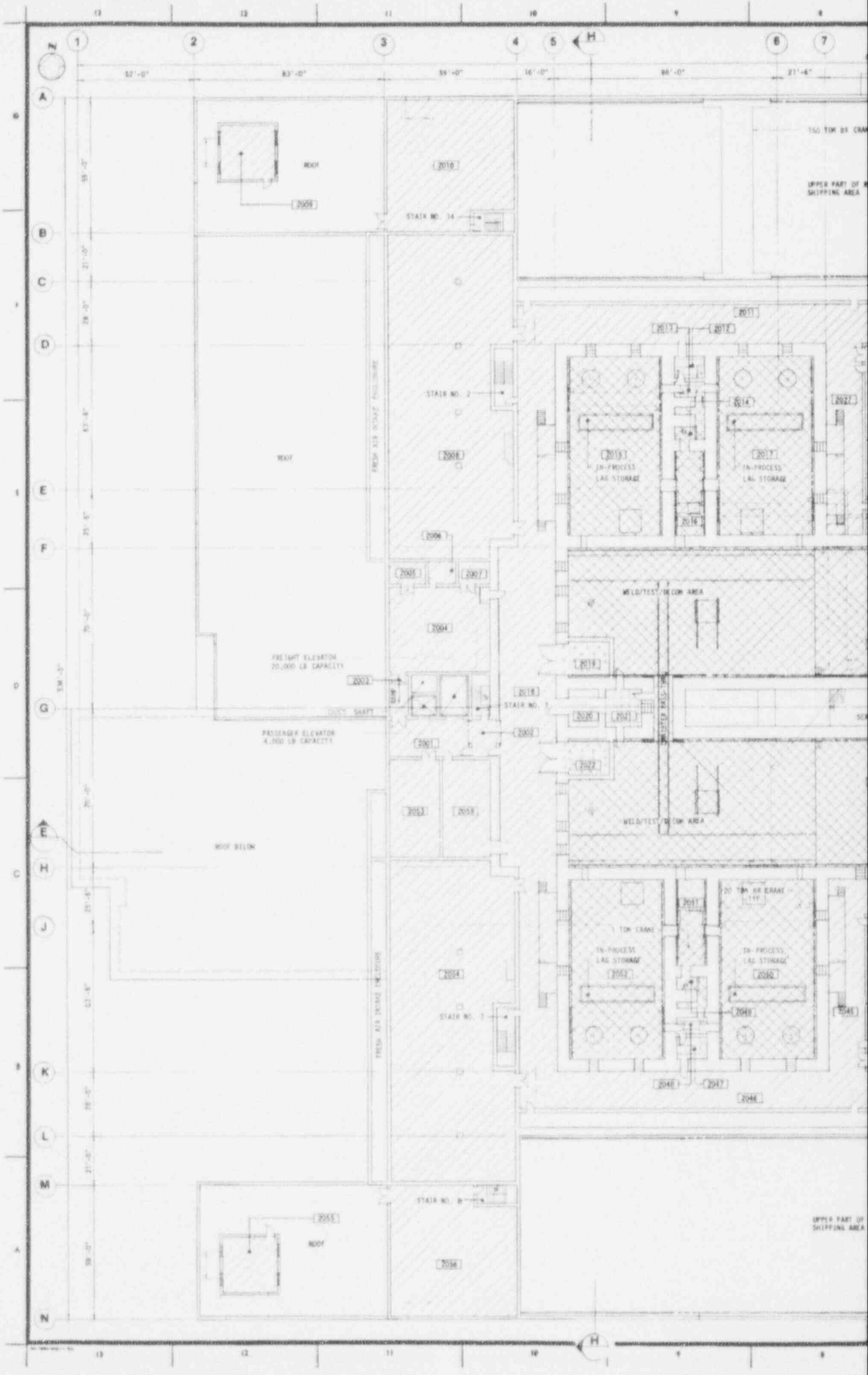
of DELAWARE
Westinghouse Electric Corp. Golder Associates

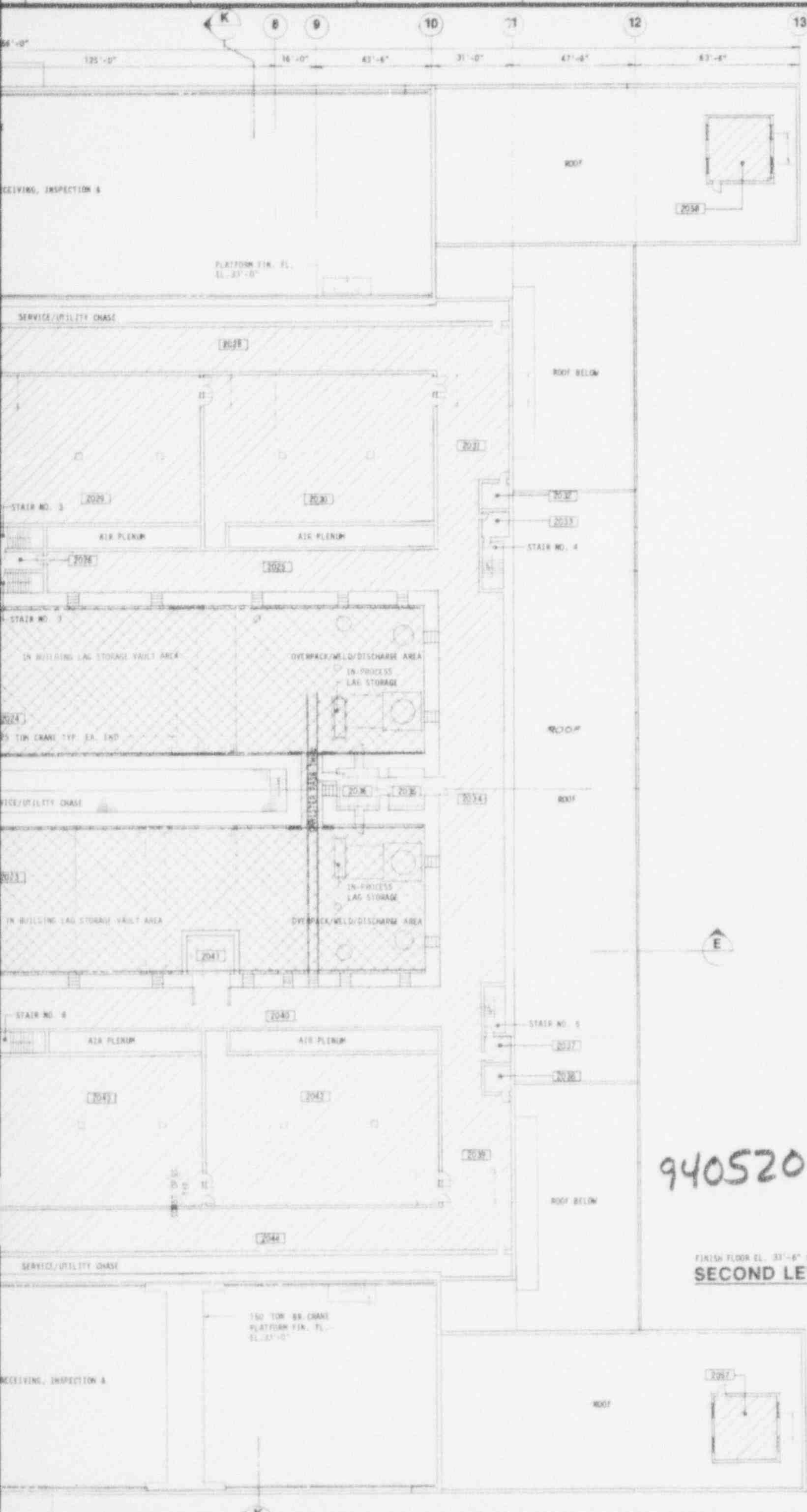
MRS FACILITY
RECEIVING & HANDLING BUILDING

ALARA AREA RADIATION
ZONING DESIGNATIONS
FIRST MEZZANINE PLAN

NOT REQD
NONE
77A-200
0800

FIGURE 30-2


ROOF
2009
2010
STAIR NO. 14
STAIR NO. 2
FRESH AIR INTAKE ENCLOSURE
2008
2006
2005
2007
2004
FREIGHT ELEVATOR
20,000 LB CAPACITY
2003
DUCT SHAFT
PASSENGER ELEVATOR
4,000 LB CAPACITY
STAIR NO. 1
2002
2001
2053
2054
ROOF BELOW
STAIR NO. 7
STAIR NO. 8
2055
2056
2011
2012
2013
2014
IN-PROCESS
LAG STORAGE
2015
2016
2017
2027
WELD/TEST/DECON AREA
2019
2018
2020
2021
2022
1 TON CRANE
2052
2051
2050
2049
2048
2047
2046
2045
UPPER PART OF
SHIPPING AREA



ALARA		AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
	1	UNCONTROLLED AREAS	0.125
	2	CONTINGENT AREAS	0.125
	3	GENERAL OPERATION & LABORATORY AREAS	0.25
	4	PROCESS OPERATION AREAS	0.75
	5	INTERMITTENT OPERATION AREAS	2.5
	6	REMOTE OPERATION AREAS	10
	7	ISOLATION AREAS	

ROOM/AREA IDENTIFICATION

2001 ELEVATOR LOBBY
2002 ACV
2003 VESTIBULE
2004 CONTROL RM.
2005 STOR. RM.
2006 SUPV. OFFICE
2007 STOR. RM.
2008 SUPPLY FAN RM.
2009 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2010 SUPPLY FAN RM.
2011 OPERATING GALLERY
2012 H.P. STOR. RM.
2013 AIR LOCK
2014 CLEAN DRUM INTRO. RM.
2015 SHIELDED PROCESS CELL NO. 1
2016 DECON CELL
2017 SHIELDED PROCESS CELL NO. 3
2018 OPERATING GALLERY
2019 WELDING STATION
2020 H.P. STOR. RM.
2021 AIR LOCK
2022 WELDING STATION
2023 SHIELDED CANYON CELL NO. 6
2024 SHIELDED CANYON CELL NO. 5
2025 OPERATING GALLERY
2026 ACV
2027 OPERATING GALLERY
2028 ACCESS CORRIDOR
2029 EXHAUST FILTER RM.
2030 EXHAUST FILTER RM.
2031 ACCESS CORRIDOR
2032 ELECT. EQUIP. RM.
2033 ACV
2034 OPERATING GALLERY
2035 H.P. STOR. RM.
2036 AIR LOCK
2037 ACV
2038 ELECT. EQUIP. RM.
2039 ACCESS CORRIDOR
2040 OPERATING GALLERY
2041 WELDING STATION
2042 EXHAUST FILTER RM.
2043 EXHAUST FILTER RM.
2044 ACCESS CORRIDOR
2045 OPERATING GALLERY
2046 OPERATING GALLERY
2047 H.P. STOR. RM.
2048 AIR LOCK
2049 CLEAN DRUM INTRO. RM.
2050 SHIELDED PROCESS CELL NO. 4
2051 DECON CELL
2052 SHIELDED PROCESS CELL NO. 2
2053 MECHANICAL EQUIP. RM. (FOR CONTROL ROOM)
2054 SUPPLY FAN RM.
2055 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2056 SUPPLY FAN RM.
2057 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2058 MECH. EQUIP. PENTHOUSE (DOOR HEATERS)
2059 MECH. EQUIP. RM. (GLYCOL & H. W. REHEAT PUMPS)

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FINISH FLOOR EL. 33'-0" UNLESS NOTED OTHERWISE

SECOND LEVEL PLAN

JOP# NONE

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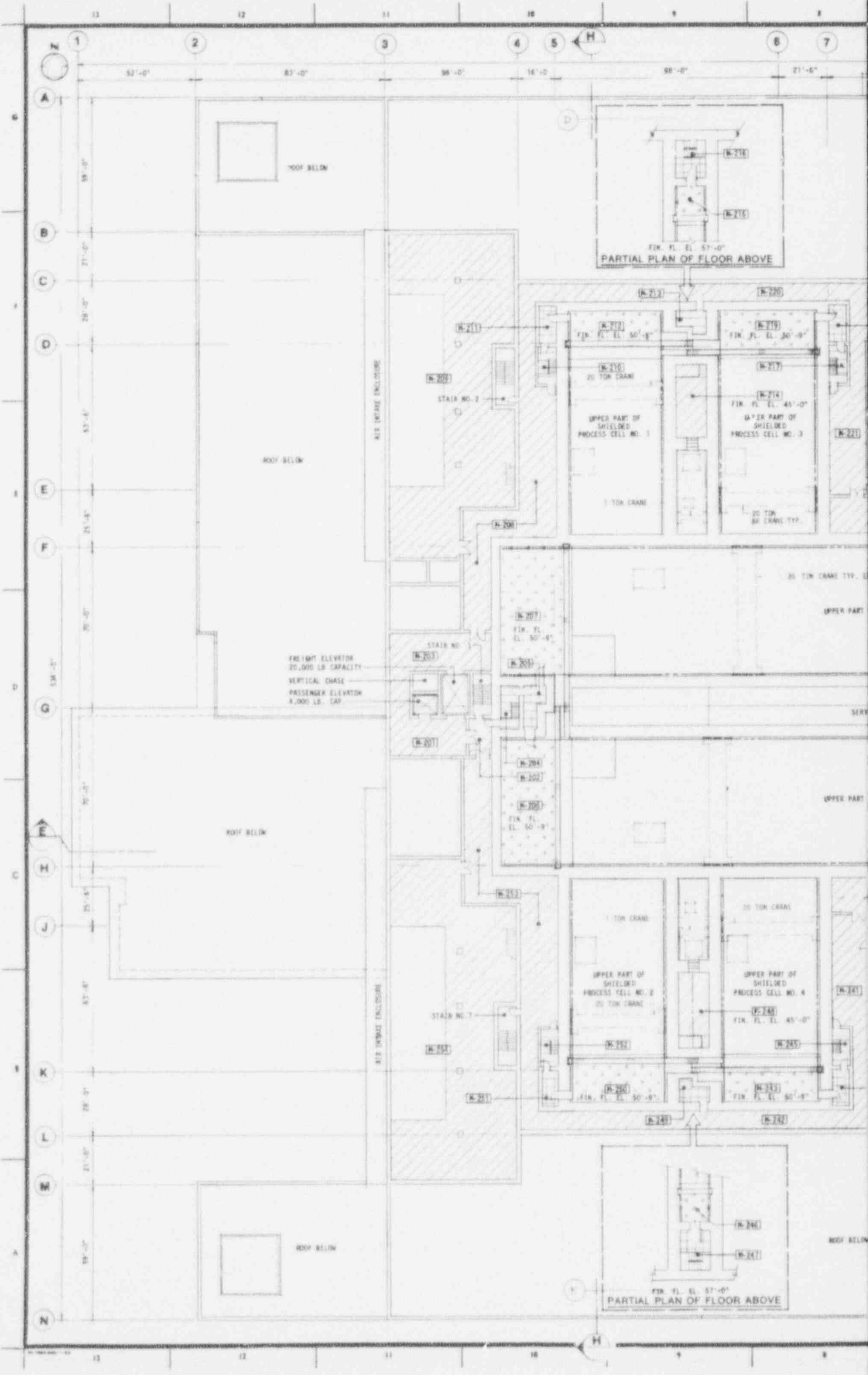
MRS FACILITY
RECEIVING & HANDLING BUILDING

ALARA AREA RADIATION ZONING DESIGNATIONS SECOND LEVEL PLAN

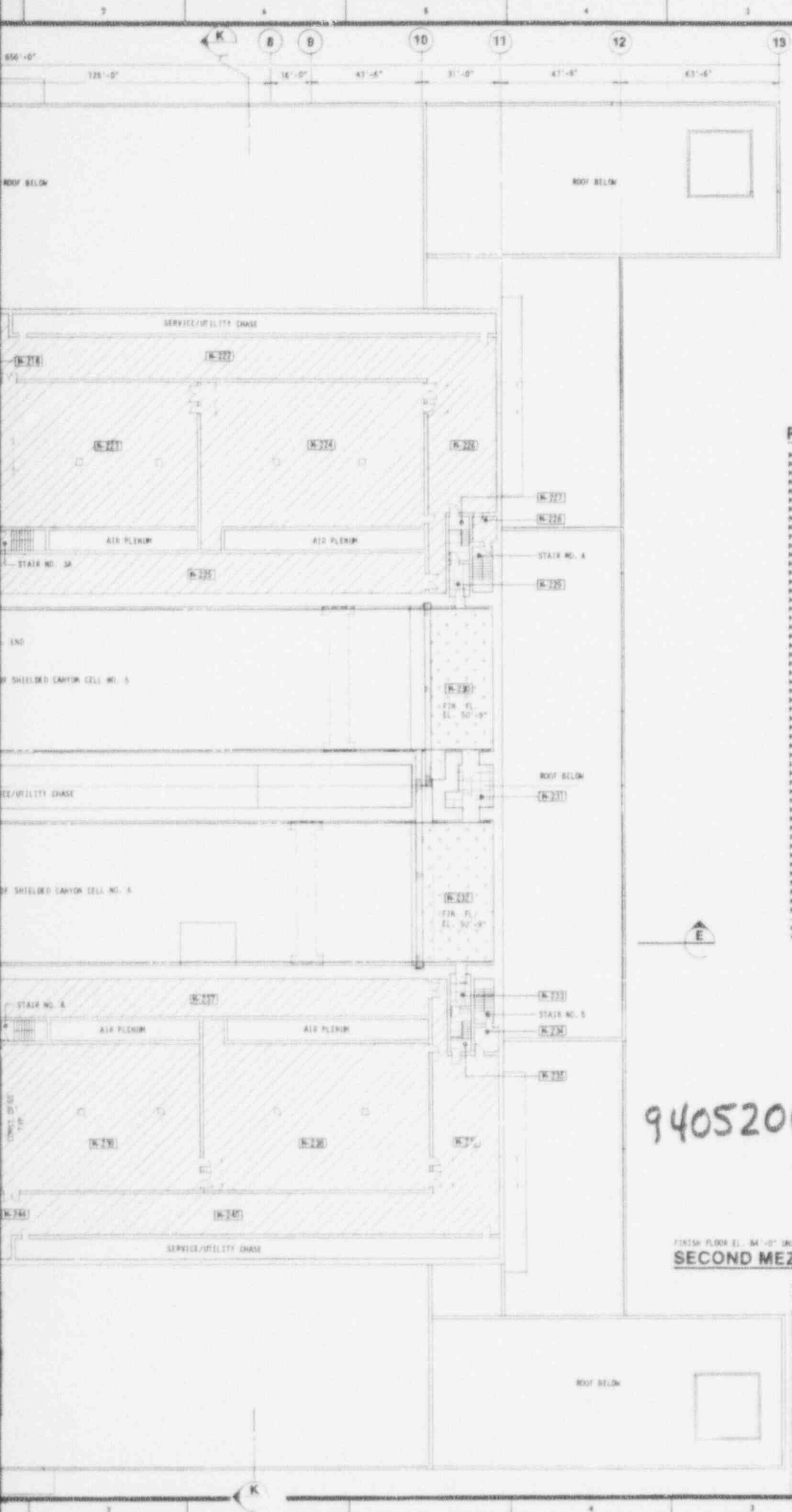
77A-200 0800

NOT REQD
NONE

FIGURE 30-3



PARTIAL PLAN OF FLOOR ABOVE
FIN. FL. EL. 57'-0"
ROOF BELOW
AIR INTAKE ENCLOSURE
STAIR NO. 2
20 TON CRANE
UPPER PART OF SHIELDED PROCESS CELL NO. 1
UPPER PART OF SHIELDED PROCESS CELL NO. 3
FIN. FL. EL. 45'-0"
FIN. FL. EL. 50'-9"
1 TON CRANE
35 TON CRANE TYP.
FREIGHT ELEVATOR 20,000 LB CAPACITY
VERTICAL CHASE
PASSENGER ELEVATOR 4,000 LB. CAP.
UPPER PART OF SHIELDED PROCESS CELL NO. 2
UPPER PART OF SHIELDED PROCESS CELL NO. 4
STAIR NO. 7
PARTIAL PLAN OF FLOOR ABOVE
FIN. FL. EL. 57'-0"



ALARA		AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
	1	UNCONTROLLED AREAS	0.125
	2	CONTINGENT AREAS	0.125
	3	GENERAL OPERATION & LABORATORY AREAS	0.25
	4	PROCESS OPERATION AREAS	0.75
	5	INTERMITTENT OPERATION AREAS	2.5
	6	REMOTE OPERATION AREAS	10
	7	ISOLATION AREAS	

ROOM/AREA IDENTIFICATION

M-201 ELEVATOR LOBBY
M-202 ACV
M-203 FREIGHT CORRIDOR LOBBY
M-204 H.P. STOR. RM.
M-205 AIR LOCK
M-206 CRANE MAINT. RM.
M-207 CRANE MAINT. RM.
M-208 CORRIDOR
M-209 SUPPLY FAN RM.
M-210 H.P. STOR. RM.
M-211 AIR LOCK
M-212 CRANE MAINT. RM.
M-213 ACCESS RM.
M-214 OPERATOR'S AREA
M-215 CRANE MAINT. DECON CELL
M-216 AIR LOCK
M-217 H.P. STOR. RM.
M-218 AIR LOCK
M-219 CRANE MAINT. RM.
M-220 CORRIDOR
M-221 CORRIDOR
M-222 CORRIDOR
M-223 EXHAUST FILTER RM.
M-224 EXHAUST FILTER RM.
M-225 FILTER RM.(HEPA)
M-226 CORRIDOR
M-227 H.P. STOR. RM.
M-228 ACV
M-229 AIR LOCK
M-230 CRANE MAINT. RM.
M-231 EQUIPMENT STOR. RM.
M-232 CRANE MAINT. RM.
M-233 AIR LOCK
M-234 ACV
M-235 H.P. STOR. RM.
M-236 CORRIDOR
M-237 FILTER RM. (HEPA)
M-238 EXHAUST FILTER RM.
M-239 EXHAUST FILTER RM.
M-240 CORRIDOR
M-241 CORRIDOR
M-242 CORRIDOR
M-243 CRANE MAINT. RM.
M-244 AIR LOCK
M-245 H.P. STOR. RM.
M-246 CRANE MAINT/DECON CELL
M-247 AIR LOCK
M-248 OPERATOR'S AREA
M-249 ACCESS RM.
M-250 CRANE MAINT. RM.
M-251 AIR LOCK
M-252 H.P. STOR. RM.
M-253 CORRIDOR
M-254 SUPPLY FAN RM.

9405200030 - 10

FINISH FLOOR EL. 84'-0" UNLESS NOTED OTHERWISE

SECOND MEZZANINE PLAN

JOP# NONE

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THE RALPH M. PARSONS COMPANY of DELAWARE

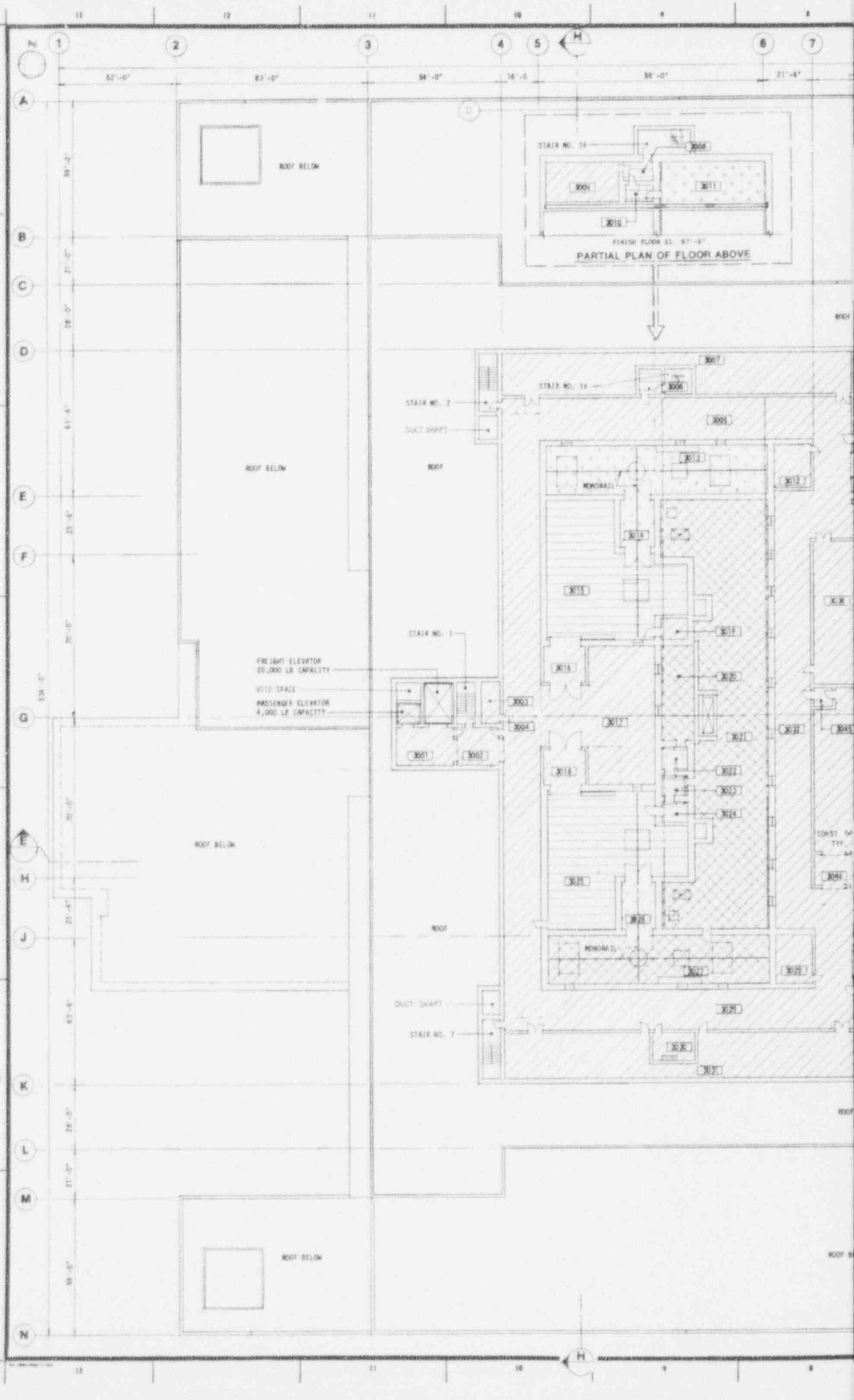
MRS FACILITY
RECEIVING & HANDLING BUILDING

ALARA AREA RADIATION
ZONING DESIGNATIONS
SECOND MEZZANINE PLAN

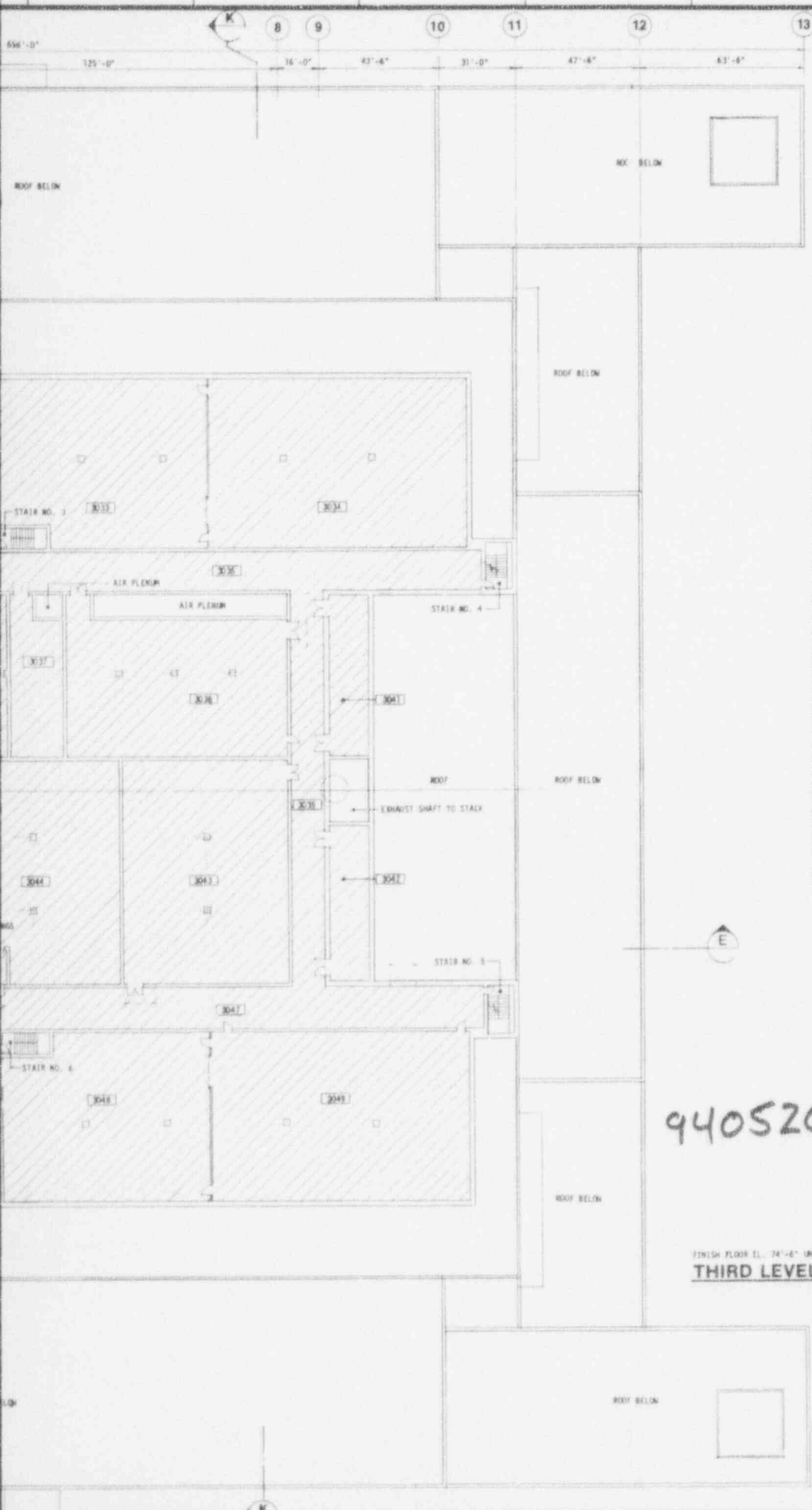
SCALE: NOT REQD
CLASSIFICATION: NONE

77A-200 0800

FIGURE 30-4



PARTIAL PLAN OF FLOOR ABOVE
STAIR NO. 16
ROOF BELOW
STAIR NO. 2
DUCT SHAFT
MONORAIL
ROOF
STAIR NO. 1
FREIGHT ELEVATOR
20,000 LB CAPACITY
VOID SPACE
PASSENGER ELEVATOR
4,000 LB CAPACITY
STAIR NO. 7



ALARA		AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
	1	UNCONTROLLED AREAS	0.125
	2	CONTINGENT AREAS	0.125
	3	GENERAL OPERATION & LABORATORY AREAS	0.25
	4	PROCESS OPERATION AREAS	0.75
	5	INTERMITTENT OPERATION AREAS	2.5
	6	REMOTE OPERATION AREAS	10
	7	ISOLATION AREAS	

ROOM/AREA IDENTIFICATION

3001 ELEVATOR LOBBY
3002 ACV
3003 STOR. RM.
3004 CORRIDOR
3005 OPERATING CORRIDOR
3006 H.P. STOR. RM.
3007 FILTER ROOM
3008 H.P. STOR. RM.
3009 STOR. & EQUIP. RM.
3010 AIR LOCK
3011 CRANE MAINT. RM.
3012 ELECT. EQUIP. RM.
3013 REMOTE TRANSFER RM.
3014 EQUIP. DECON RM.
3015 MANIPULATOR/CRANE STOR. & MAINT. RM
3016 ACV
3017 OPERATING GALLERY
3018 ACV
3019 COMPACTOR EQUIPMENT RM.
3020 FILTER COMPACTOR RM
3021 REMOTE HANDLING AIR FILTRATION CELL
3022 DRUM INTRO RM.
3023 AIR LOCK
3024 H.P. STOR. RM.
3025 MANIPULATOR/CRANE STOR. & MAINT. RM.
3026 EQUIP. DECON. RM.
3027 REMOTE TRANSFER RM.
3028 ELECT. EQUIP. RM.
3029 OPERATING CORRIDOR
3030 H.P. STOR. RM.
3031 FILTER RM.
3032 OPERATING CORRIDOR
3033 EXHAUST FAN RM.
3034 EXHAUST FAN RM.
3035 CORRIDOR
3036 FILTER STOR. RM.
3037 LAG STOR. GENERATOR RM.
3038 SUPPLY FILTER RM.
3039 CORRIDOR
3040 UNASSIGNED
3041 STOR. RM.
3042 STOR. RM.
3043 EXHAUST FAN RM.
3044 EXHAUST FILTER RM.
3045 ACV
3046 ACV
3047 CORRIDOR
3048 EXHAUST FAN RM.
3049 EXHAUST FAN RM.

9405200030-11

FINISH FLOOR EL. 74'-6" UNLESS NOTED OTHERWISE

THIRD LEVEL PLAN

JQP# NONE

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OPERATED BY BATTELLE MEMORIAL INSTITUTE

THE RALPH M. PARSONS COMPANY of DELAWARE

Westinghouse Electric Corp Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING

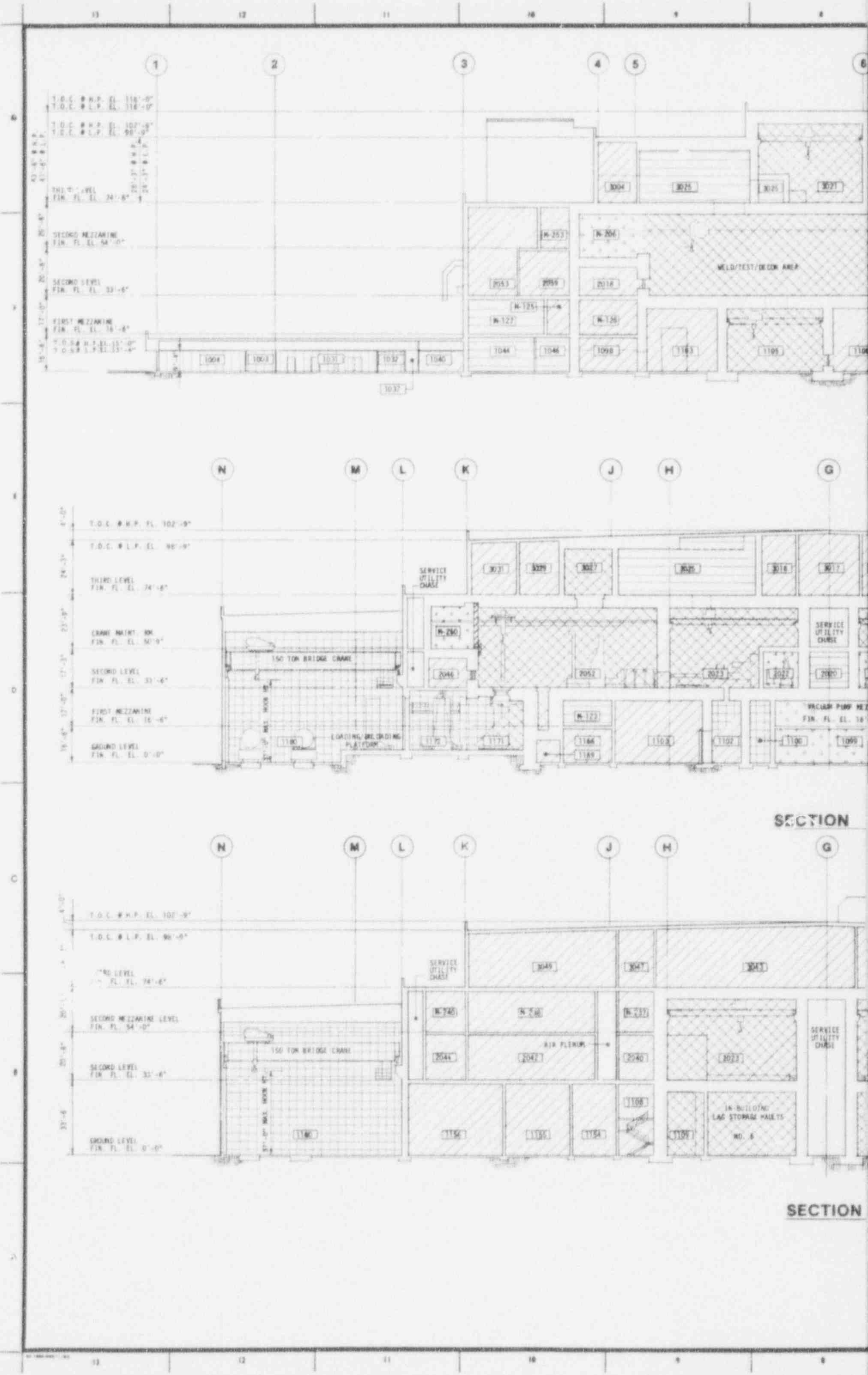
ALARA AREA RADIATION
ZONING DESIGNATIONS
THIRD LEVEL PLAN

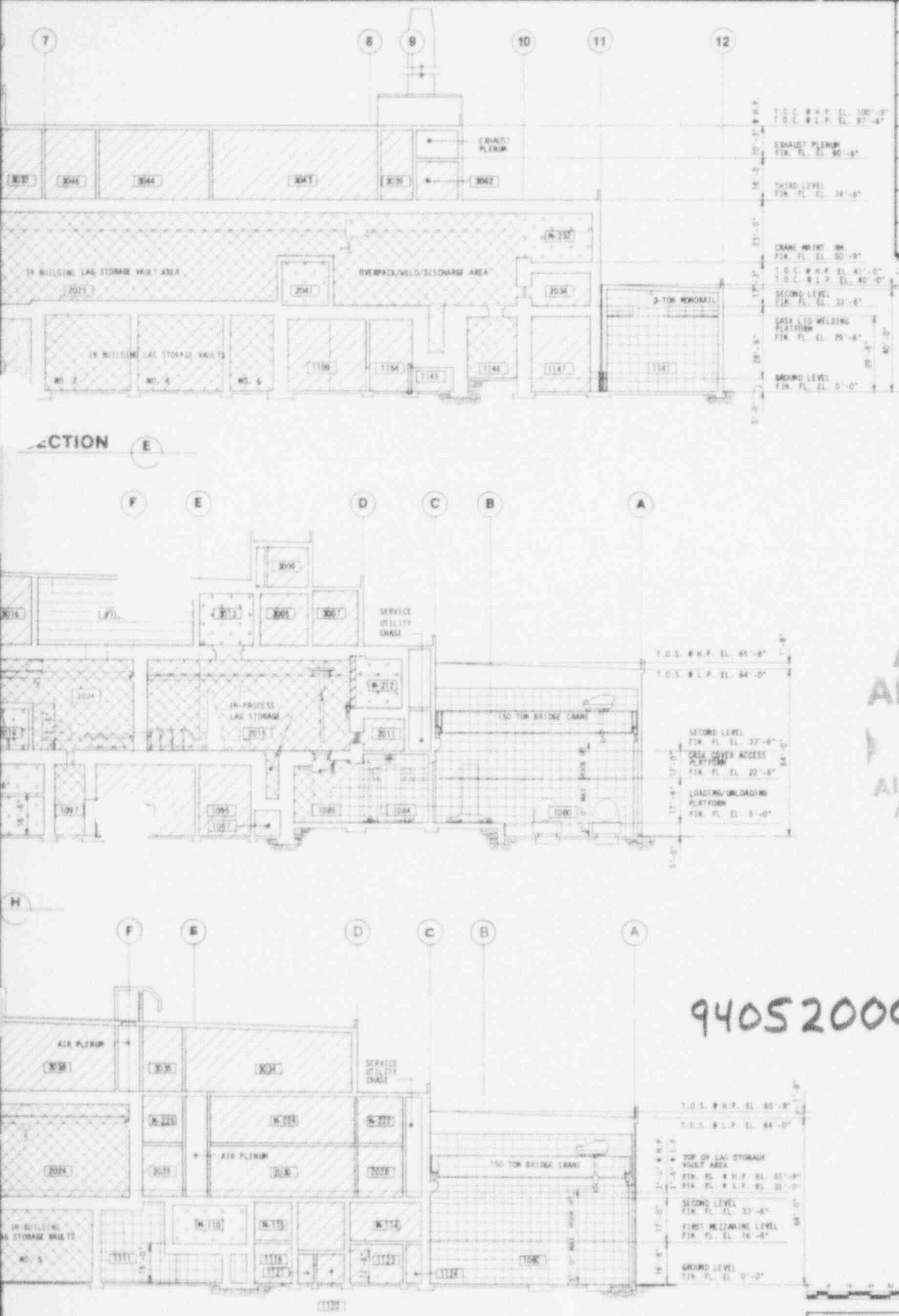
77A-200 0800

CLASSIFIED BY: NOT RE

CLASSIFICATION: NONE

FIGURE 30-5


WELD/TEST/DECON AREA
SERVICE UTILITY CHASE
150 TON BRIDGE CRANE
SECTION
AIR PLENUM
SECTION



ALARA	AREA RADIATION ZONING DESIGNATION	Dose Limit mrem/hr
1	UNCONTROLLED AREAS	0.125
2	CONTINGENT AREAS	0.125
3	GENERAL OPERATION & LABORATORY AREAS	0.25
4	PROCESS OPERATION AREAS	0.75
5	INTERMITTENT OPERATION AREAS	2.5
6	REMOTE OPERATION AREAS	10
7	ISOLATION AREAS	

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Westinghouse Electric Corp. Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING

ALARA AREA RADIATION
ZONING DESIGNATIONS
TYPICAL SECTIONS

NOT REQD

NONE

T7A-200 0801

FIGURE 30-6

SECTION 31

CONTAMINATION CONTROL

31.1 INTRODUCTION

The MRS Facility is designed to accommodate spent nuclear fuel and high-level radioactive waste resulting from civilian nuclear-power activities. It will permit continuous monitoring, management, and maintenance of such fuel and waste for the foreseeable future. The MRS Facility will safely store such spent fuel as long as may be necessary. It is equipped to: receive, inspect, unload, decontaminate, and return casks received by both truck and rail. Facilities and equipment are provided to disassemble and consolidate spent-fuel assemblies or to process intact asemblies. Facilities and equipment are also provided to receive, unload, inspect and identify, overpack or repair (as required), label, monitor, and store canisters of solidified, high-level waste (HLW); canisters of compacted, nonfuel-bearing components from fuel assemblies; and also canisters and drums of high-activity waste/remotely handled transuranic (HAW/RHTRU) waste. The facility provides for the decontamination of cask exteriors, vehicles, and equipment used in performing all operations at the facility.

31.2 CODES, STANDARDS. ORDERS, AND GUIDES

The design complies with appropriate requirements of the latest editions of the Codes and Standards, DOE Orders, and Federal Regulations listed below.

31.2.1 CODES AND STANDARDS

(1) Air Moving and Conditioning Association, Inc. (AMCA)(1973 and 1984)

(2) American National Standards Institute (ANSI)

  (a) ANSI N13.1 - 1969, Sampling Radioactive Materials in Nuclear Facilities

  (b) ANSI N42.18 - 1980, Onsite Instrumentation for Continuously Monitoring Radioactive Effluents

  (c) ANSI N16.1 - 1975, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors

(3) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standards for Heating, Ventilating and Air Conditioning

31.2.2 DOE ORDERS

DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations.

31.2.3 FEDERAL REGULATIONS

(1) 10 CFR 20, Standards for Protection Against Radiation

(2) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

31.3 LICENSING

The MRS Facility will be licensed by the Nuclear Regulatory Commission. It will comply with those portions of Title 10, Code of Federal Regulations (10 CFR), and Regulatory Guides pertaining to the control of radioactive materials.

31.4 RADIOACTIVE MATERIALS CONTAINMENT

The storage facilities will be capable of containing radioactive material within the storage package during the entire storage period, and will have a monitoring system capable of detecting releases of radioactive material greater than 0.1% of 10 CFR 20, Appendix B, Table II. Operating personnel and the public will be protected from release of radioactive particulate material and gases that would cause exposure of operating personnel and the public (as measured at the site boundary) to doses greater than those defined in 10 CFR 20, 10 CFR 72, and other federal regulations and guides.

31.5 SPENT FUEL HANDLING AND CONSOLIDATION

The dominant sources of contamination in the MRS Facility will be the spent-fuel disassembly/consolidation operation and the fuel assembly skeleton shredding operation. Several examples of contamination centers in this area are listed.

31.5.1 CONTAMINATION BARRIERS

The inlet and discharge ports will be provided with contamination barriers to prevent the spread of contamination during cask unloading/loading. These contamination barriers, at the receiving end of the process cell, will mate with shipping cask adapters designed to present a common interface to the cell intake ports. At the cell discharge ports, the contamination barrier is designed to interface with the concrete storage cask or the transfer shield.

31.5.2 CONTAMINATION CONTROL - DISASSEMBLY/CONSOLIDATION STATION

The disassembly/consolidation station will generate a large volume of loose crud. This crud will be scraped from the fuel assemblies during disassembly and consolidation. In addition, the laser cutting operation will vaporize activated fuel assembly structural metal and there will be particulates from spent-fuel pellets spilled because of fuel and breakage during the disassembly/consolidation operations. An HVAC flow duct will provide air flow downward around the disassembly/consolidation station to draw the loosened crud and vaporized metal down, away from the disassembly station and through roughing filters. This duct connects into the cell HVAC duct and filter system. The roughing filter at the disassembly station and the in-cell HVAC filter will collect most of this material.

The contaminants in the process cells that are not trapped in this system will be deposited on the process cell surfaces and equipment, and also in the HVAC system filters. This will confine the contamination and prevent its spread. A vacuum cleaner will be used in this area to assist in preventing a massive crud buildup over the facility lifetime.

31.5.3 CANISTER DECONTAMINATION

The exterior of the canisters should not be grossly contaminated during the consolidated fuel loading and the canister closure weld operations. Subsequently, the canister will be deconned with Freon 113. This operation will also leak-test the canister closure welds. After deconning, the canister will be checked for surface contamination. The canister will be released to storage when the surface contamination is reduced to acceptable levels as defined in 49 CFR 173.443.

31.5.4 SHIELDED PROCESS CELL CONTAMINATION BARRIER

The four shielded process cells have been designed with a contamination barrier that separates the process cells from the canyon cells at the interface of the fuel disassembly and the canister welding station. The purpose is to minimize carryover of contaminants from the disassembly side to the welding side, where clean canisters are processed and stored.

31.6 <u>WASHDOWN AND DECONTAMINATION AREAS</u>

An incoming air control vestibule, designed as a confinement, washdown, and inspection area, is separated from the cask receiving, inspection, and shipping areas by walls.

A personnel monitor/decontamination station is provided at each exit from the operating areas, and is supplied with hot and cold potable water and connection to LLW.

31.7 VENTILATION

The heating, ventilating, and air-conditioning (HVAC) systems for all buildings throughout the MRS Facility will provide an environment necessary for personnel comfort and safety, and for protection of personnel and equipment during normal, abnormal, and accident operating conditions.

All areas containing radioactive materials will be equipped with a ventilation system designed to maintain internal air pressure negative with respect to atmospheric pressure. These systems will be equipped with high-efficiency particulate air (HEPA) filters. Release of contaminants to the environment at the point of release is maintained within the constraints of DOE Order 5480-1A, Chapter XI, Change 6, for environmental standards for exposure to the general public or as depicted in 10 CFR 20. Building areas will be divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. To limit contamination spread, air-control vestibules, backdraft dampers, and other barriers will be provided to separate ventilation control zones from one another. The control room within the R&H Building is a Zone 4 area, and will be maintained at a slightly higher positive pressure by a separate HVAC system.

31.8 PIPING SYSTEMS

Utility piping systems will be kept to a minimum in the operating areas, and will be arranged to facilitate decontamination. All piping systems that contain contaminated gases or liquids will be isolated from noncontaminated (clean) systems. The contaminated piping systems will be constructed of corrosion-resistant materials, and will be located for easy accessibility.

Drains from the shielded process cells and other radioactive waste streams will be routed through doubly encased lines (original line inside a secondary encasing line) to the radwaste facilities for processing and disposition. Telltale sample drains will be installed in the secondary encasing pipe to monitor leaks in the original pipe. Effluent from personnel decontamination sinks and showers, and other, similar streams will be connected to the radwaste system.

31.9 RADIATION MONITORS

Area radiation monitors will be located appropriately throughout the storage facility to alert operations personnel to unusual radiation levels. Audible and visual alarms will be automatically activated at the storage site and the R&H Building control room. Air monitors and samplers will be provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from leaking storage receptacles.

All monitoring systems will be capable of measuring the process parameters related to system integrity, radiological safety, and retrievability over the full range of levels anticipated during normal or credible abnormal conditions.

All potentially contaminated work areas will be provided with personnel monitoring equipment to be used in checking all personnel for contamination upon leaving the work areas.

A monitoring system is provided to monitor:

(1) Loss of fuel or waste canister integrity
(2) Loss of storage system containment integrity
(3) Storage system operating conditions
(4) Degradation of storage system radiation shielding
(5) Loss of retrievabilty
(6) Loss of ventilation
(7) Loss of filtration
(8) Gaseous and liquid effluent

31.10 DECOMMISSIONING

Provisions have been made to facilitate decontamination of structures and equipment, and to minimize the quantity of radioactive waste and contaminated equipment resulting from decommissioning.

SECTION 32

DECONTAMINATION AND DECOMMISSIONING

In accordance with 10 CFR 72.76, the MRS Facility is designed for decommissioning at the end of its useful life. Provision is made to

(1) Facilitate decontamination of structures and equipment.

(2) Minimize the quantity of radioactive wastes and contaminated equipment.

(3) Facilitate the removal of radioactive wastes and contaminated materials at the time the facility is being permanently decommissioned.

To provide reasonable assurance that the decontamination and decommissioning can be accomplished, 10 CFR 72.18 requires a decommissioning plan to be prepared. This plan must contain sufficient information for the proposed practices and procedures for decontamination of the site and facilities and for the disposal of residual radioactive materials in such a way that the decommissioned facility will not jeopardize the safety of the public.

The decommissioning plan must also include financial arrangements to provide reasonable assurance that the planned decontamination and decommissioning will be carried out.

32.1 DECONTAMINATION

The conceptual design philosophy and rationale for equipment and utility arrangements for decontamination are based upon operational experience and procedures used for other existing radioactive material-handling facilities. Therefore, to maintain good housekeeping practices, the capability has been provided to control the buildup of contamination on facility surfaces and equipment components and to decontaminate the onsite-generated waste packages during operations to minimize the contamination levels before decommissioning. These same capabilities will be used to support the final facility and site decontamination before decommissioning the MRS Facility. The Environmental Assessment Report identifies the anticipated contamination levels before decommmissioning based on periodic decontamination activities during the MRS Facility operations.

The design rationale is to provide single and multiple decontamination stations and agents in the areas where the highest level of contamination will occur. The station locations are shown in Drawing H-3-56831, Sheets 1 through 5.

The following features have been provided in the design to facilitate decontamination activities:

(1) Expendable vacuum cleaners.

(2) Portable decontamination carts with high-pressure (1,000-psi) spray wands.

(3) Stainless steel liner plate on floor and walls of all shielded process cells, shielded canyon cells, remote handled equipment maintenance rooms, decon rooms, high-activity radwaste treatment cell, and on the floor of the liquid radwaste slurry pump, evaporator, and crane maintenance areas. The lining is seal-welded without cracks or crevices and has all corners coved. All unlined surfaces in these areas are covered with a decontaminable protective coating.

(4) All other areas within the Receiving and Handling Building, where the potential of the spread of contamination exists, have all surfaces covered with protective coatings that meet the current nuclear industry standards; i.e., resistant to decontamination agents. For room finishes, see Drawing H-3-56775, Sheets 1 through 4.

(5) All areas that house tankage or equipment containing contaminated liquids are curbed to limit the spread of the liquids.

(6) Curbs are provided throughout the Receiving and Handling Building to limit the spread of contamination during decontamination activities.

(7) The decontamination stations located at various locations within the Receiving and Handling Building contain an aqueous cleaning solution manifold. Decontaminant headers are provided in the corridors adjacent to the areas containing the decontamination stations. These headers are valved before their entrance to the potentially contaminated areas. In addition, the supply headers entering the shielded process cells are provided with removable spool pieces to prevent accidential release of liquids into the cell area. The decontamination stations are provided with quick disconnects, which can be operated for remote or hands-on connection of decontamination hoses. Depending on the area served, the stations are supplied from a central or portable decontamination solution makeup system supplying decontamination solutions (detergent, acid, caustic, steam, foam, and deionized water). The decontamination solution and steam are delivered at 50 psi and the solution at 160^{O}F.

(8) All spent decontamination solutions generated in the potentially contaminated areas are collected in sumps and jetted to either the low-level or high-activity liquid radwaste system for processing.

(9) Personnel entry into the areas of potentially high contamination (shielded process cells, shielded canyon cells, remote handled equipment maintenance rooms, decon rooms, high-activity radwaste

cell, crane maintenance area, and remote handling air filtration cells) for the purpose of expediting decontamination or emergency maintenance is through air locks and health physics storerooms adjacent to the contaminated areas. The health physics storerooms are equipped with portable radiation monitoring and survey instrumentation and with communications systems. Life support stations (breathing air manifolds and emergency air supply backup system) are provided in the air locks, health physics storerooms, or contaminated areas. A protective, disposable cover is provided to prevent the contamination of the breathing air connection.

(10) Personnel decontamination facilities are provided in the health physics treatment room.

32.2 DECOMMISSIONING

In accordance with 10 CFR 72.76, provisions have been made to facilitate the decontamination/decommissioning operations in order to reduce radiation exposure to the public and decommissioning personnel, reduce radioactive waste volumes, and reduce costs resulting from the decommissioning.

As noted herein, these provisions include good housekeeping during operations, controlled personnel access, access for equipment removal, equipment design, installed radiation monitors, adequate work space, installed decontamination systems and areas, control of all effluents, and operational documentation.

32.2.1 GOOD HOUSEKEEPING

The design has assumed, and has provided the systems and areas for, scheduled decontamination of contaminated areas and equipment during operations to prevent the accumulation of radioactive material. (See Table 32-1.) In addition, all waste packages will be surveyed and, if required, decontaminated before placement in their storage configuration to minimize the potential for contamination of the storage facilities. While in storage, the storage positions will be monitored to detect any potential leakage from the waste packages. If an off-normal condition is detected, the waste packages and cask will be returned to the Receiving and Handling Building for waste package decontamination and, if required, overpacking and cask decontamination before their return to storage. The waste package from the drywell will be retrieved, overpacked, and decontaminated in the Receiving and Handling Building; the drywell will be decontaminated and, if required, removed and shipped to a low-level waste disposal site. By use of good housekeeping procedures, the exposure level to the decommissioning personnel will be minimized.

32.2.2 CONTROLLED PERSONNEL ACCESS

Personnel access into highly contaminated areas (e.g., shielded process cell) is controlled by locked and alarmed doors at the air locks leading to the contaminated areas. (See Subsection on Decontamination, item 9.)

Table 32-1 - Decontamination of High-Activity Radiation Areas and Equipment

Radiation Area	Frequency[a]	Technique	Liquid Application Rate	Area (sq ft)
Process cells	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	15,192
Maintenance cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	38,352
High-activity radwaste cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	7,392
Remote equipment decontaminating room	All surfaces: semiannually	Remote: high-pressure rinse. Contact: as required.	1.0 gal/sq ft	1,760
Remote handling air filtration cell	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	51,213
Filter compaction area of remote handling air filtration cell	All surfaces: annually	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft	1,680
Crane maintenance room	All surfaces: annually	Contact: dry vacuum, foam, wet vacuum, high-pressure rinse.	0.5 gal/sq ft	60,048 (13 rooms)
Process cell ventilation ducts between nontestable and testable HEPA filters	Internal surfaces: 5 yr	Remote: self-propelled spray hose.	1.0 gal/sq ft	8,550
Drum decontaminating cells	All surfaces: 5 yr	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft	Each cell different size

[a]Actual decontamination will be on an as-required basis. Frequencies given are for calculation purposes only.

Table 32-1 (Contd)

Radiation Area	Frequency[a]	Technique	Liquid Application Rate	Area (sq ft)
Canyon cell	All surfaces: 5 yr	1. Floor near canister upender equipment: Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft	6,020
		2. Other surfaces: Contact: vacuum, mop, and rinse.	1.0 gal/100 sq ft	54,452
Cranes (in crane maintenance cells)	All surfaces: monthly	Contact: mops, rags, high-pressure rinse.	60 gal/decon	
Crane hooks and power mast wrist	All surfaces: monthly	Remote: high-pressure rinse.	10 gal/decon	
Compaction equipment in remote air filtration cell	Annually	Remote: high-pressure rinse. Contact: electro-polisher, as required.	1 gal/sq ft	500
Sealed storage canisters	3,253 canisters/yr	Remote: Freon.[b]	-	
In-cell equipment components	Every 2 wk	Remote: high-pressure rinse, electropolisher, or Freon spray, as required.	1 gal/sq ft	Each component different size
Secondary waste drums	1,582 drums/yr	Remote: Freon.[b]	-	
HAW filter drums	676 drums/yr	Remote: Freon.[b]	-	
Solid radwaste drums (assume 50% contaminated)	17 drums/yr	Remote: high-pressure rinse.	20 gal/drum	
Manipulators (70, once every 2 wk)	1,820 decons/yr	Remote: Freon.[b]	-	
Tool decontamination	As needed	Remote: Freon or electropolisher, as required.	-	

[b]Water-soluble contaminants are not expected.

32.2.3 EQUIPMENT ACCESS

To facilitate the removal of contaminated equipment, floor or roof panels and hatches and/or labyrinth and door openings have been provided and sized to accommodate the largest equipment component contained or handled within the potentially contaminated areas.

32.2.4 EQUIPMENT DESIGN

The design of all equipment located in potentially contaminated areas has been evaluated as to maintenance requirements and the effect on personnel exposure. Equipment items that were judged to become highly contaminated and/or located in a highly contaminated area were designed for remote removal, maintenance, and/or replacement. Provisions were made for their decontamination and repair within a shielded area. If the equipment item is unrepairable because of cost, personnel exposure, or type of failure, it will be decontaminated, reduced in size if required, packaged, and shipped to a waste disposal site. Equipment items that were judged to be repaired "hands-on" are provided with the capability to be decontaminated in-place before maintenance activities or removed from the operating area for decontamination and repair in dedicated maintenance rooms.

32.2.5 INSTALLED RADIATION MONITORS

The design includes installed continuous air monitors, installed radiation area monitors, and portable personnel monitors throughout the potentially contaminated areas of the Receiving and Handling Building. These systems will also be used during the decommissioning operations to provide for personnel safety.

32.2.6 ADEQUATE WORK SPACE

The equipment has been so arranged that adequate work space has been reserved for maintenance and for equipment removal. The space allocations include pull spaces, laydown areas, personnel access, and provision for portable and installed handling equipment, where required. Installed equipment includes remote operated cranes, manipulators, hoists, and carts.

32.2.7 INSTALLED DECONTAMINATION STATIONS

As noted in the Decontamination section, items 2 and 7, installed and portable decontamination stations or carts have been provided for the operational mode. These same systems and areas can be used for the decommissioning operation.

32.2.8 CONTROL OF EFFLUENTS

The decontamination of the MRS Facility during its decommissioning phase will primarily be conducted in the Receiving and Handling Building. Therefore, the control of effluents can be accomplished by use of the existing containment barriers, ventilation system, and radwaste treatment systems.

32.2.9 OPERATIONAL DOCUMENTATION

Operational documentation includes complete and accurate drawings, specifications, and construction material listings (including all modifications), along with operational maintenance, radiological, and decontamination records. Operational records will be useful to indicate improved methods of operation, equipment removal, or decontamination, as well as the history of the facility, including areas and possible extent of contamination. This documentation is particularly important because of the potential operating life of the MRS Facility.

32.3 DECOMMISSIONING PROCEDURES

To ensure completion of the decommissioning in a safe and reliable manner, detailed administrative controls and procedures need be developed and approved before the initiation of work. These procedures will include the methods to be used, delineation of responsibilities, safety considerations, and normal and emergency actions for all subtask levels. All steps will be taken to limit or minimize radiation exposure to onsite and offsite personnel in accordance with ALARA principles.

Under the present state-of-the-art, the following three basic methods are available to decommission the MRS Facility:

(1) DECON is the immediate removal of all radioactive material down to residual levels that are acceptable for release of the property for unrestricted use (Regulatory Guide 1.86).

(2) SAFSTOR is a means to prepare and maintain the radioactive facility in a condition that risk to public and site personnel safety is acceptable for a period of storage followed by decontamination to levels that permit release of the facility for unrestricted use.

(3) ENTOMB is the encasement and maintenance of radioactive material or property in a strong and structurally long-lived material (e.g., concrete) to ensure retention until all radioactivity decays to levels that permit release of the property for unrestricted use.

Because the basic philosophy for decommissioning the MRS Facility is to restore it to unrestricted use as soon as possible and at the lowest cost, ENTOMB was not considered as a feasible alternative. SAFSTOR, which is basically deferred decontamination, was also rejected because the ongoing maintenance and monitoring costs (assumed to be 50 to 100 years, followed by decontamination) would exceed the DECON costs. The DECON method was selected as the decommissioning method for the MRS Facility. The facility and related equipment are decontaminated to a level acceptable for unrestricted use, as defined in Regulatory Guide 1.86, Table 1. Equipment and facility components whose contamination levels remain unacceptable are dismantled and removed to a waste disposal site.

The assumptions made as to the final disposal of the MRS Facility structures and systems are:

(1) Sealed storage casks will be emptied, and decontaminated to acceptable levels, if required; the shielding plug will be replaced; each cask will then be lead sealed and permanently stored onsite. Casks that cannot be decontaminated to an acceptable level will be removed from the site.

(2) Drywells will be emptied, decontaminated to acceptable levels, if required; the shielding plug will be replaced; each drywell will then be lead sealed and covered with soil.

(3) The exterior of transportable metal casks will be decontaminated to acceptable levels, if required, and the casks will be shipped offsite.

(4) The CHTRU Facility will be emptied, and decontaminated to acceptable levels, if required; shield covers will be replaced and left onsite.

(5) Receiving and Handling Building equipment and components will be removed; decontaminated to acceptable levels, if required; and shipped offsite. The building will be sealed and left onsite.

A basic approach in this philosophy is to use the capabilities of the Receiving and Handling Building to aid in decommissioning other parts of the MRS Facility. The MRS Facility decommissioning plan has been sequenced in four phases, as shown in Figure 32-1. Phase I includes the decommissioning of the CHTRU Storage Facility concurrently with the decommissioning of the sealed storage cask or drywell storage components, transportable metal casks, and onsite transporters. Concurrently with the stored waste package loadout, the consolidation and the secondary scrap-processing equipment contained in the shielded process cells and the adjacent decon cells will be decommissioned and the areas decontaminated. Other areas of the Receiving and Handling Building would be used to directly support the SF, HLW, and RHTRU Storage Facilities and transportable metal casks decommissioning and provide utility, monitoring, and laboratory support for the decommissioning of the effort.

Phase II includes the decommissioning of the SF, HLW, and RHTRU storage area site, using the Receiving and Handling Building for utility, monitoring, and laboratory support. In addition, the decommissioning of the Receiving and Handling Building will be initiated.

Phase III includes the decommissioning of the protected area site, using the Receiving and Handling Building for utility, monitoring, and laboratory support. After completion of the site decommissioning, the decommissioning of the Receiving and Handling Building radwaste systems and laboratory will be completed.

During all of the above decommissioning phases, the MRS support buildings and limited area are required. Upon final decommissioning of the Receiving and Handling Building, all areas and facilities of the MRS Facility will be released for unrestricted use (Phase IV).

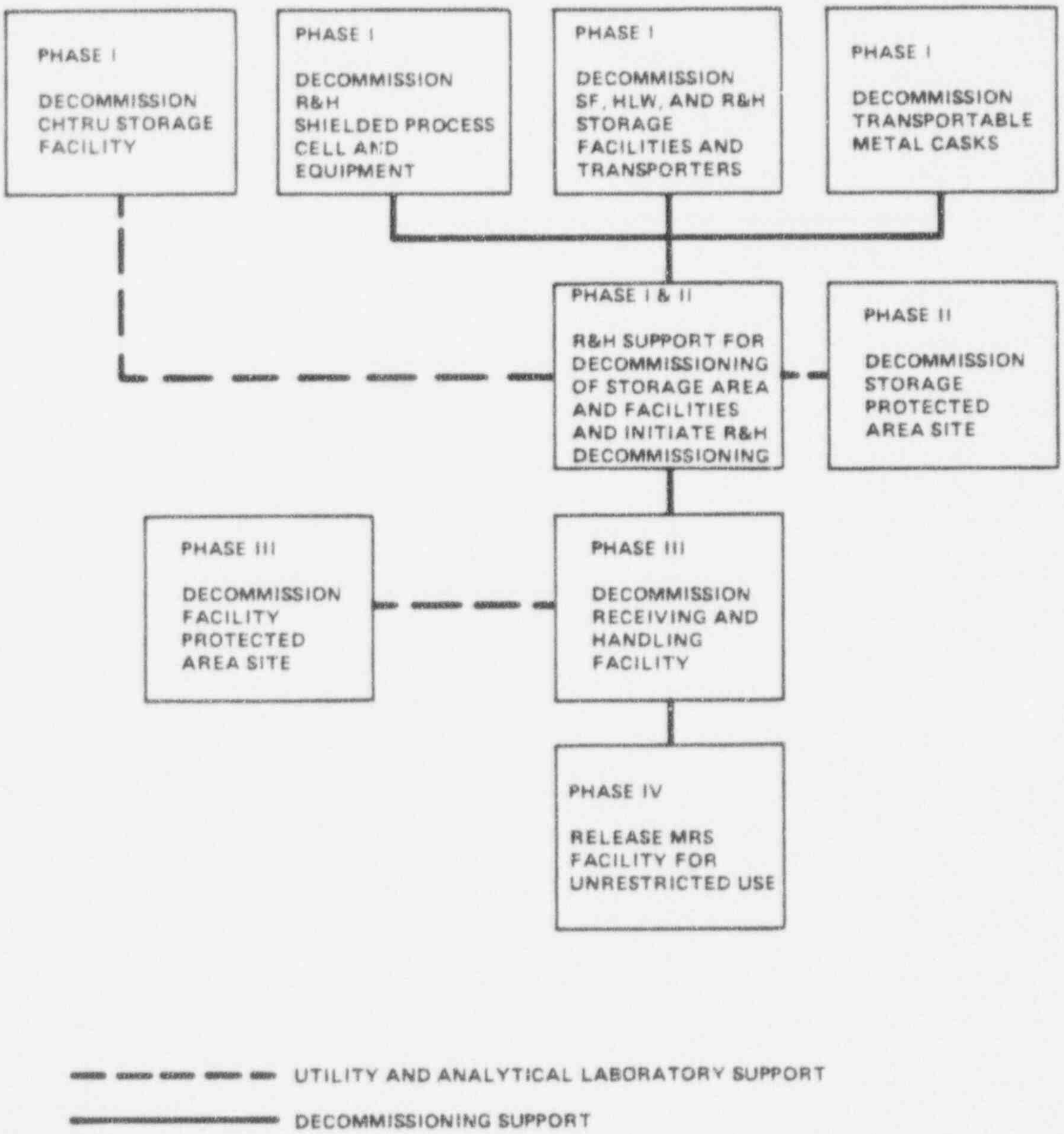

Figure 32-1

MRS Facility Decommissioning Sequence

The following discussion describes the methods and facilities to be used and the sequence for the MRS Facility decommissioning campaign.

32.3.1 SHIELDED STORAGE CASKS

It is planned that the sealed storage casks will be decommissioned in the sequence shown in Figure 32-2 and as described hereunder.

The design provides the capability to monitor the cask interior air space and the temperature of the liner. These measurements will be taken and recorded during the lifetime of monitored casks. Before a cask is removed from storage for unloading, the cask will be monitored and results compared with the historical data to determine whether any special precautions need to be taken during the unloading operation. This last sample will also provide an indication of potential contamination of the cask interior.

Upon completion of the gas sample analysis and approval to move and unload the cask, the cask transporter moves the cask to the transfer/discharge corridor within the Receiving and Handling Building, where the outer lid is removed while the cask remains on the transporter. After lid removal, the cask is moved into the loadout and decon room, where the cask is mated to a loadout port in the floor of the overpack/weld/discharge area. The cask shield plug is removed by the area crane, and the waste packages are removed, visually inspected, and loaded into a shipping cask. After removal of the waste packages, the loadout port is closed and the cask is moved into the transfer/discharge corridor, where the cask interior is surveyed and, if found to have levels less than acceptable for unrestricted use, is moved back into the loadout and decon room, where the loadout port is opened and the cask shield plug is replaced. If the cask interior is found to have a level greater than that allowed for unrestricted use, the cask is moved into a temporary decon shelter, equipped with a temporary HVAC system (HEPA filtration), located in the transfer/discharge corridor. The cask is decontaminated and, if the unrestricted use level is achieved, is moved into the loadout and decon room for replacement of the shield plug. If the acceptable level cannot be achieved, the cask is destroyed while in the enclosure, and the debris is packaged and shipped to a waste disposal site.

All casks that meet the requirements for unrestricted use are moved to their original storage positions and permanently stored.

Upon completion of this campaign, the cask transporter is surveyed; decontaminated if required or parts removed, decontaminated, and replaced; and shipped offsite. Any parts that cannot be decontaminated to a safe level are packaged and shipped to a waste disposal site. In addition, the temporary enclosure and the transfer/discharge corridor are decontaminated to acceptable levels.

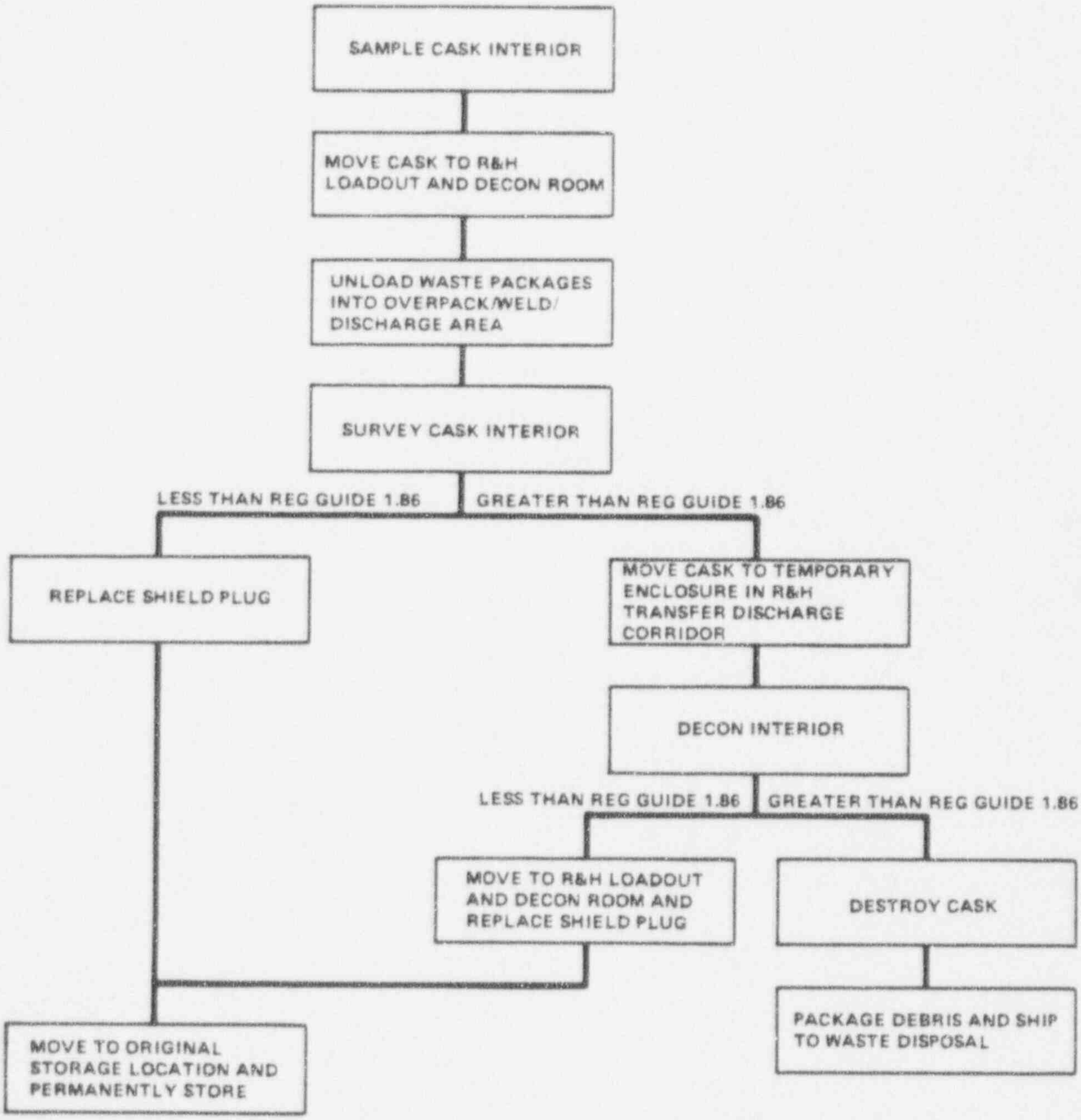

Figure 32-2

Sealed Storage Cask Decommissioning

32.3.2 DRYWELL

It is planned that the drywell will be decommissioned in the sequence shown in Figure 32-3 and as described hereunder.

The design provides the capability to monitor the drywell interior space and the temperature of the drywell casing. These measurements are taken and recorded during the lifetime of monitored drywells. Before waste package removal, the drywell is monitored and the results compared with the historical data to determine whether any special precautions need be taken during the unloading operation. This last sample will also provide an indication of potential contamination of the drywell interior. If the gas sample indicates that special precautions are required, a temporary enclosure with a self-contained HVAC system (HEPA filtration) and with special personnel protective systems will be provided during the drywell unloading.

Upon completion of the gas sample analysis and approval to open the drywell, the shielded transporter moves the waste package and shield plug to the loadout and decon room in the Receiving and Handling Building. The transporter cask is mated to the loadout port in the floor of the overpack/weld/discharge area, and the waste package is removed, visually inspected, and loaded into a transport cask. After removal of the waste package, the shield port is closed and the transporter is moved into the transfer and discharge corridor, where the shield plug and transporter are surveyed. If found to have levels less than acceptable for unrestricted use, the shield plug is moved by the transporter and placed in a drywell that has been surveyed and accepted for unrestricted use. If the transporter is contaminated and/or the shield plug is found to have a level greater than acceptable for unrestricted use, they are moved into a temporary decon shelter, with temporary HVAC system (HEPA filtration), located in the transfer/discharge corridor. The shield plug is decontaminated and, if the unrestricted use level is achieved, it is replaced in an acceptable drywell. The transporter is decontaminated, if required, and released to retrieve another waste package. The shield plug is destroyed, and the debris is packaged and shipped to a waste disposal site if an acceptable level cannot be achieved.

After the waste package is removed from the drywell, the drywell is surveyed to determine the contamination level. If the level is less than that allowed for unrestricted use, an acceptable shield plug is replaced, lid sealed, and the drywell surface is covered with soil. If the survey indicates a contamination level greater than that allowed, the drywell is decontaminated to an acceptable level within the temporary enclosure, using portable decontamination equipment. When the acceptable level is achieved, the shield plug and lid are replaced, and the drywell is covered with soil.

Upon completion of this campaign, the transporter is surveyed; decontaminated, if required, or parts removed, decontaminated, and replaced; and shipped offsite. Any parts that cannot be decontaminated to an acceptable level are packaged and shipped to a waste disposal site. In addition, the

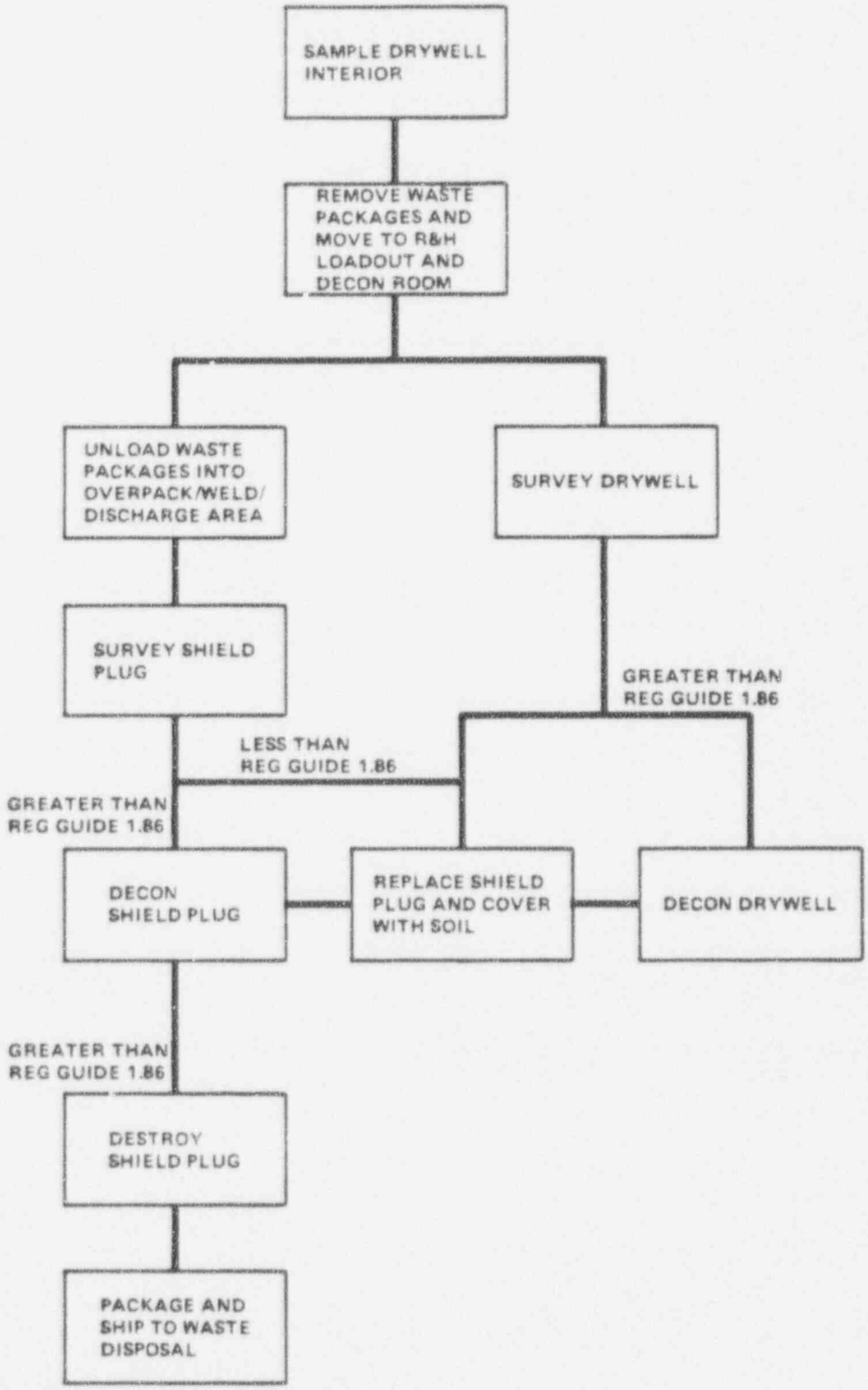

Figure 32-3

Drywell Decommissioning

temporary enclosure and the transfer/discharge corridor area are decontaminated to an acceptable level.

32.3.3 TRANSPORTABLE METAL CASKS

It is planned that the transportable metal casks will be decommissioned in the sequence shown in Figure 32-4 and as described hereunder.

The transportable metal casks are equipped for monitoring the interior of the cask, which will be accomplished on a periodic basis during its storage lifetime. Before cask removal for shipment offsite, the cask is monitored and the results compared with the historical data to determine whether any special precautions need be taken during final cask inspection.

Upon completion of the gas sample analysis and approval to move the cask, the cask is moved into a cask unloading and decon room within the Receiving and Handling Building. Using the existing cask gas sample ports, the cask is pressurized and leak-tested. If the seal performance is acceptable, the cask is loaded onto offsite transporters and shipped. If the tests indicate the seals are defective, the cask is mated to an entry port in the floor of a shielded process cell, and waste packages are unloaded and stored using the in-cell crane. The inner cask cover is replaced, the entry port is closed, and the outer cask cover is replaced, using existing equipment in the unloading and decon room. The empty cask is returned to the transportation system for repair. The stored waste is loaded into a new cask and shipped offsite.

32.3.4 CHTRU FACILITY

It is planned that the CHTRU Facility will be decommissioned in the sequence shown in Figure 32-5 and as described hereunder.

The CHTRU Facility is a compartmentalized, near-surface structure with the capability for monitoring the interior environment of each compartment. During operation, each compartment is monitored on a periodic basis. Before waste unloading and final packaging, a temporary structure with a self-contained HVAC system (HEPA filtration), such as an air structure, is placed over the CHTRU Facility. Each compartment is monitored and the results are compared with historical data to determine whether any special precautions need to be taken before removing shield plugs.

Upon completion of the gas sample analysis and approval to open the compartment, the shield plug is removed and the pallets containing the waste containers are removed, surveyed, and, if required, decontaminated. The containers, pallets, and any plates are packaged within the temporary structure into a shipping package. The decontamination fluids are routed to the Receiving and Handling Building liquid radwaste system by tank truck.

After the compartment has been unloaded, it is surveyed and any contaminated surfaces are decontaminated or removed to achieve an acceptable level for unrestricted use. Removed material is packaged and shipped to a waste disposal site.

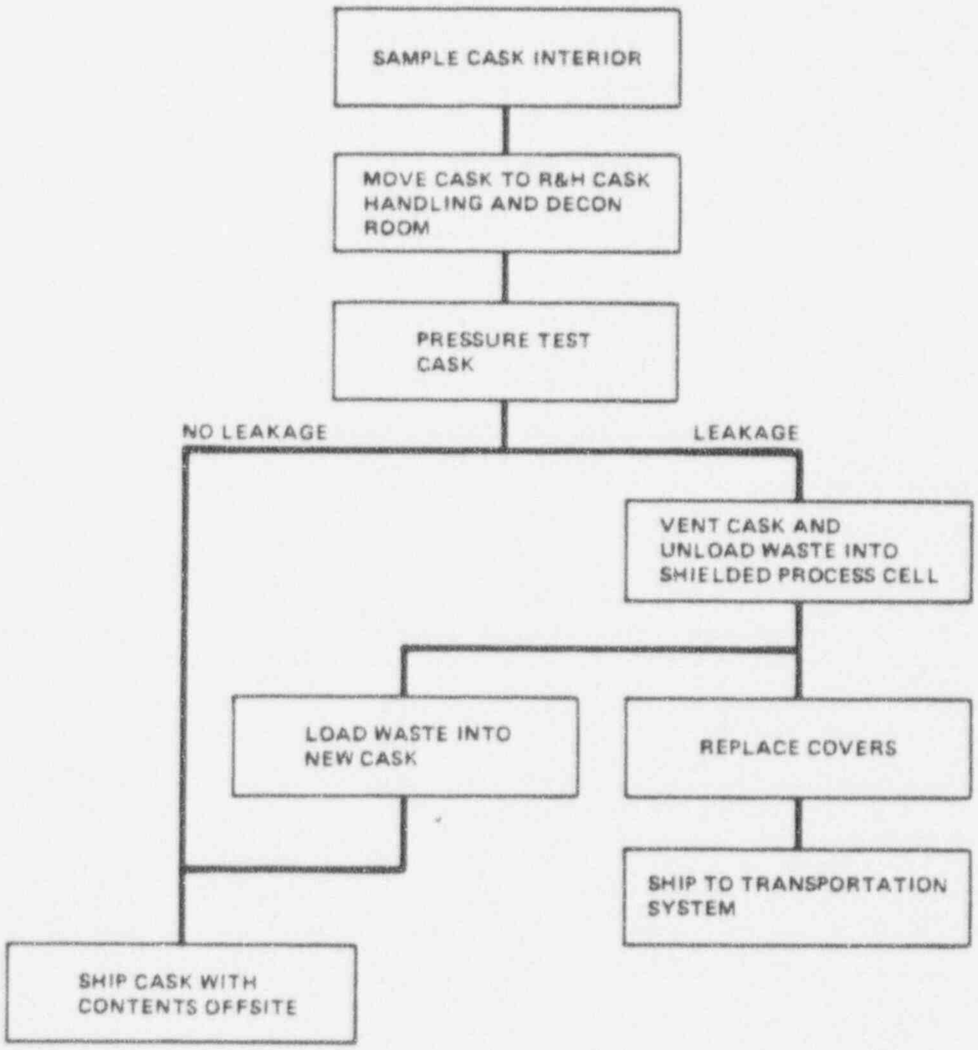

Figure 32-4

Transportable Metal Cask Decommissioning

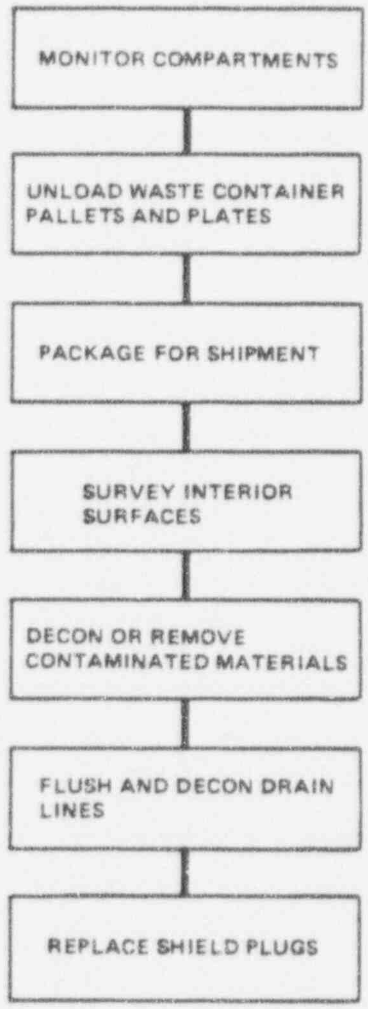

Figure 32-5

CHTRU Facility Decommissioning

Upon completion of the survey and decontamination, the shield plug is replaced and the drain lines are flushed, decontaminated, and grouted.

32.3.5 RECEIVING AND HANDLING BUILDING

It is planned that the Receiving and Handling Building will be decommissioned in the sequence shown in Figure 32-6 and as described hereunder.

As previously noted, decommissioning of the shielded process cells and their contained equipment will start and be completed during the MRS Facility waste loadout phase. Decontamination operations will be accomplished by using the existing facility decontamination system. It is planned that the overpack/weld/discharge areas will be used as the primary loadout stations. This will allow decommissioning of the shielded process cells.

Preliminary decontamination of the consolidation, secondary scrap volume reduction, lag storage rack, and other shielded process cell equipment is accomplished remotely within the shielded process cell. After initial decontamination, all equipment is transferred to the remote handled equipment maintenance room, volume reduced, surveyed, packaged, and outloaded either as low-level or high-activity waste.

Upon completion of the initial equipment decontamination and equipment removal, preliminary shielded process cell decontamination is initiated. This consists of remote vacuuming and liquid decontamination of cell surfaces. All decontamination solutions generated are routed to the high-activity radwaste treatment system. After the preliminary decontamination operation, the cell interior is surveyed, and a final contact decontamination operation is accomplished until the cell interior reaches acceptable levels as defined in 49 CFR 173.443.

After all contaminated equipment has been decontaminated and packaged, the remote handled equipment maintenance room equipment is decontaminated, packaged, surveyed, and outloaded as high-activity waste or low-level waste.

Because all spent fuel handled within the in-cell lag storage vault is contained within sealed canisters, it is not anticipated that this area will be highly contaminated. Consequently, manned entry for final decontamination is assumed for this area. To gain easy access to the storage vault area, a portion of the vault roof will be removed. All areas within the vault are surveyed and, if required, decontaminated by contact methods. All decontamination solutions generated are routed to the low-level radwaste treatment system.

Upon completion of the MRS Facility loadout phase, the decommissioning of the weld/test/decon and the overpack/weld/discharge areas is initiated. Similar to the shielded process cells, preliminary decontamination of the equipment is accomplished remotely before removal to the remote handled equipment maintenance room. Final volume reduction, surveying, and packaging

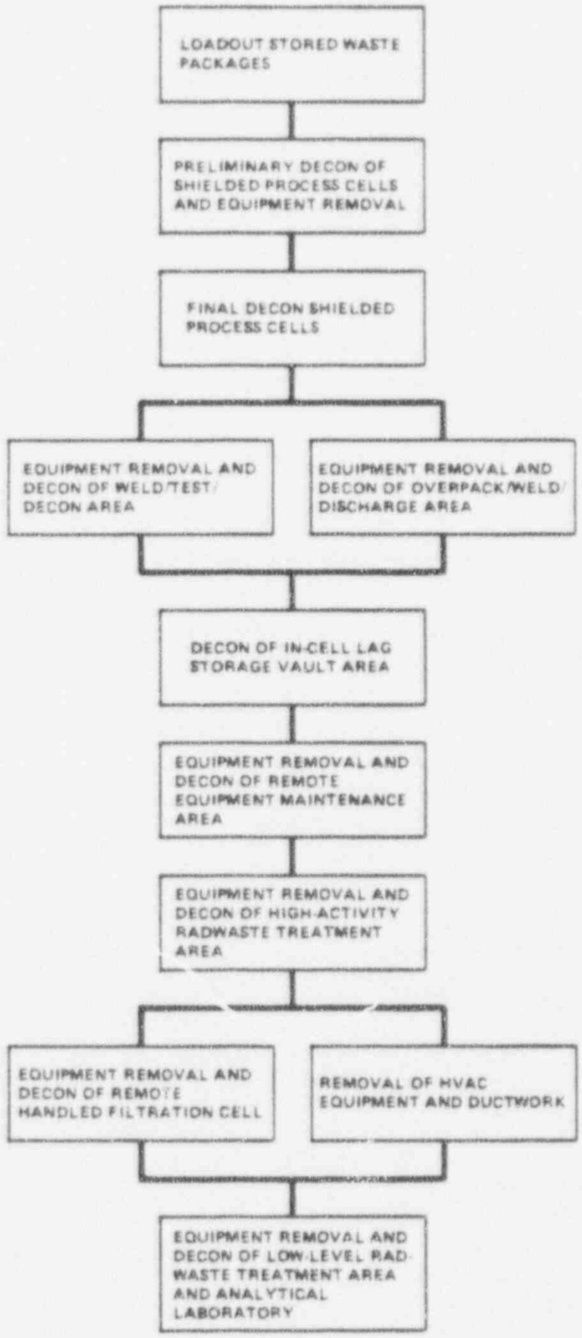

Figure 32-6

Receiving and Handling Building Decommissioning of this equipment are accomplished in the remote handled equipment maintenance room. All decontaminates generated are routed to the high-activity radwaste treatment system. Final decontamination is accomplished as described for the shielded process cells. The remote handled equipment maintenance room and service gallery are decontaminated to acceptable levels, using the existing decontamination stations and systems. All decontamination solutions generated are routed to the high-activity radwaste system.

Other equipment associated with the in-cell operations, cranes, manipulators, etc., are decontaminated to acceptable levels, dismantled, and removed from the site. All other major facility equipment is surveyed and removed from the site. All other systems, piping, electrical, etc., are surveyed and, if found to be at acceptable levels, sealed and left in place. If not found to be at acceptable levels, they are removed and shipped offsite.

All high-level radwaste streams are contained within equipment or piping systems. Except for leaks or equipment failure, the interior of the high-activity radwaste treatment cell should not become contaminated. It is assumed that, when spills are encountered during opeations, the area is remotely decontaminated to an achievable level. Before equipment, piping, and component removal, the systems are flushed with decontamination solution and recycled through the system until manned entry is feasible. Further decontamination of the system components and cell area is accomplished by contact methods. The equipment and piping are removed, volume reduced, surveyed, packaged within the cell, and shipped to a waste disposal site. All decontamination solutions generated during the final decontamination phase are routed to the low-level radwaste treatment system.

Before disassembly of the facility HVAC exhaust system, a temporary HVAC exhaust system (HEPA filtration) is installed to service the low-level radwaste areas and the analytical laboratory. The facility system will continue to operate until little, if any, radioactive particulate buildup occurs in the first- and second-stage HEPA filters. The facility exhaust system is deactivated and the ductwork and accessories between the shielded process cells, remote handled equipment maintenance room, service gallery, weld/test/decon area, and overpack/weld/discharge area are decontaminated in place and dismantled. The dismantled items are surveyed and, if required, the dismantled items are further decontaminated, packaged, and surveyed in the low-level solid radwaste area before shipment for disposal. Filter plenums are decontaminated in place, and will remain in the MRS Facility. The remaining facility HVAC exhaust and supply systems are surveyed and decontaminated to acceptable levels, if required. If acceptable levels are achieved, the equipment, ductwork, and components remain in place. If acceptable levels cannot be achieved, the items are removed and shipped offsite.

Because all radwaste resulting from the site and final phases of the Receiving and Handling Building decontamination operations is routed to and treated by the existing low-level radwaste system and the analysis of samples and swipes is made in the analytical laboratory, these two areas will remain operational until all other areas of the MRS Facility are decontaminated to an acceptable level. Before decommissioning of these final two areas, a survey of all areas and remaining components of the Receiving and Handling Building is conducted to ensure their release for unrestricted use. At the same time, the low-level liquid and solid radwaste and the analytical laboratory equipment are flushed until the contamination level of the effluent is below acceptable standards. When this level has been achieved, the analytical laboratory is disassembled, and the equipment is decontaminated, if required, and packaged for disposal in the low-level solid radwaste area.

The low-level liquid radwaste equipment is flushed with decontaminants and the liquid processed in the cementing station of the low-level solid radwaste treatment area. Final decontamination of the equipment and area is accomplished by use of portable decontamination equipment. The temporary HVAC exhaust system is operated until little or no radioactive particulation buildup occurs on the HEPA filter. A survey is conducted to ensure that hands-on disassembly can be accomplished with acceptable personnel exposure. When found to be acceptable, the low- level solid radwaste equipment and temporary HVAC system are disassembled, packaged, and shipped to waste disposal.

32.3.6 MRS FACILITY SITE

As previously noted, the decommissioning of the MRS Facility site is conducted concurrently with other decommissioning activities, with the Receiving and Handling Building providing services to support the site decommissioning. Therefore, the decommissioning operation must be completed before the decommissioning of the Receiving and Handling Building radwaste system and analytical laboratory.

The decommissioning of the site requires a complete survey of all areas within the protected area fence. If any contamination is found, the soil will be removed, packaged in drums, and shipped to disposal.

32.4 COST OF DECOMMISSIONING

In accordance with 10 CFR 72.18, the decommissioning plan must include financial arrangements made by the applicant to reasonably assure that the decontamination and decommissioning will be carried out.

Based on data available from the Conceptual Design and the decommissioning plan outlined in this section, it is anticipated that the decommissioning of the MRS Facility will cost, in 1984 dollars, approximately $46.1 million for the sealed storage cask concept and $57.5 million for the drywell concept.

These costs are based upon the following assumptions:

(1) An MRS Facility configuration designed for 3,600 MTU/yr throughput and 14,000 MTU storage capacity in sealed storage casks or drywells.

(2) All costs associated with storage and shipment of waste materials and with the associated MRS Facility administrative, security, and maintenance services are chargeable to MRS operations.

(3) Decommissioning of the SF, HLW, and HAW/RHTRU Storage Concepts; the CHTRU Storage Facility; the Receiving and Handling Building shielded process cells and contained equipment are conducted concurrently with the stored waste package loadout operation. Only those labor and material costs that are directly chargeable to the decommissioning operations have been included in the decommissioning cost noted herein. No MRS Facility administrative, security, utility, and maintenance costs accrued during this period have been included in the decommissioning costs. After waste loadout, all MRS Facility administration, security, utility, and maintenance costs have been charged to the decommissioning operation.

(4) All waste generated during decommissioning is stored within and shipped from the Receiving and Handling Building.

(5) Labor costs are $50,000 per man-year for all labor associated with the decommissioning operations.

(6) All costs are in mid-1985 dollars and include a 25% contingency factor.

(7) The CHTRU Facility has been sized to store the onsite-generated waste resulting from 15 yr of operation. It has been assumed that, after this period, all MRS-generated CHTRU waste will be shipped directly to a respository.

Several financing alternatives are available for the MRS Facility decommissioning, including:

(1) Prepayment of estimated decommissioning costs.

(2) Funded reserve, or sinking fund, with an optional insurance pool.

(3) Set-aside fund from an ongoing levy on electrical power from nuclear utilities into a combined decommissioning fund and insurance pool.

(4) Performance bond.

Of the four alternatives, it is recommended that a set-aside fund (3) be used to finance the decommissioning of the MRS Facility.

The following paragraphs provide anticipated costs and schedules for various phases of decommissioning the MRS Facility.

32.4.1 SEALED STORAGE CASK

The decommissioning costs and schedule were developed by using a storage configuration of 15,000 MTU capacity, which equates to 1,776 sealed storage casks. It is assumed that 10% of the casks require decontamination and that 10% of the contaminated casks could not be decontaminated to an acceptable level, and require destruction and disposal. In addition, it is assumed that four cask transporters, three active and one standby, are available for cask handling.

The cost associated with cask survey, decontamination, destruction and packaging, permanent cask storage, transporter decontamination, and site decontamination is estimated to be $5.1 million. The actual time to decommission is estimated to be 3.9 years and would be conducted concurrently with the stored waste package unloading and offsite shipment. The total estimated labor to accomplish this phase of the decommissioning operation is 86 man-years.

32.4.2 DRYWELL

The decommissioning costs and schedule were developed by using a storage configuration of 15,000 MTU capacity, which equates to 16,367 drywells. It is assumed that 10% of the drywells require decontamination. For cost effectiveness and to prevent the potential spread of contaminated liquids to the surrounding ground surface, it has been assumed that all contaminated drywells will be pulled and destroyed. In addition, it is assumed that four drywell waste package transporters, three active and one standby, are available for drywell unloading.

The cost associated with drywell survey, decontamination, destruction and packaging, site decommissioning, and closing of the drywells is estimated to be $16.5 million. The time to decommission is estimated to be 3.9 years and would be accomplished concurrently with the stored waste package unloading and offsite shipment. The total estimated labor to accomplish this phase of the decommissioning operation is 232 man-years.

32.4.3 CHTRU FACILITY

The decommissioning costs and schedule were developed by using a storage configuration for 15 yr of onsite-generated waste. It is estimated that a total of 5,920 drums of CHTRU waste are generated, which require 74 storage compartments. It is assumed that a temporary structure (air structure) is used to enclose the facility during unloading and packaging of the waste containers. This structure is used during the decommissioning phase, but is charged to the operation activity because it is required to unload, package, and ship the waste containers. It is assumed that 10% of the compartments require decontamination and that 1% of the contaminated compartments require some removal and packaging of materials.

The cost associated with storage survey, decontamination, removal and packaging of materials, and closing of the storage compartments is estimated to be $0.2 million. The time to decommission is estimated to be 0.4 year and would be accomplished concurrently with the stored waste package unloading and offsite shipment. The total estimated labor to accomplish this phase of the decommissioning operation is 2.4 man-years.

32.4.4 RECEIVING AND HANDLING BUILDING

The decommissioning costs and schedule were developed by using a configuration capable of processing a throughput of 3,600 MTU/yr. It is assumed that the decommissioning activities are initiated concurrently with the waste package loadout and offsite shipment. This initial activity consists of the decommissioning of the four shielded process cells. The remaining Receiving and Handling Building decommissioning activities are accomplished after the stored waste package loadout has been completed.

The cost directly associated with the Receiving and Handling Building decommissioning (including administrative, security, maintenance, and health physics supporting activities) is estimated to be $41.0 million. The total time to decommission is estimated to be 4.8 years, requiring 741 man-years.

32.5 DECOMMISSIONING SCHEDULE

The planned decommissioning operations and their estimated duration are shown in the MRS Facility Decommissioning Schedule (Figure 32-7). As noted herein, the sealed storage cask, drywell, CHTRU Storage Facility, and initial Receiving and Handling Building decommissioning will be accomplished concurrently with the waste loadout and shipping phase.

The final decommissioning of the Receiving and Handling Building will require 4.8 years to accomplish after all stored waste has been shipped from the site.

32.6 IMPACT OF DECOMMISSIONING

Under the current decontamination and decommissioning philosophy, the volume of radioactive wastes resulting from decommissioning activities is minimized by disposing only of components surveyed as contaminated above acceptable limits. The residual radioactivity before decommissioning, personnel exposure during decommissioning, and potential accidents and related environmental impacts are addressed in the Environmental Report.

The operation and subsequent decommissioning of the MRS Facility have regional impacts in addition to cost. These impacts include future use of water and land, transporting of radioactive materials to and from the site, and population character and distribution before, during, and after the operation of the MRS Facility. The Environmental Assessment describes the impacts to the depth possible for the Conceptual Design.

The decommissioning plan, schedule, and costs assume the acceptability of leaving structures and storage components in place after the removal of contaminated materials and equipment.

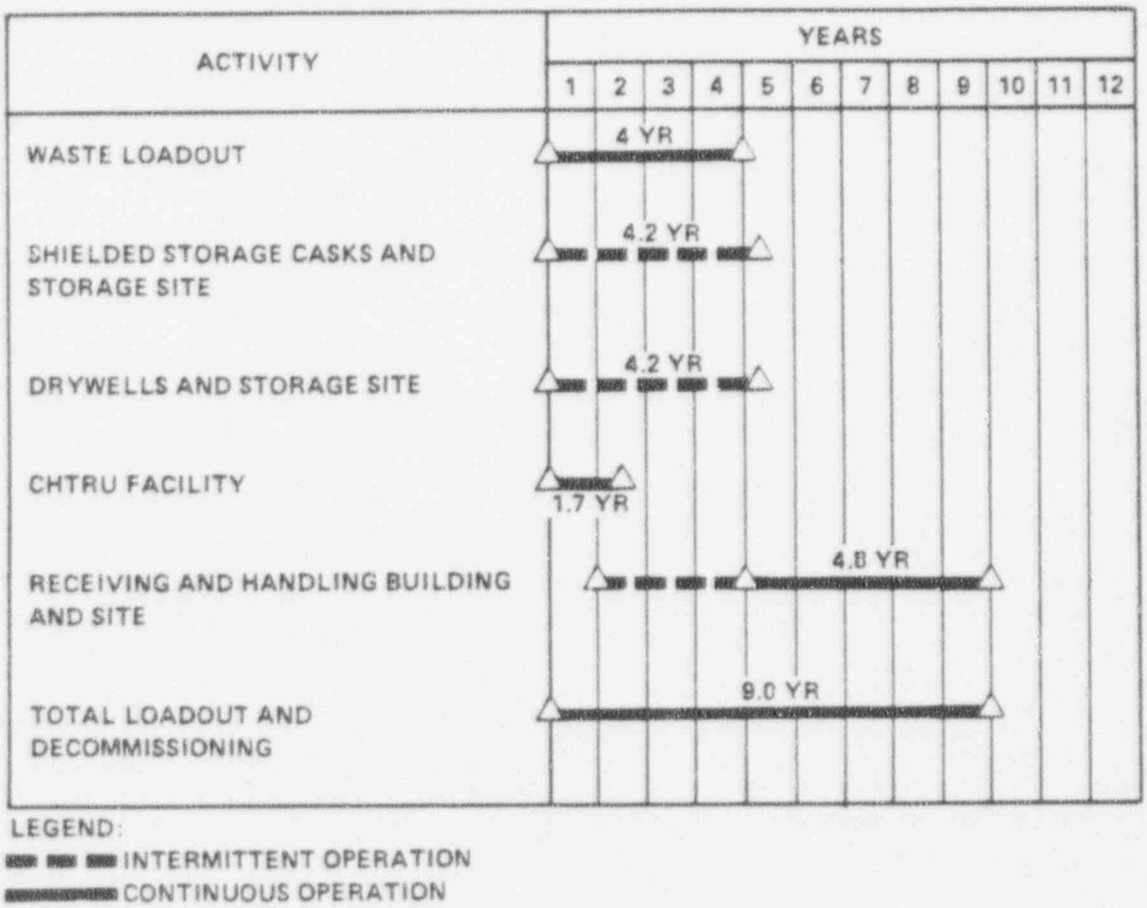

Figure 32-7 - Stored Waste Loadout and MRS Facility Decommissioning Schedule

SECTION 33

ENVIRONMENTAL ASSESSMENT

The Environmental Assessment (EA) for the MRS Facility is conducted by Pacific Northwest Laboratory (PNL). The following is a brief introduction to the EA, a summary of its contents, and the approach taken in preparing the EA.

33.1 INTRODUCTION

The Nuclear Waste Policy Act (NWPA) instructs the Department of Energy (DOE) to prepare and submit to Congress, along with the proposal for construction of the MRS Facility, an Environmental Assessment, which includes an analysis of the relative advantages and disadvantages of a specific primary site and two alternate sites and two storage concepts for each site.

The purpose of this EA is to provide information that will be used by Congress to help determine whether and how to proceed with development of plans for an MRS Facility.

33.2 SUMMARY

The EA document includes a discussion of the purpose and need for MRS facilities, a description of the two selected storage concepts, a description of the three sites, a discussion of the impacts associated with each site/concept combination, and a comparison of the impacts from the six site/concept combinations.

33.3 APPROACH

The Environmental Assessment:

(1) Estimates and analyzes the relative advantages and disadvantages of two MRS storage concepts at three sites.

(2) Supports the selection of key siting factors for the site selection process.

(3) Provides information for consideration related to site location, preferred concept selection, and facility design.

The potential environmental consequences associated with the six site/concept combinations described in the EA include:

(1) Radiological
(2) Air quality
(3) Water quality and use
(4) Land use
(5) Biological
(6) Socioeconomic
(7) Resource requirements and costs

This information is based on estimates of the consequences or impacts and for environmental dose calculation for activities such as construction, operation (normal and accident), decommissioning, and transportation.