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INTEGRAL MONITORED RETRIEVABLE STORAGE (MRS) FACILITY

CONCEPTUAL BASIS FOR DESIGN

Prepared for

UNITED STATES DEPARTMENT OF ENERGY
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THE RALPH M. PARSONS COMPANY OF DELAWARE
Westinghouse Electric Corporation
Golder Associates

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INTEGRAL MONITORED RETRIEVABLE STORAGE FACILITY

CONCEPTUAL BASIS FOR DESIGN

REVISION 1

Approved by _____ 10/15/85
PARSONS

Concurrence by _____ 10/14/85
PARSONS

Approved by _____ 10/17/85
PNL

FOREWORD

PURPOSE

The purpose of the Conceptual Basis for Design is to provide a control document that establishes the basis for executing the conceptual design of the Integral Monitored Retrievable Storage (MRS) Facility. This conceptual design shall provide the basis for preparation of a proposal to Congress by the Department of Energy (DOE) for construction of one or more MRS Facilities for storage of spent nuclear fuel, high-level radioactive waste, and transuranic (TRU) waste.

DEFINITIONS

1. Design Criteria

The Functional Design Criteria (FDC), Rev. 4, August 1985, as provided by Pacific Northwest Laboratory (PNL), is the technical baseline document for the MRS Facility. It defines the facility design objectives and the minimum acceptable concepts and requirements to form a basis for, and to provide constraints governing, design of a safe, operable, practical, and decommissionable facility adequate for its intended purpose. The Functional Design Criteria provide the baseline from which all subsequent phases of the facility design are developed. It shall remain in effect for the life of the MRS Program.

The Design Criteria portion in each section of this document is from the FDC and is not subject to change by Parsons.

2. Basis for Design

The Basis for Design portion in each section was prepared by Parsons and describes the limits, environmental conditions, rates, sizes, and engineering interpretations of the criteria, codes, standards, guides, interfaces, design methods, values, etc., required to perform design activities on a discipline basis while complying with the requirements of the FDC. It also contains supplemental amplification or clarification to the FDC as documented by Client letters of direction, meeting minutes, records of telephone calls, and any other material identified as criteria by Parsons project management.

The General section of the Basis for Design Report contains codes, standards, specifications, DOE Orders, Federal Regulations, and Guides common to all buildings and facilities in the MRS Facility. Some of the codes, standards, specifications, and the like are repeated in the Basis for Design portion, emphasizing the date of issue and revision of these documents.

REVISIONS

The information herein reflects current program requirements. Should these requirements change, this document shall be revised accordingly. Resulting revisions and changes to this document shall be approved by Parsons and PNL.

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
CAE/CAD	computer-aided engineering/design
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

MPC-hours	maximum permissible concentration-hours
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
TRUPACT	transuranic package transporter
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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SECTION 1

GENERAL REQUIREMENTS

1.1 INTRODUCTION

This section contains the overall design requirements for an Integral MRS Facility referred to throughout this document as "MRS Facility." Subsequent sections develop the specific requirements for individual buildings, facilities, and utilities. The design requirements in Section 1 are given in overall terms in the Introduction, followed by requirements specific to individual engineering disciplines, and then by specialized requirements.

The primary structure of the section is based on providing three subdivisions, as follows:

1.X.1 Design Criteria
1.X.2 Basis for Design
1.X.3 ALARA Requirements

where X refers to one of the topics listed below.

For example: Section 1.9.2 provides Basis for Design for the piping discipline.

1. Introduction
2. Civil and Site Development
3. Structural
4. Architectural
5. Material Handling, Maintenance, and Remote Systems
6. Process (Radwaste Treatment)
7. Mechanical Process
8. Instrumentation and Control
9. Piping
10. Electrical
11. HVAC
12. Fire Protection
13. Industrial Health and Safety
14. Nuclear Criticality and Safety
15. Radiation Protection and Shielding
16. Contamination Control
17. Security and Safeguards
18. Decontamination/Decommissioning
19. Quality Assurance

The ALARA requirements are given in Sections 1.1 through 1.11 and Section 1.15. Consequently, all of the applicable ALARA requirements for specific engineering disciplines and technical specialties for the MRS Facility are contained in Section 1, General Requirements, only.

1.1.1 DESIGN CRITERIA

The MRS Facility shall be designed to include all facilities and equipment required to receive, unload, consolidate, canister, and ship to a geologic repository, receive and temporarily store onsite, or retrieve from storage and ship commercial spent fuel and HLW. It shall also be designed to store and ship the hardware resulting from consolidation of the fuel assemblies and other radioactive materials resulting from operation of the facility. Because there is a potential for these materials to contain TRU, they shall be called TRU wastes for the purpose of this document. It shall provide for lag storage of canistered spent fuel within the processing area. It must provide for the monitoring, maintenance and management of the spent fuel and wastes stored onsite. The storage facilities shall be designed to store spent fuel, HLW, and TRU. All stored spent fuel and waste packages shall be readily retrievable for shipment to a geologic repository or other elements of the Federal waste management system or for examination and repackaging.

The MRS Facility shall include, in addition to the required processing and storage facilities, those supporting facilities required to provide the

- administration
- maintenance
- security
- safeguards
- environmental surveillance
- inventory
- fire protection
- waste disposal
- utilities and communications systems
- roads
- railroads
- site improvements

necessary to provide a complete and operable installation.

The MRS Facility shall be licensed by the Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 72 or other appropriate regulations (20-year license, renewable).

In addition to the requirements for licensing of a spent fuel (also assumed here for HLW and TRU) storage facility, as identified in Title 10 of the Code of Federal Regulations, Part 72 (10 CFR 72) and other regulatory requirements, the MRS Facility design shall comply with the appropriate requirements of the latest edition of the codes, standards, and specifications and guides listed herein. The legal hierarchy of laws, regulations, orders, standards, and codes shall be used in the design; i.e.,

federal laws take precedence over regulations in the Code of Federal Regulations, which in turn take precedence over DOE Orders, ANSI standards and codes, and other organizational or professional standards and specifications. The criteria herein are based on NRC and DOE requirements. If these requirements differ, the most restrictive ones shall apply.

1.1.2 BASIS FOR DESIGN

The MRS Facility, as an Independent Spent Fuel Storage Installation (ISFSI), as defined in 10 CFR Part 72.3, shall provide for all of the general requirements of Section 1.1.1. Structures, systems, and components of the MRS Facility shall meet the design basis external man-induced events set forth in 10 CFR Part 72.63 criteria that are site-specific. In addition, more specific requirements set forth in this document shall be satisfied to provide a complete, operating facility, including elements listed below.

1.1.2.A. Processing and Storage Facilities

- Receiving and Handling Building
- CHTRU Facility
- SF, HLW, and HAW/RHTRU Storage Facilities

1.1.2.B. Supporting Facilities

- Administration Building
- Security Building
- Main Gate/Badgehouse
- Inspection Gatehouse
- Protected Area Gatehouse
- Storage Area Gate Station
- Site Services Building
- Warehouse
- Vehicle Maintenance Building
- Standby Generator Building
- Fire Station
- Water Treatment Facility
- Sewage Treatment Facility
- Cask Manufacturing Facility (Primary Storage Concept only)
- Steam Generator Building
- Cooling Tower

1.1.2.C. Primary Storage Concept (Sealed Storage Cask) and Alternate Storage Concept (Field Drywells)

These concepts depict two viable alternative approaches that can be used for the design of an MRS Facility. For the final design, one of these alternatives shall be selected as the optimum solution. The Primary Concept considers material storage to be placed on top of the ground, whereas the Alternate Concept considers placing material storage in near-surface drywells.

The functional relationships among the facilities in terms of personnel and vehicular traffic flows are shown graphically in the Site Functional Flow Diagram, Drawing No. H-3-55201.

1.1.3 ALARA REQUIREMENT FOR MRS FACILITY

Included below is a Design Checklist for ALARA from the Monitored Retrievable Storage (MRS) Facility Licensing Design Guide.

The basis for design for ALARA has been arranged under the following titles as applicable to highlight the design considerations that shall be taken by the various engineering disciplines to conform with the ALARA principle for:

- Minimization of Exposures
- Contamination Control
- Decommission Consideration
- Remote versus Contact Maintenance
- Confinement Consideration
- Maintenance Consideration
- Isolation of Radwaste from Clean Area
- Safety (Criticality)
- Remote Operations
- Compaction

To assist the designer in achieving the ALARA principles, the above items have been addressed in the following checklist.

1.1.3.A. Minimize Time

1. Have design features been considered that would minimize in-service inspection requirements?

2. Do design features implement or facilitate remote maintenance operations?

3. Have design features or requirements been provided for ease of maintenance access to systems or components?

4. Does the design incorporate features that would permit the rapid and easy replacement of routinely maintained equipment and/or shielding?

5. Have features or concepts been used that would minimize or eliminate inspection, calibration, testing, or maintenance tasks?

6. Does component or system layout permit adequate working space?

7. Have design features been used that improve reliability?

8. Have maintenance instructions or system/component information been provided that would facilitate improved maintenance planning?

9. If insulation or other covering covers an area or component that must be inspected or serviced periodically, do design features permit rapid removal and reassembly of the insulation or covering?

10. If auxiliary ventilation systems can provide local control of airborne contaminants when equipment containing potential airborne sources is opened to the atmosphere, can fittings or attachments be provided that would facilitate the operation?

1.1.3.B. Increase Distance

1. Do the design features provide for rapid disassembly and removal to a low radiation area for maintenance?

2. Is the system designed and laid out to maximize the distance between sources and work locations?

3. Can application of special tools result in lower exposure?

4. Are instrumentation, monitors, and control readouts or control points located in low radiation zones?

1.1.3.C. Allow for Shielding

1. Have design features been incorporated that would permit the use of shielding between the sources and the work location?

2. Is streaming and scattering of radiation from locally shielded components minimized?

3. Is permanent shielding adequate?

1.1.3.D. Reduce Source

1. Can equipment or components be eliminated without loss of system function and reliability and result in reduced radiation exposures?

2. Can components that require service be located in lower radiation zones?

3. Does component or equipment layout provide for minimum impact on exposures from adjacent sources?

4. If design incorporates valves, are the valves installed in a stem-up orientation?

5. Do valve packing and seals specified result in minimally contaminated liquid leakage and maximum reliability?

6. If the design incorporates manually operated valves that cause exposure, can the valve be eliminated, remotely operated using reach rods, or replaced by a motor-operated valve?

7. Have crud traps been minimized in the system to a practical extent?

8. Are storage tanks containing contaminated fluid designed with bottoms sloped toward outlets?

9. Has instrumentation that contains minimal quantities of contaminated working fluid been used?

10. Have design features that permit the isolation, decontamination, draining, and flushing of the system been considered?

11. Do design features consider drainage control to limit the contamination due to leakage of contaminated liquid systems?

12. Do design features minimize or eliminate the potential for contamination due to leakage of contaminated liquid systems?

13. Have design features been considered that reduce the radiation source through addition or increase of removal capability (such as filtration or demineralization)?

14. Has decontamination been considered when specifying materials, surfaces, and crevices? Are they:

- Smooth?
- Nonporous?
- Free of cracks?
- Free of crevices?
- Free of sharp corners?

15. Do design features incorporate highly corrosion-resistant materials that are in contact with liquids?

1.1.4 CATEGORY CLASSIFICATION

1.1.4.A. General

Facilities, systems, and structures at the MRS Facility range from ordinary, utilitarian-type (i.e., office buildings and shops), to those that must remain functional during and after credible natural phenomena (i.e., shielded hot cells). Therefore, the MRS Facility is divided into two subgroups: Category I and Non-Category I.

Components, systems, and structures are designated Category I if, during or following an extreme environmental load, including Design Basis Earthquake, Operating Basis Earthquake, and Design Basis Tornado, they would be required to perform either of the following safety functions:

- Prevent or mitigate the consequences of an uncontrolled release of radioactivity with potential radiological consequences in excess of the limits in 10 CFR 72.

- Maintain nuclear criticality safety.

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.

1.1.4.B. Classification Criteria

Acceptable limits of release and radiation exposure limits and criticality safety are established by DOE Orders and Federal Regulations for both normal operation and postulated accident scenarios. The criteria in these documents are used to determine whether or not a component, system, and/or structure shall be Category I. Drawing H-3-55203, Classification (Criteria), shows the various applicable DOE Orders and Federal Regulations for normal and postulated accident conditions.

1.1.4.C. Category Classification

Based on the Functional Design Criteria, the classification criteria, and conceptual design development, the category classification of components, systems, and structures shall be determined (refer to Drawing H-3-55204, Classification Work Plan). The classification procedure shall be applied by each engineering discipline to the area and items within its design responsibility.

After identification of radiation sources, it shall be established whether or not a source is present in a component, system, or structure. Items not dealing with a source shall then be evaluated to discern whether they are important to safety (as defined in the classification criteria), either directly or indirectly as support function. If the component, system, or structure is safety-related, it shall be further evaluated in terms of the postulated accidents. Items not safety-related nor containing a source shall be classified Non-Category I.

Components, systems, or structures handling or containing radiation sources shall be evaluated in terms of defined, postulated accident or failure scenarios. A method of safety analysis shall be established; client concurrence shall be obtained, and then applied to the accident scenarios as they affect each component, system, and/or structure. Based on the classification criteria, if the exposure, release, or criticality limits are exceeded, the component, system, and/or structure shall be defined as Category I.

1.2 CIVIL AND SITE DEVELOPMENT

1.2.1 DESIGN CRITERIA

The design criteria for civil and site development are set forth in the paragraphs that follow.

1.2.1.A. Codes, Specifications, Orders, Regulations, and Standards

The following codes, standards, specifications, DOE Orders, federal regulations and guides, and specific design requirements shall be adhered to in the design of the MRS Facility.

1. Codes. ANSI N2.19 - Guidelines for Establishing Site Related Parameters for Site Selection and Design of an Independent Spent Fuel Installation.

2. Specifications.

(1) American Association of State Highway and Transportation Officials (AASHTO)

(2) American Concrete Institute (ACI-318)(ACI-349)

(3) American Railway Engineering Association (AREA), Manual of Recommended Practice, Vol. I and II

(4) American Society for Testing Materials (ASTM)

(5) American Water Works Association (AWWA) Standards for water pipe and water storage tanks

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 5632 (Draft), Physical Protection of DOE Security Interest

(4) DOE 5632.2, Physical Protection of Special Nuclear Materials

(5) DOE 6430.1, General Design Criteria

(6) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal Regulations.

(1) 10 CFR 50, Appendix B (Quality Assurance) and Appendix E (Emergency Planning)

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

(3) 10 CFR 73, Physical Protection of Plants and Materials

(4) 29 CFR 1910, Occupational Safety and Health Standards

(5) 40 CFR 122, National Pollutant Discharge Elimination System

(6) 40 CFR 141, National Interim Drinking Water Regulations

5. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.2.1.B. Site

The design values given herein are intended to encompass the specific design values for the three proposed sites. Where the specific design values are readily available, they shall be used for the conceptual design. The MRS Facility shall be designed to minimize the impact on the site.

1. Location. The three candidate site locations for an integral MRS Facility are the cancelled Clinch River Breeder Reactor Project site, the cancelled Hartsville Nuclear Power Plant site, and a site in the Bear Creek Valley of the Oak Ridge Reservation. Specific information on each of the sites is available in the MRS Facility Site Screening and Evaluation Report, issued in May 1985.

2. Site Geology

The proposed sites are all located on stable rock formations. There is negligible potential for ground movement caused by liquefaction, subsidence, or landsliding and no significant identified surface faulting. The allowable bearing capacity for compacted fill or natural soil is equal to or greater than 4,000 psf minimum. The allowable bearing capacity for fresh bedrock is 15,000 psf minimum. The thermal conductivity of the site bedrock is assumed to be equal to or greater than 1.2 W/m/°K.

3. Site Meteorology

The climatic conditions at the three proposed sites include the ASHRAE recommended summer design temperature of 95°F DB to 75°F WB and a winter design temperature of 2°F. The heating loads shall be calculated based on an average of 4,000 degree days. The average freezing depth of the soil during the winter season is 2 ft.

4. Utility Access Construction

The following distances to existing utilities/transportation access can be used:

Electrical lines	10 miles
Telephone lines	10 miles

Highway construction	5 miles
Railroad construction	5 miles

5. Site Improvements

Site improvements shall consist of security fences and devices, yard lighting, parking areas, storage yards, landscaping, paving, and related site development.

1.2.1.C. Utilities

Plant utilities shall be obtained from local systems where feasible.

(Refer to Part IV for Utilities. Part IV defines the key utility requirements for electrical, water distribution, sanitary sewer, process sewer, fuel distribution, and oily sewer systems.)

1.2.1.D. Roads and Parking

Roads shall consist of the main road(s) connecting the MRS Facility site to the nearest main highway and the MRS Facility road and street grid. The main access road shall be capable of handling heavy, oversize loads. Parking facilities shall also be included for personal and plant vehicles, and a lag storage parking area shall be provided for loaded and unloaded trucks and cask transport vehicles The facility design shall assume that 30% wt of spent fuel received is by truck.

1.2.1.E. "Off-Normal" Lag Storage Area

A separate lag storage area for nonstandard or off-normal shipment vehicles shall be provided. Parking spaces shall be provided for approximately 10 shipping vehicles (rail or truck evenly distributed) of incoming radioactive shipments.

1.2.1.F. Railroads

The plant railroad system shall include a main spur from a nearby domestic railroad system capable of accommodating frequent rail shipments of heavy, shielded casks. The main spur shall be used for transportation of spent fuel and waste shipments and also for ordinary rail shipment of materials to and from the MRS Facility. The railroad system shall also include the in-plant service grid and lag storage yard, including a nonstandard or off-normal rail/truck isolation area(s). The MRS Facility design shall assume that spent fuel is received 70% wt by rail. All spent fuel and waste will most likely be shipped from the MRS Facility via rail.

1.2.1.G. Drainage

1. Flood Requirements. The MRS Facility shall be sited at a location above the probable maximum flood (PMF). No special flood requirements will be needed beyond normal site drainage to accommodate precipitation runoff. The maximum precipitation recorded at the candidate sites in 24 hr is less than or equal to 9 in. The maximum precipitation recorded at the candidate sites in 1 hr is less than or equal to 3 in.

2. Storage Facilities. All storage facilities shall be located and designed to preclude flooding caused by atmospheric or man-made conditions.

3. Grading. The site shall be graded to ensure adequate site drainage to preclude the potential for flooding of buildings.

1.2.1.H. Security and Safeguards

Site security shall be established to prevent unauthorized access to or removal of items of security interest.

1. Design Basis Threats. The design basis threats for an MRS Facility are:

(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.

2. Fencing. Site security shall provide physical protection and access controls to deter, assess, and respond to the above threats. A site security fence shall be provided around the entire developed area of the MRS Facility. (This is not necessarily the site boundary. The site boundary may be located a substantial distance away from the operational MRS Facility. The site boundary shall be identified by a 3-strand barbed wire fence.) The site security fence provides the boundary to the "Limited Area" as described in DOE Order 5632, Chapter III (draft) for DOE facilities. All MRS facilities (including such nonprocess buildings as the Administration, Site Services, Warehouse, Security, Fire Station, and similar buildings) shall be located in the limited area.

A "Protected Area" per DOE Order 5632.2 (see also 10 CFR 73.2.g) shall be established. This area shall contain the R&H Building; the Spent Fuel, HLW, and HAW/RHTRU Storage Facilities; the CHTRU Facility; the radioactive shipment lag storage and nonstandard/off-normal vehicle storage areas; and any other process support facilities considered vital to safe operation of these facilities.

All "Vital Area(s)" [DOE Order 5632, Chapter III (draft), and 10 CFR 73.2.h] and "Material Access Area(s)" [DOE Order 5632, Chapter III (draft), and 10 CFR 73.2.j] for the MRS Facility shall be located within the protected area.

The protected area shall be enclosed within two physical barriers (fences) as described in DOE 5632.2.q (10 CFR 73.2.f). An "Isolation Zone" (10 CFR 73.2.k) shall be established around the buildings or facilities within the protected area. The minimum distance from the spent fuel handling and storage facilities to the nearest boundary of the protected area outer fence shall be at least 100 meters (10 CFR 72.68). The isolation zone described above may be included within the 100 meters. An alarm zone, nominally 100 ft wide, shall be provided between the fences. A patrol road shall be located to facilitate routine surveillance and alarm response. Where appropriate, the outer barrier of the protected area may be part of the limited access site security fence line (i.e., three site security fences are not necessary).

Access to the protected area shall be controlled by manned security checkpoints. Access to the R&H Building and material storage areas shall be controlled by an access control system.

1.2.1.I. Landscaping

Landscaping shall be provided, as appropriate, considering a blend of aesthetics, functional requirements, initial cost, and operational economics.

1.2.1.J. Heliport

Space shall be provided for a heliport for emergency medical air evacuation from the facility.

1.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.1, the following criteria shall be used.

1.2.2.A. Codes and Specifications

In addition to the codes and specifications listed in Section 1.2.1.A, the following shall also be used:

1. Codes.

   (1) NFPA 80A, Protection of Buildings from Exterior Fire Exposures, 1980

   (2) NFPA 20, Fire Pumps, Centrifugal, 1983

   (3) NFPA 22, Water Tanks for Private Fire Protection, 1981

   (4) NFPA 24, Private Fire Service Mains, 1984

2. Specifications.

(1) AASHTO, Geometric Design Standards for Highways Other Than Freeways, 1969

(2) AASHTO, A Policy on Geometric Design of Rural Highways, 1965

(3) AASHTO, A Policy on Design of Urban Highways and Arterial Streets, 1973

(4) AASHTO, Geometric Design Guide for Local Roads and Streets, 1971

(5) AASHTO, Standard Specifications for Highway Materials and Methods of Sampling and Testing, 1982

(6) AASHTO, Guide Specification for Highway Construction, 1979

(7) ANSI Standard D6.1, Manual on Uniform Traffic Control Devices for Streets and Highways, 1978

(8) AREA, Manual for Railway Engineering (Fixed Properties), 1984-1985

(9) AWWA-D-100-79, Standard for Welded Steel Elevated Tanks, Standpipes, Reservoirs, for Water Storage

(10) AWWA-C-900-81, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water

(11) AWWA-C-506-78, Standard for Backflow Prevention Devices, Reduced Pressure Principle and Double Check Valve Types

(12) AWWA-C-500-80, Standard for Gate Valves, 3 in. through 48 in., for Water and Other Liquids

(13) AWWA-C-502-80, Standard for Dry Barrel Fire Hydrants

(14) AWWA-C-701-78, Standard for Cold Water Meters, Turbine Type for Customer Service

(15) AWWA-A-100-66, Standard for Deep Wells

(16) AWWA-C-950-81, Glass Fiber Reinforced Thermosetting Resin Pressure Pipe

(17) ASCE Manual No. 60, Gravity Sanitary Sewer Design and Construction

3. Federal Regulations.

10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria

1.2.2.B. Site

The three candidate site locations for an integral MRS Facility are the cancelled Clinch River Breeder Reactor Project site, the cancelled Hartsville Nuclear Power Plant site, and a site in the Bear Creek Valley of the Oak Ridge Reservation.

1.2.2.C. Utilities

Refer to Drawing H-3-56706, Site Utilities Distribution Flow Diagram, which forms the Basis for Design for site utilities. Part IV, Site Utilities, defines the utility requirements for electrical distribution, water distribution, sanitary sewer, process sewer, fuel distribution, and oily sewer systems.

1.2.2.D. Roads and Parking

The road from the nearest main highway shall bring all traffic to the site to the Main Gate/Badgehouse or Inspection Gatehouse entrances. A road network shall provide access to all facilities within the site.

In addition to criteria listed in Section 1.2.1.D, the following criteria shall be used.

1. General. Roads shall be classified within the following four major categories:

(1) Primary road - paved
(2) Secondary road - paved
(3) Tertiary road - stabilized aggregate
(4) Transport vehicle road - stabilized aggregate

2. Road Design. Roads shall be designed to conform to the following:

(1) Design Speed

Roads shall be designed for a maximum speed of 25 miles per hour.

(2) Grades

Road grades shall be limited to a maximum of 8%. Lesser grades shall be used wherever possible. Ramp grades to buildings, or access driveways to storage and parking areas, shall be graded not to exceed 13%. The road grade for the storage transporter shall be limited to a maximum of 3%.

(3) Road Widths

(a) Primary Road

- Two lanes, 12 ft each
- Shoulders, 6 ft each

(b) Secondary Road

- Two lanes, 10 ft each
- Shoulders, 4 ft each

(c) Tertiary Road

- Roadway, 20 ft each
- Shoulders, none

(d) Transport Vehicle Road

- Roadway, sufficient width for two-way transport vehicle traffic
- Shoulders, none

3. Road Pavements. Various road types shall be paved as follows:

(1) Primary Road - Flexible pavement shall be designed for medium/heavy traffic.

(2) Secondary Road - Flexible pavement shall be designed for light/medium traffic.

(3) Tertiary Road - Stabilized aggregate surface, infrequently used and designed to meet individual requirements.

(4) Transport Vehicle Road - Stabilized aggregate surface, designed to meet individual requirements.

Primary roads onsite shall be designed to routinely accommodate 80,000-lb GVW trucks on five axles and occasionally 96,000-lb GVW trucks on six axles.

4. Road Drainage. All soils and pavement shall provide the highest support and minimum maintenance when adequately drained. An elevated roadbed shall be obtained wherever possible. Surface water shall be carried away, either by surface runoff resulting from a suitable cross section or by separate storm drains. Adequate subgrade drainage shall be provided by elevating the section, ditching, or using subdrains.

5. Parking. Parking for all employees and visitors shall be provided outside the Main Gate/Badgehouse. The parking spaces nearest to the Main Gate/Badgehouse shall be reserved for handicapped persons. Additional parking for site vehicles shall be provided for the facilities that require them, and shall be identified in the design criteria for each building.

6. Walkways. Walkways shall be provided from the employee parking area outside the Main Gate/Badgehouse to the entrances of all the manned facilities at the MRS site. Ramps to provide access for handicapped persons shall be provided at all street intersections and at building entrances.

1.2.2.E. Off-Normal Lag Storage Area

Lag storage areas and fenced off-normal shipment storage areas shall be provided for both railroad and truck vehicles within the protected area.

1.2.2.F. Railroads

In addition to criteria listed in Section 1.2.1.F, the following criteria shall be used:

1. General. Design of railroad facilities shall be in accordance with the latest issue of the manual on design and practices of the American Railway Engineering Association, and with these criteria. The design shall also require compliance with standards set by the railroad serving the facility and the company owning the railroad, as well as Federal, State, and County regulations.

Trackage and railroad beds over which cask shipments are to travel shall be designed to handle cars weighing 263,000 lb GVW on four axles, an occasional load of 364,000 lb GVW on six axles, and an occasional load of 440,000 lb GVW on eight axles.

(1) The plant railroad system shall be a continuation of the offsite commercial railway system. Two lines from the main spur shall run from the Inspection Gatehouse through the protected area, where they shall end at the SF, HLW, and HAW/RHTRU Storage Facilities.

(2) Various sidings and spurs shall be provided to the facilities requiring rail access.

(3) All switches shall be manually operated. A switch control shall also be provided at the alarm monitoring station (AMS) to shunt the rail traffic away from the protected area and R&H Building.

(4) Engine and railcar routine maintenance shall be accomplished at the Vehicle Maintenance Building, which shall be served by a rail spur.

2. Types of Construction.

(1) Process and mainline tracks shall be tracks used for inter-area deliveries and operations process train movements.

(2) Service tracks shall be permanent tracks other than process or mainline.

3. Design Requirements.

(1) Layout

Track layouts shall be designed to provide flexibility and economy of operation for the service required. Construction trackage layout

shall fit, as nearly as possible, the final operational layout requirements to avoid duplication of track construction.

Process and mainline tracks shall be located and built to provide the greatest possible insurance, within reasonable economic limits, against derailment, overturn, or collision of the process trains.

(2) Design Speed

Railroads shall be designed for a maximum speed of 20 miles per hour.

(3) Horizontal Alignment

All horizontal curves shall be simple curves, without spirals, and shall meet the minimum requirements of the serving railroad. Broken-back, compound, or reverse curves shall not be used.

Superelevation shall be in accordance with the American Railway Engineering Association superelevation standards, in accordance with the expected speed of the trains.

(4) Grades and Vertical Curves

The maximum grade on process, mainline, or service track shall be 2%, including compensation for curves, which shall be at the rate of 0.04% per degree of curvature.

Parabolic vertical curves shall be used where the change in grade exceeds 0.2%. Minimum length of vertical curves shall be 20 ft for each 0.1% difference in grade.

(5) Turnouts and Frogs

Design of turnouts and frogs shall be in accordance with American Railway Engineering Association recommendations and the standards of the servicing railroad.

(6) Underground Pipe Crossings

Underground crossings of pipes carrying fluids that, by their nature or pressure, might cause damage if escaping under or in the vicinity of the track shall be encased in concrete.

(7) Drainage

Adequate provision shall be made for drainage of the roadbed.

1.2.2.G. Drainage

1. General. Drainage systems shall be designed to properly drain all surface and subsurface water that can cause damage to the facilities, property, and adjoining land.

2. Storm Drainage. For storm drainage, open drainage ditches, protected against erosion, shall be used to the maximum extent practicable, and shall be designed for not less than a 25-year frequency storm. One-hundred-year frequency storms shall be evaluated for consequences of damage to the drainage areas. Materials locally available shall be used for culverts and piping systems, where economical. Where required for safety or sanitary reasons, or where determined to be economical from a drainage system maintenance standpoint, short, closed-piping systems may be extended from the open-drainage systems to allow complete removal of the 25-year overland storm flow from the street system. Auxiliary structures or appurtenances (such as headwalls, catch basins, and manholes) shall be the minimum necessary to satisfy requirements. Corps of Engineers design manuals shall be consulted for technical support in the areas of hydrology and open-channel design.

(1) Line Sizes

- Minimum size of main lines shall be 15 in.
- Minimum size of short (not over 30-ft-long) branch lines shall be 12 in.
- Minimum velocity, when flowing full, shall be 2 ft per second, unless this velocity cannot be maintained because of local conditions, such as extremely flat topography.

(2) Culverts

Culverts shall be provided under highways, railroads, and dikes wherever the natural drainage pattern is interrupted and a bridge is not required.

- The minimum diameter shall be 15 in.
- Culverts shall be aligned with and generally match the slope of stream or channel, as nearly perpendicular to the obstruction as possible.
- An endwall with suitable downstream channel protection (such as paved apron, riprap, channeling and, in extreme cases, an energy dissipater) shall be provided below the culvert outlet. Normally, a headwall shall also be used at the upstream end. Debris barriers with access for cleaning shall be provided where necessary.

(3) Ditches

Open ditches shall be used where closed conduits cannot be justified economically and where an open ditch does not interfere with the

intended use of an area. Ditches shall have a maximum velocity of 2 to 2.5 ft per second for unlined channels, depending upon soil classification.

3. Grading.

(1) Areas Adjacent to Buildings and Structures

Unpaved areas adjacent to buildings and structures shall be sloped to direct surface water and roof drainage, including snowmelt, away from buildings and structures at a minimum slope of 5% for the first 10 ft. Surfaces paved with portland cement concrete shall have a slope of not less than 0.5%, and bituminous pavements not less than 1.5%, to ensure adequate drainage without ponding.

(2) Unoccupied Site Areas

Portions of the site not occupied by buildings, structures, or pavements shall be provided with adequate continuous slopes to drain toward water courses, drainage swales, roadways, and the minimum necessary storm-drainage inlets. The runoff shall be carried under walkways and roads in pipes sufficiently large to preclude clogging by debris or grass cuttings. Turf banks, where required, shall be graded to permit the use of gangmowers, providing a maximum slope of 3 to 1. The tops and bottoms of all slopes shall be gently rounded in a transition curve for optimum appearance and ease of maintenance.

1.2.2.H. Security and Safeguards

In addition to the criteria listed in Section 1.2.1.H, the following criteria shall be used:

The main access to the protected area shall be controlled by the Protected Area Gatehouse, located inside the inner fence of the 100-ft-wide alarm zone. All personnel and vehicles requiring access to the protected area shall undergo inspection and monitoring for weapons and explosives.

"Controlled areas" shall be established around the spent-fuel handling and storage facilities.

1.2.2.I. Landscaping

In addition to the criteria listed in Section 1.2.1.I, the following criteria shall be used:

Landscaping shall provide the creation and maintenance of an attractive setting commensurate with the location and type of facilities to be constructed. Plantings shall be simple, functional, and economical to maintain, and plant species proven to be locally hardy and tolerant of specific site conditions shall be selected. The species of trees, and their location in planting, shall be such as to preclude roots from damaging underground

utility lines and adjacent surface facilities, wherever possible. Landscaping shall be consciously used as an element in energy-conservation design solutions for buildings. Proper landscaping benefits shall include reduction of solar radiation during cooling season, heat loss from wind, and heat loss during heating season.

Irrigation shall be provided as required. See Section 20.2.2.E.

All disturbed earth areas not covered by structures, paving, or landscaping shall be stabilized.

1.2.2.J. Heliport

A heliport shall be provided outside the limited access area for emergency medical air evacuation.

1.2.3 ALARA REQUIREMENTS FOR CIVIL AND SITE DEVELOPMENT

No additional requirements.

1.3 STRUCTURAL

The structural design of the MRS Facility shall conform with the following design criteria and basis for design.

1.3.1 DESIGN CRITERIA

1.3.1.A. Codes, Specifications, Orders, Regulations, and Guides

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, and guides listed herein.

1. Codes.

   (1) ANSI A58.1 - Minimum Design Loads for Buildings and Other Structures

   (2) Uniform Building Code (UBC)

   (3) ANSI N101.6 - Concrete Radiation Shields

2. Specifications.

   (1) American Association of State Highway and Transportation Officials (AASHTO)

   (2) American Concrete Institute (ACI-318)(ACI-349)

   (3) American Institute of Steel Construction (AISC)

(4) American Iron and Steel Institute (AISI)

(5) American Railway Engineering Association (AREA), Manual of Recommended Practice, Vol. I and II

(6) American Society for Testing Materials (ASTM)

(7) American Welding Society (AWS)

(8) Steel Joist Institute (SJI)

(9) Structural Clay Products Institute (SCPI)

3. DOE Orders.

(1) DOE 6430.1, General Design Criteria

(2) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal Regulations.

10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

5. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.3.1.B. Site

The three candidate site locations for an integral MRS Facility are the cancelled Clinch River Breeder Reactor Project site, the cancelled Harstville Nuclear Power Plant site, and a site in the Bear Creek Valley of the Oak Ridge Reservation.

1.3.1.C. Classifications

Facilities, systems, and structures at the MRS Facility range from ordinary, utilitarian type (i.e., office buildings and shops) to those that must remain functional during and after credible natural phenomena (i.e., shielded hot cells). Therefore, the MRS Facility has been divided into two subgroups, Category I and Non-Category I.

1.3.1.D. Design Loads

1. Category I Structures

Components, systems, and structures are designated Category I if, during or following an extreme environmental load, including Design Basis Earthquake,

Operating Basis Earthquake, and Design Basis Tornado, they would be required to perform either of the following safety functions:

- Prevent or mitigate the consequences of an uncontrolled release of radioactivity with potential radiological consequences in excess of the limits in 10 CFR 72.

- Maintain nuclear criticality safety.

(1) Seismic Design

Seismic Category I components, systems, and structures shall be designed to withstand loadings resulting from either of the following earthquakes:

- Design Basis Earthquake (DBE). All Category I components, systems, and structures shall not suffer a loss of safety functions, as described above, following a DBE. The DBE is the same as the safe shutdown earthquake (SSE) described in DOE Order 6430.1, and shall be considered to have a maximum ground acceleration of 0.25 g.

- Operating Basis Earthquake (OBE). All Category I components, systems, and structures shall have the capability for continued operation 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 the DBE.

The loading combinations and stress limits shall be as outlined in DOE Order 6430.1, Chapter XXI, Section 7.a.3.d. Amplification factors for seismic design shall be determined from site evaluations that consider the regional and local geology and seismology and the characteristics of the subsurface material. Design response spectra shall be developed from the evaluation or from NRC Regulatory Guide 1.60. The percentages of damping used in the seismic analysis shall conform with those in NRC Regulatory Guide 1.61.

(2) Design Basis Tornado

Category I components, systems, and structures shall be designed to withstand a design basis tornado having a tangential speed of 290 mph, a translational speed ranging from 5 to 70 mph, and a maximum pressure drop of 3.0 psi and rate of pressure change of 2.2 psi/sec. This will also involve the tornado-generated missiles as described in DOE 6430.1, Chapter XXI.

(3) Roof Loads

- Roof live loads shall be in accordance with ANSI A58.1, Section 4.

- Snow loads shall be in accordance with ANSI A58.1, Section 7.

2. Non-Category I 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.

(1) Wind Loads

These facilities shall be designed in accordance with ANSI A58.1, Section 6, using the following criteria:

- Basic wind speed determined from site history
- Importance Factor III
- Exposure Category C

The highest wind speed at 10 meters height with an annual probability of 0.02 for the proposed sites is 100 mph.

(2) Earthquake Loads

Earthquake loads shall be calculated and designed in accordance with the Uniform Building Code (UBC), Chapter 23, for a seismic zone of 2 or less.

(3) Roof Loads

- Roof live loads shall be in accordance with ANSI A58.1, Section 4.
- Snow loads shall be in accordance with ANSI A58.1, Section 7.

1.3.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.3.1, the following criteria shall be used.

Structures for the MRS Facility shall be assigned to one of the defined categories, depending upon the severity of radioactive release that could be caused by structural failure. The classification of each building or structure is given hereafter under its specific requirements.

Structural design, including load combinations, shall be in accordance with editions of pertinent nationally recognized codes and standards as referenced.

The objectives of Structural Basis for Design are as follows:

- To ensure that all decisions of structural design work are based on rational assumptions.

- To establish the baseline control of structural design.

1.3.2.A. Codes, Specifications, Orders, Regulations, and Guides

In addition to the codes, specifications, orders, regulations, and guides listed in Section 1.3.1.A, the following shall also be used:

1. Codes.

   (1) International Conference of Building Officials, Uniform Building Code (UBC), 1982 Edition

   (2) American National Standards Insitute (ANSI), Building Code Requirements for minimum design loads in buildings and other structures, ANSI A58.1-1982

2. Specifications.

   (1) American Concrete Institute (ACI)

      (a) Building Code Requirements for Reinforced Concrete, ACI 318-1983

      (b) Code Requirements for Nuclear Safety Related Concrete Structures, ACI 349-1980

      (c) Building Code Requirements for Concrete Masonry Structures, ACI 531-1979

   (2) American Institute of Steel Construction (AISC), Manual of Steel Construction, 8th Edition

   (3) American Society for Testing Materials (ASTM)

      (a) Structural Steel, ASTM A36-81a
      (b) High Strength Bolts, for Structural Steel Joints, ASTM A325-82
      (c) Billet Steel Bars for Concrete Reinforcement, ASTM A615-82
      (d) Other applicable standards

   (4) American Association of State Highway and Transporation Officials (AASHTO), Guide Specification for Highway Construction, 1979

   (5) American Welding Society (AWS), Structural Welding Code, AWS D1.1-83

   (6) American Iron and Steel Institute (AISI), Specification for the Design of Light Gage Cold-Formed Steel Structural Members

3. DOE Orders. Department of Energy (DOE), General Design Criteria, DOE 6430.1

4. Federal Regulations.

   10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria

5. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

6. References and Guides.

Electric Power Research Institute/SANDIA Laboratories, Full Scale Tornado Missile Impact Tests; EPRI NP-440, Project 339, Final Report, 1977.

1.3.2.B. Site

The specific siting factors to be considered in the structural design, such as seismic risk zone, wind, tornado, snow load, soil bearing capacity, and frost line, are defined in the subsequent text.

1.3.2.C. Classifications

Two categories of facilities are established and defined below:

1. Category I Structure.

(1) Receiving and Handling Building (except portions of building designated as Non-Category I)

(2) SF, HLW, and HAW/RHTRU Storage Facilities

(3) CHTRU Facility

(4) Standby Generator Building

2. Non-Category I Structure.

(1) Administration Building
(2) Security Building
(3) Main Gate/Badgehouse
(4) Inspection Gatehouse
(5) Protected Area Gatehouse
(6) Storage Area Gate Station
(7) Site Services Building
(8) Warehouse
(9) Vehicle Maintenance Building
(10) Fire Station
(11) Sewage Treatment Facility
(12) Water Treatment Facility
(13) Cask Manufacturing Facility
(14) Water storage tank
(15) Fuel storage tank
(16) Cooling tower
(17) Steam Generator Building

1.3.2.D. Design Loads

1. Dead Loads. Dead loads shall include the weight of structure, apparatus, partitions, equipment, ducts and plenums, piping, cable trays and conduits, and other permanent items.

2. Live Loads. Live loads shall include all movable loads, such as personnel, materials in storage, maintenance equipment, and the following:

(1) Roof

Roof live load and its reduction shall be in accordance with ANSI A58.1. Primary structural members supporting a roof shall be designed to carry a suspended, concentrated load of 2,000 lb in addition to the dead loads.

(2) Floor

Minimum live loads listed in ANSI A58.1 shall be used where applicable. Reduction of live load shall be applied in accordance with Section 23.06 of the Uniform Building Code.

3. Vehicle Loads. These loads shall be treated as live loads. The truck loads shall be based on AASHTO H20 loading, the cask-transporting truck shall be a 48-ton semitrailer, and the railcar shall have a 220-ton gross weight. The following vehicle loads shall be considered in the design:

- Forklift
- Truck, trailer
- Cask-transfer cart
- Railcar
- Cask transporter
- Drywell transporter

4. Snow Loads. Snow loads shall be considered as live loads. Snow loads and snow drifts shall be in accordance with ANSI A58.1, Section 7, Exposure C and Importance Category III. The design snow loads and snow drifts are presented in Table 1.3-1. Maximum ground snow load is to be 25 psf.

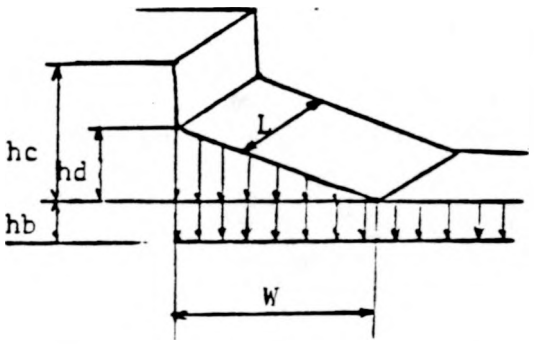
5. Impact Loads. The structural elements carrying live loads that may be subjected to unusual vibration and impact forces shall be designed for the impact loads not less than the following percentage increase:

Table 1.3-1 - Snow Loads

P_g	P_f	Snowdrift					
		γ	h_b	h_d	W	W_1	P_d
25	24.0	15	1.60	4.0	12.0	16.0	60

Reference ANSI A58.1 - 1982

P_g = Ground snow load (psf)
P_f = Flat roof snow load (psf)
P_d = Drift surcharge load (psf)



$P_f = 0.7\ C_e C_t I\ P_g$
$= 0.84\ P_g$
$P_f \geq P_g I$ for $P_g \leq 20$ psf
$P_f \geq 20\ I$ for $P_g > 20$ psf

C_e = Exposure factor $C_e = 1$
C_t = Thermal factor $C_t = 1$ for heated building
I = Importance factor $I = 1.2$ for Category III
γ = Snowdrift density (pcf)
$h_b = P_{f/\gamma}$ (ft)
$h_d = \frac{2IP_g}{C_e \gamma}$ (ft)
W = Width of snowdrift (ft)

10 ft $\leq W = 3\ h_d$ for $L \leq 50$ ft

W_1 = Width of snowdrift (ft)

10 ft $\leq W_1 = 4\ h_d$ for $L > 50$ ft

$P_d = h_d \gamma$ (psf)

Structural Elements	Increase of Moving Load (%)
Elevator supports	100
Light machinery	20
Reciprocating machinery	50
Hangers supporting floors	33
Crane and hoist support	25
Crane runway horizontal support:	
Transverse	20 (trolley and lift load)
Longitudinal	10 (maximum wheel load)

6. Thermal Loads. Thermal loads are the self-straining forces arising from contraction or expansion resulting from temperature change. A 50°F change in temperature from ambient temperature to maximum or minimum design temperature shall be assumed during the life of the facility.

7. Wind Loads. Wind loads shall be in accordance with ANSI A58.1, Section 6, with a basic wind speed of 80 miles per hour, Exposure C and Importance Category III. The design wind loads for buildings and structures and their components are given in Tables 1.3-2 and 1.3-3.

8. Earthquake Loads.

(1) Non-Category I structures shall meet UBC seismic requirements for Zone 2 and Importance Factor 1.5.

(2) Category I structures shall be designed to withstand the Design Basis Earthquake (DBE), described as ISFSI design earthquake in 10 CFR 72.

The maximum ground acceleration of 0.25 g, accompanied by a vertical acceleration of 0.167 g, shall be used in the conceptual design. The response spectrum (see Figures 1.3-1 and 1.3-2) and damping values shall be in accordance with NRC Regulatory Guide 1.60 and 1.61, respectively. (The DBE is equivalent to the safe shutdown earthquake for a nuclear power plant.)

Category I structures shall also be designed to withstand the Operating Basis Earthquake (OBE). The maximum ground acceleration shall be one-half of the DBE, with the same response spectrum.

Table 1.3-2 - Wind Loads on Main System

Elev (ft)	K_z	G_h	q_z, q_h	P_w	P_{L1}	P_{L2}	P_{L3}	P_r
15	0.80	1.32	23.4	24.7	15.5	9.2	6.3	21.7
20	0.87	1.29	25.4	26.3	16.4	9.8	6.6	23.0
30	0.98	1.26	28.7	28.9	18.1	10.9	7.2	25.3
40	1.06	1.23	31.1	30.6	19.1	11.4	7.7	26.7
50	1.13	1.21	33.1	32.0	20.0	12.0	8.0	28.1
60	1.19	1.20	34.9	33.4	20.9	12.5	8.4	29.2
70	1.24	1.19	36.3	34.7	21.7	13.0	8.6	30.3
80	1.29	1.18	37.8	35.6	22.3	13.4	8.9	31.2
90	1.34	1.17	39.3	36.7	23.0	13.8	9.2	32.2

Reference: ANSI A58.1 - 1982

K_z See Table 6 (Reference)
G_h See Table 8 (Reference)

Basic wind speed V = 100 mph
Exposure C
Importance Category III, I = 1.07
$q_z, q_h = 0.00256\ K_z\ (VI)^2$
$= 29.31\ K_z$ (psf)

Roof slope $\theta \leq 10^o$

Windward wall:

$P_w = q_z G_h C_p \quad C_p = 0.8$

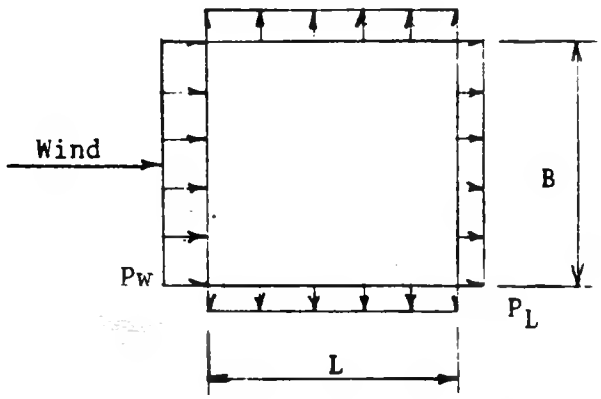
Leeward wall:

$P_L = q_h G_h C_p$

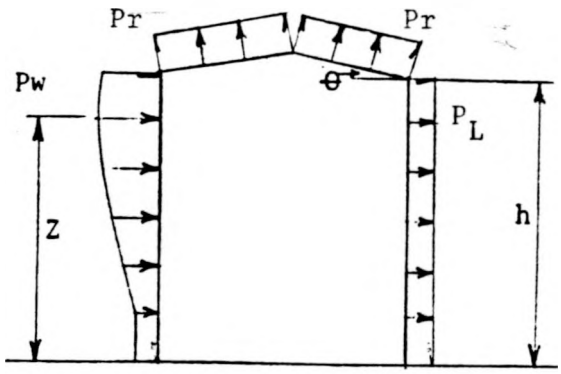
$P_{L1} = L/B \leq 1 \quad C_p = 0.5$
$P_{L2} = L/B = 2 \quad C_p = 0.3$
$P_{L3} = L/B \geq 4 \quad C_p = 0.2$

Roof:

$P_r = q_h G_h C_h \quad C_p = 0.7$



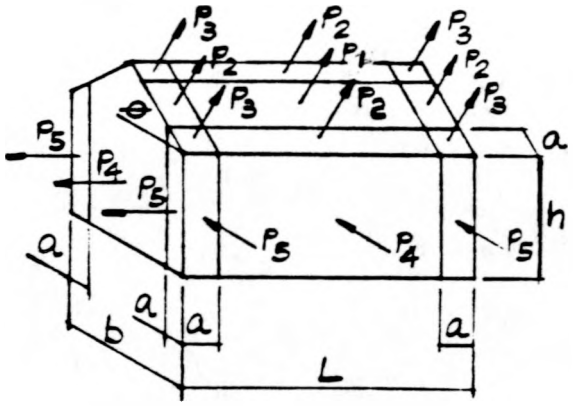
PLAN



ELEVATION

Table 1.3-3 - Wind Loads on Building Components

h (ft)	q_h	P_1	P_{1*}	P_2	P_{2*}	P_3	P_{3*}	P_4	P_{4*}	P_{4**}	P_5	P_{5*}	P_{5**}
15	23.4	38.8	34.1	56.9	41.1	99.7	41.1	41.1	36.4	31.7	52.8	41.1	31.7
20	25.4	42.0	36.9	72.7	44.5	108.3	44.5	44.5	39.5	34.4	57.3	44.5	34.4
30	28.7	47.5	41.7	81.9	50.3	122.2	50.3	50.3	44.5	38.8	64.7	50.3	38.8
40	31.1	51.3	45.2	88.6	54.4	132.2	54.4	54.4	48.1	42.0	70.0	54.4	42.0
50	33.1	54.7	48.0	94.4	58.0	140.8	58.0	58.0	51.4	44.7	74.5	58.0	44.7
60	34.9	57.5	50.5	99.4	60.9	148.1	60.9	60.9	54.0	47.0	79.4	60.9	47.0



Reference: ANSI A58.1 - 1982

Basic wind speed = 100 mph
Exposure C, roof slope $\theta \leq 10^o$
Importance Category III
q_h See Table 1.3-2

$P = q_h (GC_p \pm GC_{pi})$ psf

GC_p See Figure 3a, Figure 3b (Reference)

GC_{pi} = 0.25 for minimum openings

P_n = load for A $\leq$ 10 sf

P_n* = load for A $\geq$ 100 sf

P_n** = load for A $\geq$ 500 sf

A = tributary area

$0.04b \leq a \leq 0.1b$
$0.04L \leq a \leq 0.1L$
3 ft $\leq a \leq 0.4h$

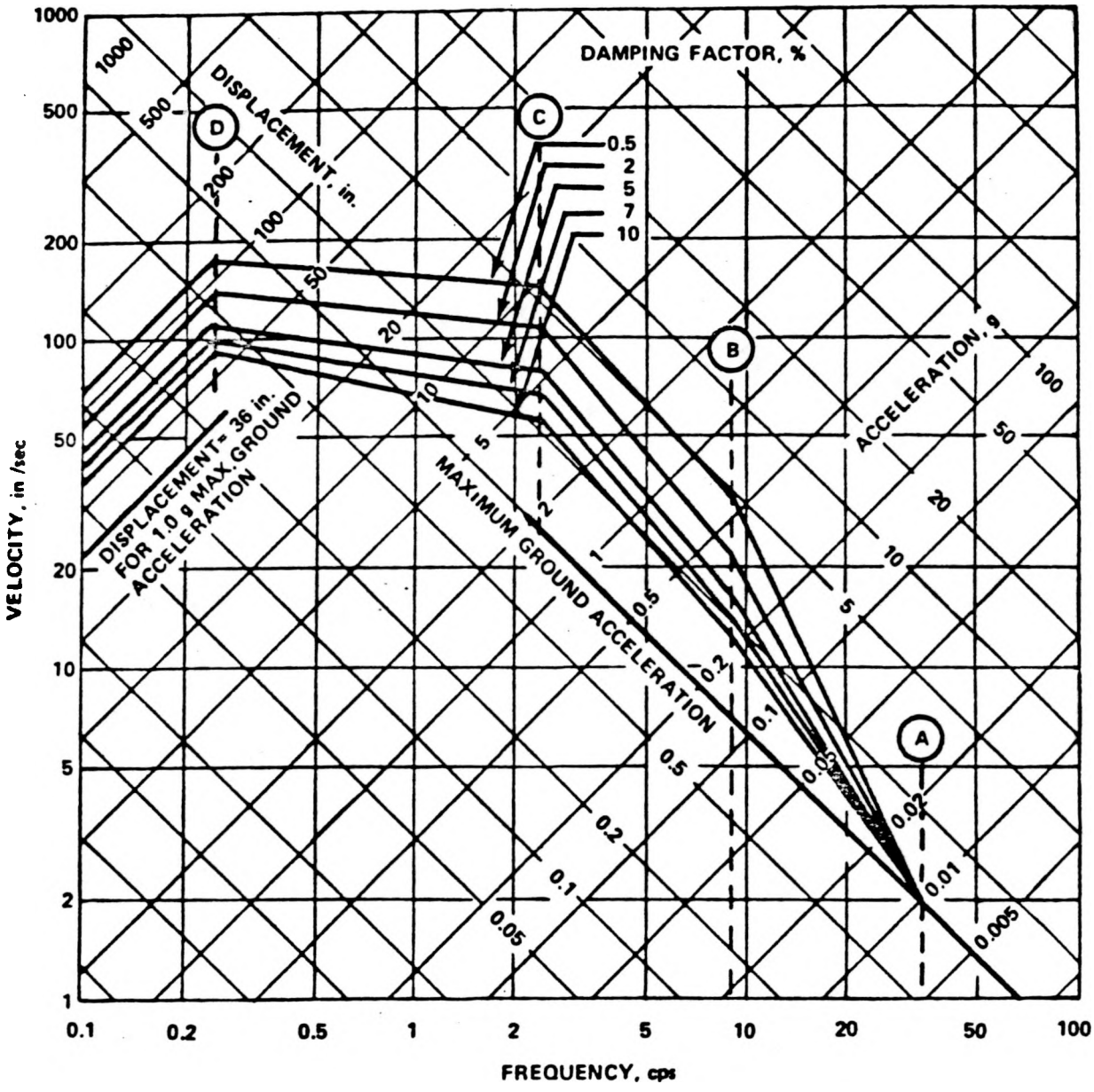


Figure 1.3-1 - Horizontal Design Response Spectra - Scaled to 1g Horizontal Ground Acceleration

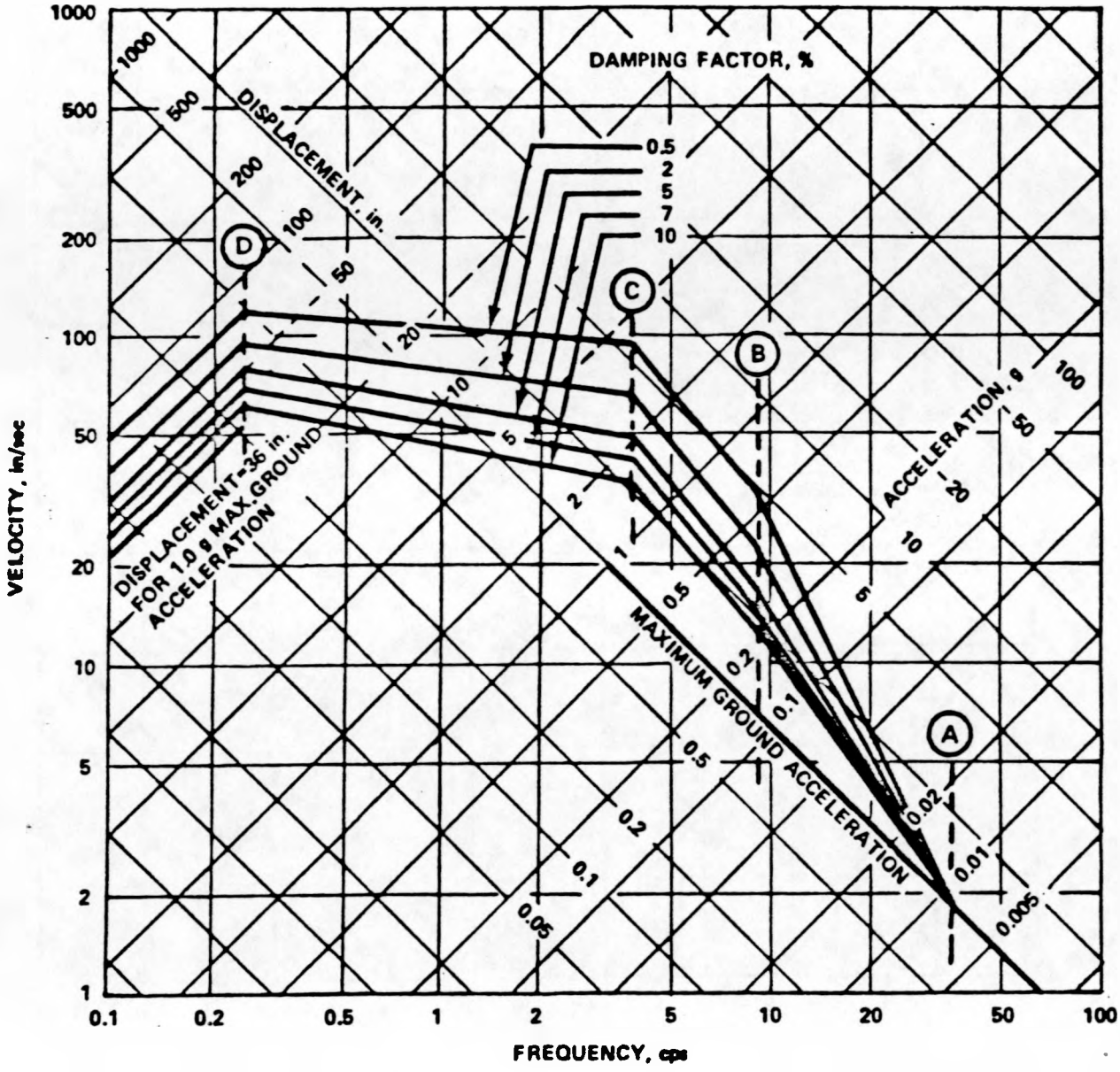


Figure 1.3-2 - Vertical Design Response Spectra -
Scaled to 1g Horizontal Ground Acceleration

9. Tornado Loads.

(1) Category I structures shall be designed to withstand a design basis tornado having the following characteristics:

Maximum wind speed:	360 mph
Rotational speed:	290 mph
Translational speed:	70 mph
Radius of maximum rotational wind:	150 ft
Pressure drop:	3 psi
Rate of pressure drop:	2.2 psi/sec

Tornado-generated missiles shall be considered in the design. The following missiles and associated impact velocities shall be considered:

Missile	Velocity (ft/sec) Horizontal	Vertical
Wood plank, 4 in. x 12 in. x 12 ft long, wt 115 lb	272	190
Steel pipe, 6 in. dia, Schedule 40, 15 ft long, wt 287 lb	170	119
Steel rod, 1 in. dia x 3 ft long, wt 9 lb	167	167
Utility pole,* 13-1/2 in. dia, 35 ft long, wt 1,125 lb	180	126
Steel pipe, 12 in. dia, Schedule 40, 15 ft long, wt 750 lb	154	108
Automobile* (20 sq ft frontal area), wt 4,000 lb	193	135

(2) Tornado loads consist of three components: tornado wind load (Ww), tornado differential pressure load (Wp), and tornado missile load (Wm).

According to NRC Standard Review Plan, Section 3.3.2, the total tornado load (Wt) will be the most severe of the following possible combinations of components:

- Wt = Ww
- Wt = Wp
- Wt = Wm
- Wt = Ww + 0.5 Wp
- Wt = Ww + Wm
- Wt = Ww + 0.5 Wp + Wm

The above combinations are made with due regard to the sign (direction) of the component loads.

*Missiles to be considered at elevations up to 30 ft above grade.

10. Lateral Earth Pressure. Lateral earth pressure shall include both the static earth pressure loads and dynamic earth pressure loads caused by earthquake (Category I structures only). Shown below are the lateral soil pressures assumed for various conditions:

(1) Static Earth Pressure

- Active earth pressure (top of wall unrestrained) 30 pcf
- At-rest earth pressure (top of wall restrained) 55 pcf
- Surcharge: A construction surcharge, adjacent to the structure, of 300 psf or 20,000 lb wheel load, whichever governs.

(2) Dynamic Earth Pressure

- DBE: $P = 10.3\ H^2$ lb/ft

  where H is the height of the wall from base to top of grade. The resultant of pressure (P) will set on wall at a height of 0.67 H above its base. This is based on the assumption that the dynamic soil pressure has the distribution of an inverted triangle.

- OBE: $P = 5.15\ H^2$ lb/ft

11. Air-Pressure Differential. Primary contamination control shall be ensured by maintaining air-pressure differentials between operating zones. In Zone 1, (-)2. to (-) 4. inches of water shall be used.

12. Test Loads. Test loads shall be considered part of the live loads. Any component that is to be tested, along with its supporting structure, shall be designed to withstand the loads that arise from the static or dynamic test procedures. This load shall be evaluated in the final design.

13. Crane and Hoist Loads. All crane and hoist loads, including their impact loads, shall be treated as live loads in the design of supporting structural members.

1.3.2.E. Load Combinations

1. Loads, Definitions and Nomenclature.

D = Dead loads.

L = Live loads; included as live loads shall be vehicle loads, snow loads, impact loads, test loads, and crane and hoist loads.

Roof live loads shall not be combined with snow loads.

F = Lateral and vertical loads caused by fluid pressure; included in this load condition shall be the air-pressure differential (except tornado pressure drop).

H = Lateral earth pressure.

To = Thermal effects caused by thermal gradient during operation.

E = Earthquake loads for Non-Category I structure (UBC loads).

Eo = Operating basis earthquake, including dynamic effects on fluid and earth pressure.

Ed = Design basis earthquake, including dynamic effects on fluid and earth pressure.

W = Wind loads.

Wt = Loads generated by the design basis tornado; the tornado wind load, tornado differential pressure, tornado missile loads, and their combinations shall be included. See Section 1.3.2.D.9.

2. Load Combination and Allowable Stress Limits.

(1) Category I Structures

Load combinations are derived from DOE 6430.1, NRC SRP 3.8.4, ACI 349, and ACI 318. The most stringent cases are listed below:

(a) Concrete Structures

$U = 1.4 (D + F) + 1.7 (L + H) + 1.9 Eo$
$U = 1.4 (D + F) + 1.7 (L + H) + 1.7 W$
$U = 0.9 D + 1.4 F + 1.7 H + 1.9 Eo$
$U = 0.9 D + 1.4 F + 1.7 H + 1.7 W$
$U = 0.75 [1.4 (D + F) + 1.7 (L + H + To) + 1.9 Eo]$
$U = 0.75 [1.4 (D + F) + 1.7 (L + H + To + W)]$
$U = 1.1 (D + L + F + H + To) + Ed$
$U = 1.1 (D + L + F + H + To) + Wt$
$U = 0.9 D + F + H + To + Ed$
$U = 0.9 D + F + H + To + Wt$

(b) Steel Structures

$S = D + L + F + H + Eo$
$S = D + L + F + H + W$
$1.3 S = D + L + F + H + Eo + To$
$1.3 S = D + L + F + H + W + To$
$1.5 S = D + L + F + H + To + Ed^*$
$1.5 S = D + L + F + H + To + Wt^*$

*Stresses shall be limited to 0.95 Fy. Plastic section modulus of steel shapes may be used.

(2) Non-Category I Structures

(a) Concrete Structures

$$U = 1.4 (D + F) + 1.7 (L + H)$$
$$U = 0.9 D + 1.4 F + 1.7 H$$
$$U = 0.75 [1.4 (D + F + To) + 1.7 (L + H + W)]$$
$$U = 0.75 [1.4 (D + F + To) + 1.7 (L + H) + 1.87 E]$$
$$U = 0.9 D + 0.75 [1.4 F + 1.7 (H + W)]$$
$$U = 0.9 D + 0.75 (1.4 F + 1.7 H + 1.87 E)$$

(b) Steel Structures

$$S = D + L + F + H + To$$
$$1.33 S = D + L + F + H + To + W$$
$$1.33 S = D + L + F + H + To + E$$

where

U = section strength required to resist design loads based on the strength design methods described in ACI 318.

S = the required section strength based on the elastic design methods and allowable stresses defined in AISC, Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

1.3.2.F. Design Methods

1. Reinforced Concrete. All reinforced concrete shall be designed in accordance with the Strength Design Method described in ACI-318. Category I structures shall be designed in accordance with ACI-349.

2. Steel Structures. All steel structures shall be designed in accordance with the Working Stress Method and AISC, Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.

3. Masonry. Masonry shall comply with Chapter 24 of the Uniform Building Code and ACI 531, Building Requirements for Concrete Masonry Structures.

4. Seismic Analysis.

(1) Non-Category I Structures

Analysis shall comply with Chapter 23 of the Uniform Building Code, Seismic Zone 2.

(a) Structure $V = ZIKCSW = 0.079$ kW
$Z = 3/8$
$I = 1.5$
$CS = 0.14$

(b) Elements of structure $F_p = Z\ I\ C_pW_p$

$= 0.56\ C_pW_p$

(2) Category I Structures

(a) Dynamic Analysis

The Response Spectra Method shall be used in accordance with NRC Standard Review Plan, Section 3.7.2, Seismic System Analysis.

A simplified lump-mass mathematical model with soil spring shall be used. The seismic analysis shall take into consideration three orthogonal directions of seismic motions, two horizontal and one vertical. The maximum response to each of the three components of motion shall be determined separately, and shall be combined by the square root of sum of the square (SRSS) method to obtain the total seismic responses. The design parameters shall be as follows:

(b) Maximum horizontal ground acceleration at bedrock:

DBE 0.25 g
OBE 0.125 g

(c) Vertical acceleration at bedrock:

DBE 0.167 g
OBE 0.083 g

(d) Response spectrum from NRC Regulatory Guide 1.60, Design Response Spectrum for Seismic Design of Nuclear Power Plant.

(e) The soil-structure interaction shall be assumed at 1.0 between bedrock and foundations, and 1.5 between fill/natural soil and foundations, in the conceptual design. Soil amplification factor shall be determined from soil investigation in the final design.

(f) Damping value (percent of critical damping) shall be as tabulated below:

Structure or Component	OBE	DBE
Welded steel structures	2	4
Bolted steel structures	4	7
Reinforced concrete structures	4	7

(3) Equivalent Static Load Analysis

For conceptual design, the Equivalent Static Load Method shall be used in accordance with the following parameters:

(a) Static loads:

Longitudinal direction = XW
Transverse direction = YW
Vertical direction = ZW

where W = D + 0.25 L
X, Y, Z percentages of W, assumed as follows:

Structural Elements	OBE			DBE		
	X	Y	Z	X	Y	Z
Floor at ground level	0.3	0.3	0.3	0.5	0.5	0.5
Floor and roof up to 33 ft above ground	0.4	0.4	0.4	0.6	0.6	0.6
Floor and roof up to 74 ft above ground	0.5	0.5	0.5	0.8	0.8	0.8
Floor and roof above 74 ft above ground	0.6	0.6	0.6	1.0	1.0	1.0

For slab, beam, and wall design, the numbers shall be increased by 50%.

5. Tornado Analysis.

(1) Tornado wind load (Ww) shall be determined in accordance with NRC Standard Review Plan, Section 3.3.2, and ANSI A58.1. The tornado average velocity pressure, the design loads for main resisting systems, and those for building components are presented in Tables 1.3-4, 1.3-5, and 1.3-6.

(a) The Maximum Velocity Pressure, P, will be based on the Maximum Tornado Velocity, V.

$P = 0.00256\ V^2$ psf in which V is in mph.

(b) The velocity pressure shall be assumed constant with the height.

(c) Velocity and velocity pressure vary with horizontal distance from the center of tornado.

(d) Gust factor shall be taken as unity.

Table 1.3-4 - Tornado Wind Load

L (ft)	L/R_m	C_s	q(psf)
20	0.13	0.92	305
40	0.27	0.87	289
60	0.40	0.82	272
80	0.53	0.77	256
100	0.67	0.73	242
120	0.80	0.69	229
140	0.93	0.65	216
160	1.07	0.62	206
180	1.20	0.59	196
200	1.33	0.56	186
220	1.47	0.53	176
240	1.60	0.51	169
260	1.73	0.49	163
280	1.87	0.47	156
300	2.00	0.45	149

V max = maximum design wind velocity
360 mph

P max = velocity pressure at radius of maximum wind

$P_{max} = 0.00256\ V^2_{max}$
$= 332$ psf

q = average velocity pressure

$q = C_s P_{max}$

L = dimension of structure perpendicular to wind

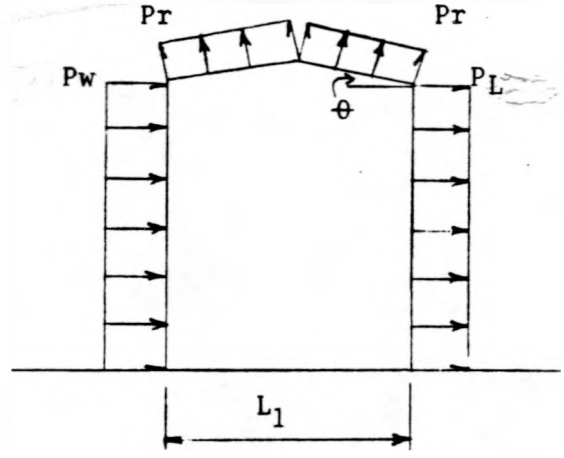
$R_m = 150$ ft

C_s = size coefficient
(See Figure 1.3-4.)

Table 1.3-5 - Tornado Wind Loads on Main System

L (ft)	q(psf)	P_w	P_{L1}	P_{L2}	P_{L3}	P_r	$C_{pi}q$
20	305	244	153	92	61	214	76
40	289	231	145	87	58	202	72
60	272	218	136	82	54	190	68
80	256	205	128	77	51	179	64
100	242	194	121	73	48	169	61
120	229	183	115	69	46	160	57
140	216	173	108	65	43	151	54
160	206	165	103	62	41	144	52
180	196	157	98	59	39	137	49
200	186	149	93	56	37	130	47
220	176	141	88	53	35	123	44
240	169	135	85	51	34	118	42
260	163	130	82	49	33	114	41
280	156	125	78	47	31	109	39
300	149	119	75	45	30	104	37

Reference: ANSI A58.1 - 1982



q See Table 1.3-4.

L = Dimension of structure perpendicular to wind

$\Theta \leq 10^{o}$

Windward wall: $P_w = qC_p$ $C_p = 0.8$

Leeward wall: $P_L = qC_p$

$P_{L1} = L_{1/L} \leq 1$, $C_p = 0.5$

$P_{L2} = L_{1/L} = 2$, $C_p = 0.3$

$P_{L3} = L_{1/L} \geq 4$, $C_p = 0.2$

Roof $P_r = qC_p$, $C_p = 0.7$

Internal wind pressure = $P_i = C_{pi}q$, $C_{pi} = 0.25$

Table 1.3-6 - Tornado Wind Loads on Building Components

L (ft)	q	P_1	P_{1*}	P_2	P_{2*}	P_3	P_{3*}	P_4	P_{4*}	P_{4**}	P_5	P_{5*}	P_{5**}
0	332	465	398	863	498	1,328	498	498	432	365	664	498	365
20	305	427	366	793	458	1,220	458	458	397	336	610	458	336
40	289	405	347	751	434	1,156	434	434	376	318	578	434	318
60	272	381	326	707	408	1,088	408	408	354	299	544	408	299
80	256	358	307	666	384	1,024	384	384	333	282	512	384	282
100	242	339	290	629	363	968	363	363	315	266	484	363	266

Reference: ANSI A58.1 - 1982

q = See Table 1.3-4.

L = dimension of building components perpendicular to tornado wind

$\Theta \leq 10^{o}$

$P = qC_p$

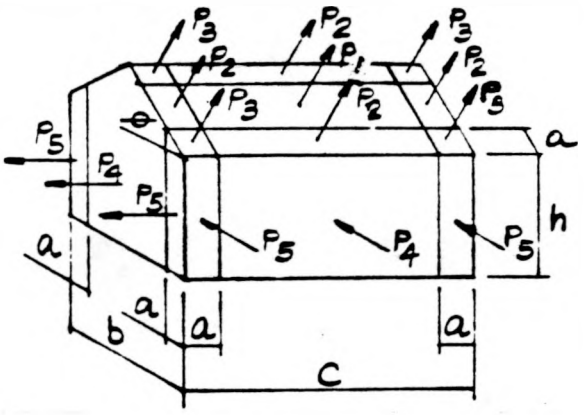
C_p = See Figure 3a, Figure 3b (Reference)

P_n = load for A $\leq$ 10 sf

P_n* = load for A $\geq$ 100 sf

P_n** = load for A $\geq$ 500 sf

A = tributary area



$0.04b \leq a \leq 0.1b$
$0.04c \leq a \leq 0.1C$
3 ft $\leq a \leq 0.4h$

NOTE: Combine P_n with internal wind pressure load $C_{pi}q$ for component design. See Table 1.3-5 for $C_{pi}q$ (varies with building dimensions).

(2) Differential pressure loads caused by atmospheric pressure change shall be considered in the design of unvented Category I buildings. The R&H Building and CHTRU Facility shall be considered as unvented and consequently subject to the full value of pressure drop.

(3) Tornado-generated missile impact loads (Wm) shall be used for the prediction of local damage to the barrier or portions thereof caused by the missile impact.

a. Local Damage Prediction. Concrete barriers shall be designed to prevent missile perforation. For hard missiles (steel rod, pipes), the following Modified National Defense Committee (NDRC) formula shall be used to determine the penetration and scabbing thickness. The concrete thickness shall be at least 20% thicker than the scabbing thickness. The design for punching shear is not required. The calculated missile penetrations are given in Table 1.3-7. The 12-in. pipe is the critical missile; however, the penetration is excessive compared to the actual test results in the EPRI, Full Scale Tornado Missile Impact Tests. The 24-in. walls and 18-in. roof slabs are selected in the conceptual design to prevent scabbing.

b. Modified NDRC Formula:

$$ts = \begin{cases} 2.12\ d + 1.36\ X & \text{for } X/d \geq 0.65 \\ 7.91\ x - 5.06\ X^2/d & \text{for } X/d < 0.65 \end{cases}$$

$$G = \begin{cases} (X/d)^2 & \text{for } X/d \leq 2.0\ (G \leq 1.0) \\ (X/d)^2 & \text{for } X/d < 2.0\ (G < 1.0) \end{cases}$$

$$G = KNd^{0.2}\ \frac{W}{d^3}\ \left(\frac{V}{1{,}000}\right)^{1.8}$$

where

$K = 180/(fc')^{1/2}$

N = a missile shape factor that has a value of 0.72 for flat-nosed bodies

V = velocity of missile in feet per second

W = missile weight in pounds

Table 1.3-7 - Tornado Missile Penetration

Missile	Direction	W	V	A_c	d	G	x	t_s	t
B 6-in. Sch 40 pipe	Horiz	287	170	5.58	2.67	1.39	6.38	14.3	17.2
	Vert	287	119	5.58	2.67	0.73	4.56	11.9	14.2
C 1-in. steel rod	Horiz	9	167	0.785	1.00	0.66	1.62	4.3	5.2
	Vert	9	167	0.785	1.00	0.66	1.62	4.3	5.2
E 12-in. Sch 40 pipe	Horiz	750	154	14.6	4.31	0.79	7.67	19.6	23.5
	Vert	750	108	14.6	4.31	0.42	5.58	16.7	20.1

Modified National Defense Research Committee Formula (NDRC):

$$G = KNd^{0.2}\frac{W}{d^3}\left(\frac{V}{1{,}000}\right)^{1.8}$$

Where $K = \frac{180}{\sqrt{fc'}} = 2.85$

$$G = \begin{cases} (X/2d)^2 \text{ for } X/d \leq 2.0 (G \leq 1.0) \\ (X/d-1) \text{ for } X/d > 2.0 (G > 1.0) \end{cases}$$

$fc' = 4{,}000$ psi

$N = 0.72$ for flat-nosed bodies

$t_s = 2.12\,d + 1.36\,X$ for $X/d \geq 0.65$

$t_s = 7.91\,d - 5.06\,X^2/d$ for $X/d < 0.65$

A_c = contact area ($in.^2$)

$d = \sqrt{\frac{4A_c}{\pi}}$ (in.)

$t = 1.2\,t_s$

V = impact velocity (fps)

X = penetration (in.)

t_s = scabbing thickness (in.)

t = overall thickness of concrete member (in.)

fc' = concrete compressing strength in pounds per square inch

$d = \sqrt{\frac{4A_c}{\pi}}$ = effective missile diameter in inches

A_c = missile contact area in square inches

ts = scabbing thickness defined as the thickness of concrete required to prevent scabbing

X = missile penetration in inches (given in Table 1.3-7)

For soft missiles (wood plank, pole, automobile), there shall be no penetration. Local impact effect will be governed by punching shear. The punching shear load shall be taken as 20% greater than the effective missile load on the crushing force of the missile.

c. Steel Barriers. Steel barrier shall be designed to prevent missile penetration. The Ballistic Research Laboratory (BRL) formula shall be used to solve the steel plate thickness, T, which shall just be perforated by the missile:

$$T = \frac{\left(\frac{MV^2}{2}\right)^{2/3}}{672D}$$

where

T = steel plate thickness to just perforate in inches
M = mass of the missile (lb sec/ft^2)
V = velocity of missile in feet per second
D = diameter of missile in inches

The plate thickness shall be at least 25% greater than the perforate thickness to prevent perforation.

d. Overall Response Prediction. The response of structure or barrier to missile impact shall be investigated. Postelastic deformation of the structure shall be permitted in the vicinity of local impact, consistent with the inherent ductility of the structure. For concrete walls and slabs, potential yield line mode of failure shall be hypothesized and investigated to ensure that the energy-absorption potential exceeds the kinetic energy released by an impacting missile. The idealized force-time history shall be used for automobile missile (see Figure 1.3-3).

6. Foundation Design. Foundations for buildings and structures shall be spread footings and continuous wall footings. Exterior footings shall be located below the frost line.

SOURCE: Proceedings of Symposium on Structural Design on Nuclear Power Plant Facilities, 1972 - University of Pittsburgh

$F_1 = 1.14\ WV_o$ W in pounds, V_o in mph

$t_d = 0.08$ sec

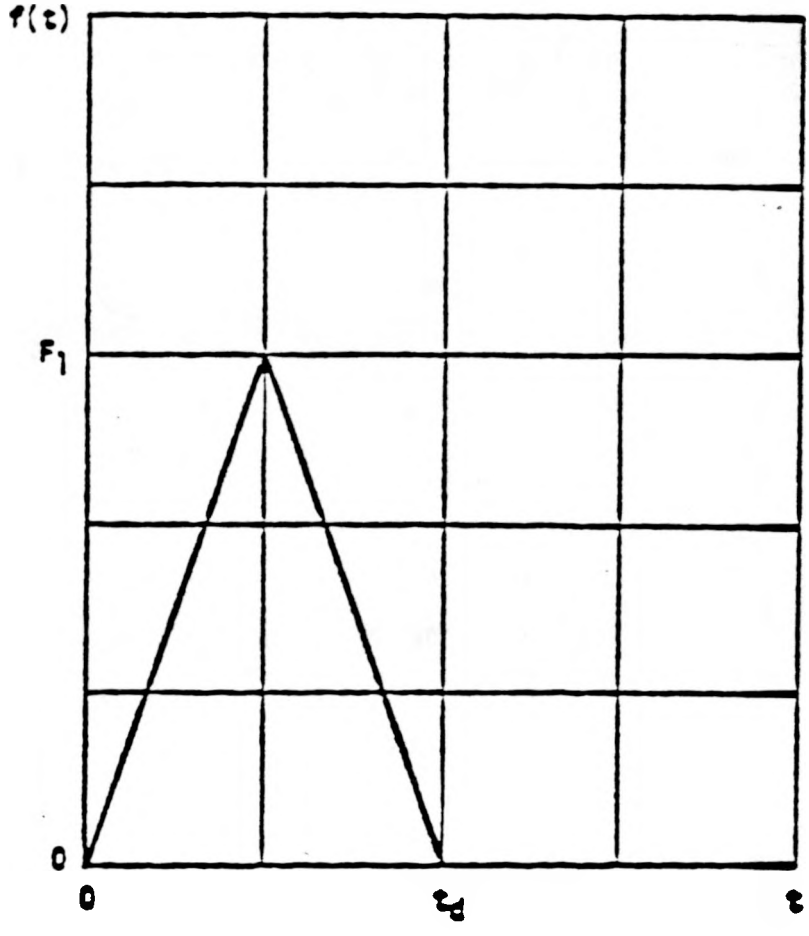


Figure 1.3-3 - Idealized Force-Time History for Automobile

7. Sliding and Overturning. For loading conditions with wind, UBC seismic loads, or operating earthquake loads, the factor of safety against overturning or sliding shall be 1.5. For loading conditions with tornado loads or design basis earthquake loads, the factor of safety against overturning or sliding shall be 1.1.

1.3.2.G. Structural Materials

1. Concrete. Concrete for Category I structures shall have a minimum fc' = 4,000 or 5,000 psi at 28 days. Concrete for Non-Category I structures shall have a minimum fc' = 3,000 psi.

2. Reinforcing Steel. All reinforcing steel for concrete work shall be deformed bars conforming to ASTM A615, Grade 60, except that stirrups and ties shall be ASTM A615, Grade 40. All reinforcing steel for masonry work shall be ASTM A615, Grade 40. Wire mesh shall conform to ASTM A185.

3. Steel. Structural steel shall conform to ASTM A36 (Fy = 36,000 psi). Bolt connection shall be ASTM A325 high-strength bolt, friction type.

4. Masonry. Reinforced hollow unit masonry shall be ASTM C90, Grade N, with compressive strength fm' = 1,350 psi minimum.

5. Stainless Steel. Stainless steel plate shall conform to ASTM A167, Type 304L. Stainless steel shapes shall conform to ASTM A276, Type 304.

1.3.2.H. Soil

For final design, the soil parameters shall be based on the actual geological investigation of the selected sites. For conceptual design, the following parameters shall be assumed:

- Bearing capacity: 4,000 psf for compacted fill or natural soil
  15,000 psf for bedrock or weathered rock

  1/3 increase for wind, seismic, OBE
  1/2 increase for tornado, DBE

- Active soil pressure: Section 1.3.2.D.10

- Passive soil pressure: 400 pcf

- Modulus of subgrade reaction: 400 kips/ft^3

- Friction coefficient: 0.5

- Frost line for footings: 2 ft below grade

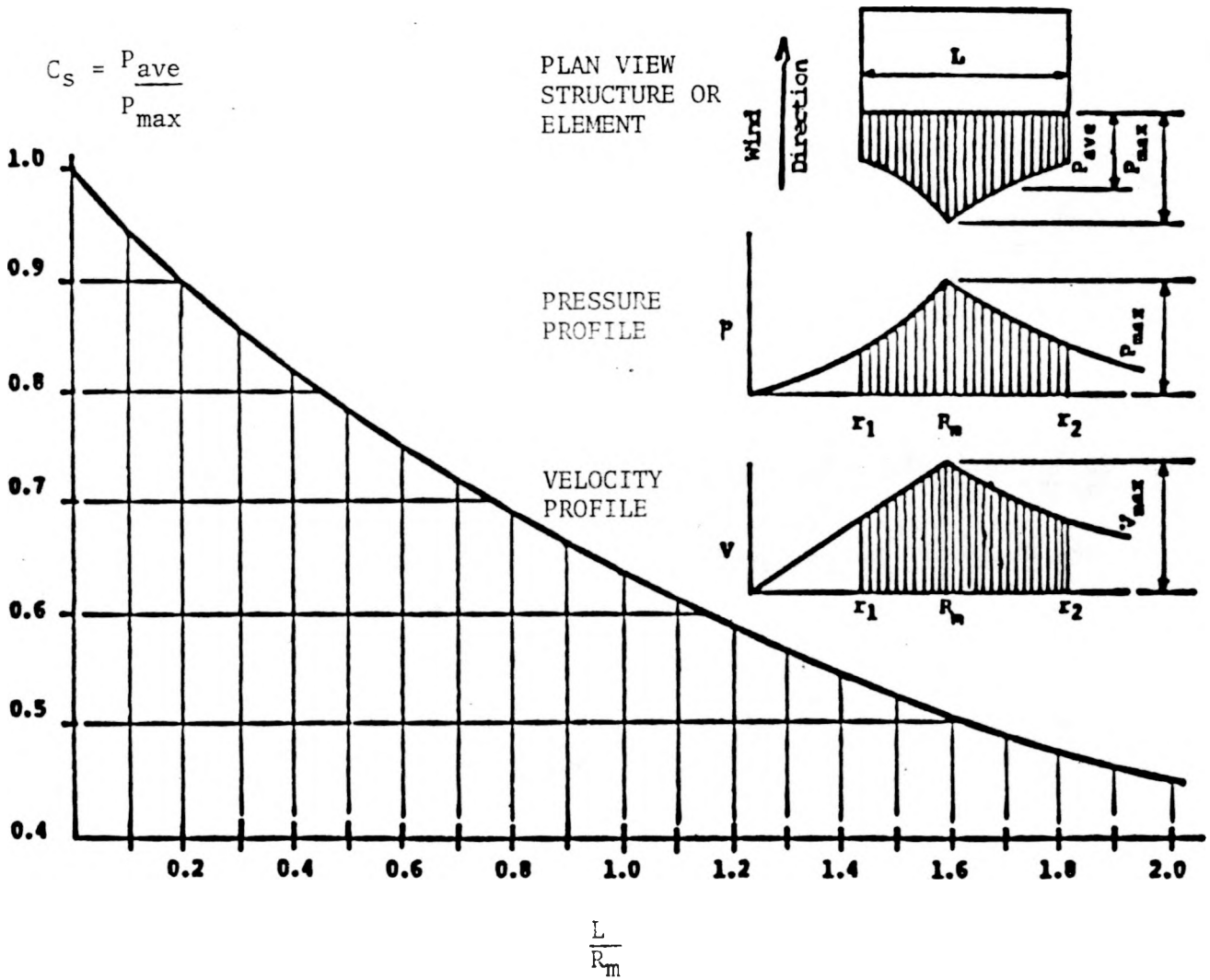


Figure 1.3-4 - Size Coefficient, C,
for Average Tornado Velocity Pressure Loading

1.3.3 ALARA REQUIREMENTS FOR STRUCTURAL

Structures, systems, and components important to safety, as defined in 10 CFR 72.3 (w), shall be designed as Category I structures in accordance with the requirements of 10 CFR 72, Subpart F - General Design Criteria.

The primary confinement (hot cells and process enclosures) shall be constructed of reinforced, normal-weight concrete designed to keep radiation dose rates from exceeding FDC maximum allowables through the shielding. High-density concrete, steel, or lead may be used for shielding where required by space limitation.

The secondary confinement (operating areas and their ventilation and air-cleaning system) shall be enclosed by a reinforced concrete structure designed to withstand all normal and extreme environmental loads, to protect all Category I structures, systems, and components.

1.4 ARCHITECTURAL

The architectural design of the MRS Facility shall conform with the following design criteria and basis for design.

1.4.1 DESIGN CRITERIA

1.4.1.A. Codes, Standards, and Specifications

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the codes, standards, specifications, and guides listed herein.

1. Codes

   (1) National Fire Codes
   All as applicable

   (2) Uniform Building Code (UBC)

   (3) Uniform Plumbing Code (UPC)

   (4) ANSI 101.6, Concrete Radiation Shields

2. DOE Orders

   The applicable portions of the following DOE Orders shall be applied to the design of this facility:

   (1) DOE 4320.1A, Site Development and Facility Utilization Planning

   (2) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(3) DOE 5632.2, Physical Protection of Special Nuclear Materials

(4) DOE 6430.1, General Design Criteria

(5) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

3. Federal Regulations

An MRS Facility must be licensed by the Nuclear Regulatory Commission (NRC) under the appropriate parts of Title 10, Code of Federal Regulations (10 CFR). Principal among these is Part 72, which deals specifically with storage of spent nuclear fuel and other radioactive materials in facilities independent of reactors. The parts of 10 CFR applicable to the design, construction, and operation of an MRS Facility are:

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

(2) 10 CFR 50, Appendix E (Emergency Planning)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(5) 10 CFR 73, Physical Protection of Plants and Materials

(6) 40 CFR 191 (latest draft), Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

(7) 29 CFR 1910, Occupational Safety and Health Standards

4. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

5. Federal and State Standards

Other federal and state standards, permits, and licenses

6. Specifications

Federal Specifications as applicable

1.4.1.B. Design Requirements for Natural Phenomena

Facilities, systems, and structures at the MRS Facility range from ordinary, utilitarian type (i.e., office buildings and shops) to those that must remain functional during and after credible natural phenomena (i.e., shielded hot cells). Therefore, the MRS Facility has been divided into two subgroups, Category I and Non-Category I, which are defined in the following sections. Specific criteria for wind and earthquake loadings are also included for each category.

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, Operating Basis Earthquake, and Design Basis Tornado, they would be required to perform either of the following safety functions:

- Prevent or mitigate the consequences of an uncontrolled release of radioactivity with potential radiological consequences in excess of the limits in 10 CFR 72.

- Maintain nuclear criticality safety.

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.

3. Flood Requirements. The MRS Facility shall be sited at a location above the probable maximum flood (PMF). No special flood requirements shall be needed beyond normal site drainage to accommodate precipitation runoff. The maximum precipitation recorded at the candidate sites in 24 hours is less than or equal to 9 inches. The maximum precipitation recorded at the candidate sites in 1 hour is less than or equal to 3 inches.

1.4.1.C. Functional Requirements

1. General. The MRS Facility shall be an independent installation complete with its own supporting facilities. It must be licensed by the Nuclear Regulatory Commission (NRC). It shall be connected to and served by public highways and roads, railroad, and electrical and telephone utilities. The facility layout should minimize the impact on the environment. It shall consist of:

- Receiving and Handling (R&H) Building
- Spent Fuel, HLW, and HAW/RHTRU Storage Facilities
- CHTRU Facility
- Supporting facilities
- Site improvements, roads, railroad
- Utilities

2. Design Life of Facilities. The design life of the R&H Building shall be 50 years, maintainable or replaceable to at least 100 years, irrespective of licensing intervals. The design life of the storage facilities shall be 100 years. The design life of supporting facilities shall be 30 years, except for exterior finishes that may require periodic maintenance to satisfy the 30-year requirement.

The primary functions of these facilities are described herein.

3. Capabilities.

(1) The MRS Facility shall have the capability to routinely receive, inspect, repackage, consolidate (spent fuel only) and package, ship out, place in short-term lag storage, and/or store, and retrieve for subsequent shipment, spent fuel, solidified HLW, and RHTRU that has been out of reactor 10 years. The design throughput capacity shall be 3,600 MTU/yr of spent fuel and a small amount (less than 300 canisters) of HLW and possibly RHTRU. Throughput capacities should be based on 3 shifts-per-day, 7 days-per-week, year-round operation. Facilities shall be provided in the R&H Building for short-term lag storage of 1,000 MTU of canistered spent fuel. The Storage Facility capacity of the MRS Facility shall be 15,000 MTU of spent fuel and a small amount (less than 300 canisters) of HLW.

(2) The MRS Facility shall be capable of receiving shipments by rail and truck, and shall be capable of receiving, unloading, loading, and shipping all reference rail and truck spent fuel, HLW, and RHTRU shipping casks. The MRS Facility design shall assume that spent fuel is received 70 wt% by rail and 30 wt% by truck. Nonstandard or off-normal cask shipments shall be routed to a special lag storage area to await special disposition of the shipment. After the appropriate procedure is in place, a nonstandard or off-normal shipment shall be routed through the MRS Facility in conformance with the requirements of the procedure. All spent fuel and waste will most likely be shipped from the MRS Facility via rail.

(3) Spent fuel may be received fully assembled, either encapsulated or bare, or disassembled and consolidated in canisters. Fully assembled fuel shall be either sealed in canisters as one unit, or disassembled and consolidated in canisters at the MRS Facility. Canisters of consolidated fuel rods shall be inspected, recanistered or overpacked as appropriate, and labeled. All fuel rods from a fuel assembly shall be consolidated in the same canister. Broken rods, jammed rods, and others that cannot be readily consolidated with their original assembly may be collected in a separate canister. This canister may contain rods from several assemblies and shall be identified as such in the inventory system. Nonfuel-bearing components of the assemblies shall be reduced in volume and placed in drums or canisters.

(4) The MRS Facility shall be designed to prevent nuclear criticality events.

(5) Fuel and waste storage facilities shall be capable of attenuating the radiation and passively dissipating the heat generated primarily by 33,000 MWD/MTU spent fuel and/or equivalent HLW and RHTRU out of reactor 10 years. As much as 10% of the spent fuel received shall be considered fuel 5 years out of reactor and/or 10-year-old spent fuel with burnups as high as 55,000 MWD/MTU.

(6) The storage facilities shall be capable of confining radioactive material within the storage container (cask, drywell, etc.) during the entire storage period and shall have a monitoring system capable of detecting releases to the environs of radioactive material in excess of 1/10 of 10 CFR 20 Appendix B, Table II. Stored material shall be protected against likely natural or man-created events, excluding acts of war. In addition, all packages of waste must be retrievable at any time for examination, repair, or shipment offsite.

(7) The MRS Facility shall be capable of annually receiving at least 12,400 fuel assemblies (60 wt% PWR/40 wt% BWR) and a small amount of HLW and RHTRU.

(8) The MRS Facility shall be capable of accommodating equipment for placing a suitable overpack around the spent fuel or waste package that satisfies specific repository disposal criteria.

4. Receipt and Inventory Verification. For receipt and inventory verification, provisions shall be included to account for the quantity, type, and history of the material stored in the facility.

5. Security. Security, surveillance, and physical protection of the spent fuel and waste containers shall be provided for the facility, including the designation of vital areas, in accordance with federal regulations.

6. Radiation. Radiation exposures shall be kept as low as is reasonably achievable (ALARA). The facility shall be designed and constructed to protect operating personnel and the public from the radiation emitted from operating facilities and stored materials. Designs shall limit direct radiation exposure of onsite and offsite personnel within the limits established in 10 CFR 20, DOE Order 5480.1A, and other applicable regulations. DOE 5480.1A requires as a design objective that operating personnel exposure levels shall be less than one-fifth of the permissible dose equivalent limits promulgated by that order. The public shall also be protected from release of radioactive particulate material and gases that would cause exposures (as measured at the site boundary) to doses in excess of those defined in 10 CFR 20, 10 CFR 72, and other applicable federal regulations.

7. Other Facilities. Support facilities, site improvements, roads, railroads, and utilities shall be included to provide a complete and operable facility capable of satisfying the functional requirements described above.

1.4.1.D. Accommodations for the Physically Handicapped

Buildings shall accommodate the physically handicapped in compliance with Public Law 90-480, as amended, and Federal Property Management Regulation Subpart 101-19.6. Exception to these standards shall be made only to portions of buildings where, because of the intended use, the area is inaccessible to physically handicapped persons. In those cases, only those measures to accommodate a specific class of handicapped persons shall be excluded. Standards for all other classes of physically handicapped persons shall be applicable.

1.4.1.E. Energy Conservation

1. General. An overall energy conservation plan shall be prepared, which should include all of the design and operating considerations necessary for optimal energy conservation. In addition, alternative energy sources shall be considered. Meters shall be provided on utility sources to each building.

2. Building Design. Selection of building materials should be based on thermal emissivity, thermal mass, and the thermal absorptive and reflective properties of materials.

Designs shall minimize infiltration of outside air.

Insulation and insolation factors shall be considered in the building design. For example, window design should consider insolation factors such as number, size, and location of windows with respect to sunlight, shading, multiple panes, tinting, and controlled thermal barriers.

1.4.1.F. Expansion Areas (CHTRU Storage)

The CHTRU Facility shall be incrementally expandable to permit storing CHTRU wastes generated onsite in subsequent years of operation of the MRS Facility.

1.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.1, the following criteria shall be used.

1.4.2.A. Codes, Standards, and Specifications

In addition to the codes, standards, and specifications listed in Section 1.4.1.A, the following shall also be used (including specific publication editions for those previously listed):

1. Codes

(1) National Fire Codes
NFPA No. 101 - Life Safety Code, 1985 Edition

(2) Uniform Building Code (UBC), 1985 Edition

(3) Uniform Plumbing Code (UPC), 1982 Edition

(4) ANSI N512-1974, Protective Coating for Nuclear Industry

2. Standards

(1) Department of Energy (DOE Orders)

(a) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

(b) DOE 5632 (draft), Physical Protection of Security Interests

(2) Nuclear Regulatory Commission (NRC) Regulatory Guides

No additional regulations.

(3) Federal and State Standards

Architectural and Transportation Barriers Compliance Board - Minimum Guidelines and Requirements for Accessible Design (36 CFR, Part 1190), Amended 1982.

1.4.2.B. Specific Design Requirements

1. Category I Components, Systems, and Structures.

In accordance with 10 CFR 72.72, components, systems, and structures subject to the requirements of Category I criteria shall have design and structural characteristics as required to satisfy the criteria. Tornados and earthquakes shall be suitably resisted, and adequate radiation shielding shall be provided. Special heavy-duty, solid-steel doors and other barriers shall protect exterior openings from pressure differentials and missiles.

2. Non-Category I Components, Systems, and Structures.

There are no requirements in addition to those described in Section 1.4.1.B.2.

3. Flood Requirements. There are no requirements in addition to those described in Section 1.4.1.B.3.

1.4.2.C. Functional Requirements

1. General. There are no requirements in addition to those described in Section 1.4.1.C.1.

2. Design Life of Facilities. There are no requirements in addition to those described in Section 1.4.1.C.2.

3. Capabilities. The capabilities of the MRS Facility described in Section 1.4.1.C.3, relating to throughput and storage capacities, shall be considered in general as minimum amounts. "Standard" rail and truck shipping casks are those casks identified as "reference" casks in Table 1.5-1. "Nonstandard" casks are any casks other than the "reference" casks. "Off-normal" shipments are those that are received in damaged condition, are leaking, or have higher than normal surface dose rates (greater than 200 mR/hr).

4. Receipt and Inventory Verification. In addition to receiving and inventory verification capabilities at the R&H Building, similar limited functions shall be provided at the gatehouses controlling access to various parts of the MRS Facility and the storage facilities.

5. Security. These are the requirements in addition to those described in Section 1.4.1.C.5: An Emergency Planning Zone (EPZ), in accordance with 10 CFR 72, shall be established for the MRS Facility site, which shall provide reasonable assurance that protective actions beyond its outer boundary would not be necessary. The boundaries of the EPZ shall be determined by taking into account both the characteristics of the facility and local conditions, such as demography, topography, land characteristics, access routes, and local jurisdictional boundaries.

6. Radiation. In addition to the requirements described in Section 1.4.1.C.6, the MRS Facility spent-fuel handling, transfer, and storage systems shall be designed to be maintained subcritical and to prevent a nuclear criticality accident. The design shall be based on favorable geometry (spacing).

7. Other Facilities. There are no requirements in addition to those described in Section 1.4.1.C.7.

1.4.2.D. Accommodations for the Physically Handicapped

There are no requirements in addition to those described in Section 1.4.1.D.

1.4.2.E. Energy Conservation

1. General. There are no requirements in addition to those described in Section 1.4.1.E.1.

2. Building Design. In addition to the requirements of Section 1.4.1.E.2, safety, fire protection, economy, ease of maintenance, decontamination, decommissioning, structural requirements, and appearance shall also be considered in selecting materials for all buildings. Noncombustible and heat-resistant materials shall be used wherever practicable throughout the facilities.

1.4.2.F. Expansion Areas

Space shall be allocated for the ultimate provision of the SF, HLW, and HAW/RHTRU Storage Facilities. The CHTRU Facility shall have incremental addition of 24 cells approximately every 5 years.

1.4.2.G. Storage Facilities

Consideration has been given to the concrete cask storage concept and the manufacturing, transport, and storage/staging aspects of the casks. It is probable that the casks shall be manufactured by an independent contractor at or near the site. It is recommended that the cask manufacturing plant be as near as possible to the R&H Building because the casks shall be moved from the manufacturing plant staging area to the R&H Building by a very slow-moving transport vehicle. The transport vehicle shall also be used for movement from the R&H Building to the storage facility.

1.4.3 ALARA REQUIREMENTS FOR ARCHITECTURAL

1.4.3.A. General

Architectural design of the site arrangement, the R&H Building, and the Storage Facility shall conform to the requirements of 10 CFR Part 72 (Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation), including referenced 10 CFR parts and regulatory guides that are applicable to the ALARA principle. Specifically, DOE 5480.1A (Environmental Protection, Safety, and Health Protection Program for DOE Operations) and 10 CFR 20 (Standards for Protection Against Radiation) shall be the guidelines for design of all radiation-protection features. DOE/EV/1830-T5, A Guide to Reducing Radiation Exposures to As Low As Reasonably Achievable (ALARA), shall serve as a guide for building layout.

1.4.3.B. Site

At the MRS Facility site, both the R&H Building and the Storage Facility shall be located inside a double-fenced, controlled, protected area. The site boundary, as it relates to radioactive emissions, shall be considered to be a distance of 100 m from the source or the protected area fence, whichever is greater. The distance shall be increased, if necessary, to prevent an individual, located on or beyond the nearest boundary of the protected area, from receiving a dose greater than 5 rem to the whole body or any organ from any design basis accident; or to limit the annual dose to 25 mrem for continuous occupancy during normal operations.

The controlled protected area shall be arranged so that a Protected Area Gatehouse fully controls all traffic ingress/egress. Another consideration shall be a safe distance from the building for evacuation route(s) and staging areas for criticality events.

1.4.3.C. Receiving and Handling Building

For the R&H Building, architectural design considerations to meet ALARA requirements shall include the following:

1. Minimum Time of Exposure.

- Design of an integrated approach to controlled access and emergency egress. Aisles, corridors, operating galleries, changerooms, and service areas shall be arranged so as to provide rapid, easy egress through emergency exits from the building in case of evacuation and to provide easy access for routine operations, in accordance with Section 5, Means of Egress, and Section 28, Industrial Occupancies, of the NFPA No. 101 Life Safety Code, and Chapter 33 of the Uniform Building Code (UBC).

- R&H Building design that allows for a minimum of radiation exposure to operating and maintenance personnel.

2. Contamination Control.

- Design of completely remote process operation and maintenance operation for all hot cells and contiguous fuel-transfer and maintenance areas. Personnel entry to these areas during operations shall be restricted and only allowed while under complete control of health physics supervision.

- Spaces for health physics services, personnel changerooms, and decontamination activities shall be provided as necessary.

3. Decommissioning Considerations. Provisions shall be made to facilitate decontamination of structures and equipment at the time the facility is permanently decommissioned. Decontamination and decommissioning considerations by architectural design shall include that, in all potentially contaminated rooms, all floors, wall, and ceiling surfaces shall be smooth, free of cracks and crevices, free of sharp corners between adjoining planes, and shall receive special, nonporous-epoxy protective coatings complying with the specifications contained in ANSI N512-1974, Protective Coating for Nuclear Industry. All hot cells shall have floors, base, and walls (up to crane rails) of stainless steel plate liner over concrete, and shall receive a special coating on upper walls and ceilings.

4. Remote Versus Contact Maintenance.

- The equipment maintenance and transfer area, located directly below the hot cells, shall allow for completely remote maintenance and/or replacement of modular-designed processing equipment by way of floor access hatches.

- Exhaust system HEPA filters (located either in hot cells, the maintenance and transfer area, or in the remote handled air filtration cell) shall all be replaced and loaded out remotely.

- Crane maintenance and decon rooms shall be located at the ends of hot cells, and shall require contact-type maintenance because of special requirements.

5. Confinement Considerations and Multiple Zone Criteria. Generally, the DOE/EV/1830-T5 recommended technique for achieving proper building layout by establishing a system of sequential zones shall be followed. This concept is somewhat similar but not parallel to the ventilation-control zones, using a dissimilar nomenclature. The area radiation zoning designations, the maximum area design dose rate, and the R&H Building functions included within each area shall be as follows:

a. Area No. 1 - Uncontrolled Areas ($\leq$ 0.125 mrem/hr). These shall include unrestricted work and rest areas for personnel where direct radiation exposure is not necessary for job performance, and include:

- Administration offices and conference rooms
- Lunch, toilet, and changerooms

b. Controlled Access Areas

(1) Area No. 2 - Contingent Areas ($\leq$ 0.125 mrem/hr). These shall include access corridors that are adjacent to, or connect with, areas that contain radioactive materials. The main function of these areas shall be to control contamination and to isolate controlled areas from uncontrolled areas, and include:

- Clean drum/canister storage rooms
- Outgoing air-control vestibules (ACVs)
- Access corridors
- ACVs
- Operating galleries
- Health physics facilities
- Materials receiving and storage room
- Cold maintenance room
- Aqueous and chemical decon makeup
- Control room
- Exhaust filter rooms
- Supply fan room
- Operator's room
- Mechanical and electrical equipment rooms
- Compressor room

(2) Radiation Areas. These shall include four general types of radiation areas in which occupancy and working conditions shall be controlled to minimize personnel exposure to radiation.

(a) Area No. 3 - General Operation and Laboratory Areas ($\leq$ 0.25 mrem/hr). Work with small or moderate inventories of radioactive materials with low contamination potential and/or dose rate, including:

- Low-level solid radwaste (including waste collection storage, maintenance, drum inspection, and decon room, drum curing room, and filled drum storage)
- Low-level liquid radwaste
- Analytical laboratories
- Laboratory filter room
- Counting room
- Manipulator/crane storage and maintenance room
- Personnel decon room (health physics)
- Health physics storeroom
- Laundry room

(b) Area No. 4 - Process Operation Areas ($\leq$ 0.75 mrem/hr). Involve more radioactivity than work performed in general operation areas, including:

- Incoming ACVs
- Loadout and decon rooms
- Air locks
- Transfer/discharge corridor
- Cask handling and decon rooms
- Receiving, inspection, and shipping areas

(c) Area No. 5 - Intermittent Operation Areas ($\leq$ 2.5 mrem/hr).

- Contact handled equipment maintenance
- Crane maintenance rooms
- Welding stations

(d) Area No. 6 - Remote Operation Areas ($\leq$ 10 mrem/hr). Usually remote or automatic control functions for process monitoring or operations adjustment of high hazard and/or forbidden occupancy.

- Remote transfer rooms (3rd level)
- Equipment decon rooms (3rd level)
- Decon cell in remote handling equipment maintenance

These areas shall also include one type of radiation area containing spaces where process design requires high dose rates or airborne contamination, that cannot be occupied by unauthorized personnel, prohibited by interlocks.

(e) Area No. 7 - Isolation Areas (Limited or No Access). Where process design requires high dose rates or airborne contamination, including:

- Remote handling equipment maintenance
- Cask unloading rooms
- Shielded process cells and shielded canyon cells (hot cells)
- Drum/canister transfer rooms
- High-activity radwaste cell
- Remote handling air filtration cell
- Filter compactor room

c. Shielding

Concrete and/or steel shielding shall be provided in the form of walls, floors, ceilings, and doors of all hot cells, remote maintenance areas, cask unloading, loadout, decontamination rooms, air filtration cells, air plenums, and radwaste areas, as necessary, to reduce radiation dose levels for all process operating and maintenance personnel. Boron shall also be used for shielding of special doors.

d. Ventilation System

- Arrangement of air locks and air-control vestibules as required for passage between and maintenance of HVAC system differential pressures between ventilation control zones.

- Design of pressure-sealed doors for air locks and gasket-stripped doors for air-control vestibules where it is necessary to maintain differential air pressure.

e. Facility Envelope

For all controlled access areas containing radioactive materials, the building envelope (including walls, roofs, doors, and other openings) shall be tornado- and missile-resistant and designed to provide for all potential credible natural phenomena for a Category I structure.

f. Multiple Zone Criteria

DOE/EV/1830-T5, Table 5.1 - Recommended Limits for Annual, Weekly, and Daily Occupational Dose Equivalents - shall be generally followed for the types of areas indicated herein.

6. Maintenance Considerations. Design considerations for maintenance activities shall be a major concern during facility layout. The building configuration shall provide horizontal corridors, doorways, and aisles and vertical hatches, stairs, and elevators as adequate access for maintenance operations.

The remote-handled equipment maintenance area shall be designed to be remotely operated from the adjacent operating gallery.

Operating galleries shall be amply sized to facilitate removal of remote manipulators and necessary equipment.

Service galleries and utility chases shall be sized to allow space to perform maintenance activities.

7. Isolation of Radwaste from Clean Area. The radwaste areas shall be completely isolated from all clean areas by concrete shielding walls, corridors, and air-control vestibules.

8. Cost Analysis. Cost tradeoffs shall be made for shielding.

1.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

1.5.1 DESIGN CRITERIA

The design criteria for material handling, maintenance, and remote systems are stated below.

1.5.1.A. Codes, Standards, Regulations, and Specifications

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the codes, standards, regulations, specifications, and guides listed herein.

1. Codes.

   (1) American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section VIII

   (2) AEC-ERDA RDT Standards for F8-6T, Hoisting and Rigging of Critical Components and Related Equipment

2. Standards.

   (1) American National Standards Institute (ANSI)

   - ANSI N16.1, Safety Standards for Operations with Fissionable Materials Outside Reactors
   - ANSI/ASME NQA-1-1983, Quality Assurance Program Requirements for Nuclear Facilities
   - ANSI/ANS 57.9, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)

   (2) American Society for Testing and Materials (ASTM)

   (3) American Welding Society (AWS)

(4) Crane Manufacturers Association of America (CMAA), Specification No. 70

(5) Occupational Safety and Health Administration (OSHA) Standards

3. DOE Orders

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5630.2, Control and Accountability of Nuclear Materials

(3) DOE 5632.2, Physical Protection of Special Nuclear Materials

(4) DOE 5700.6, Quality Assurance

(5) DOE 6430.1, General Design Criteria

(6) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal Regulations

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

(2) 10 CFR 50, Appendix B (Quality Assurance)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 71, Packaging of Radioactive Materials for Transport

(5) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI)

5. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

6. Federal and State Standards. Other federal and state standards, permits, and licenses.

7. Federal Specifications. As applicable.

8. Specifications.

(1) American Institute of Steel Construction (AISC)
(2) American Iron and Steel Institute (AISI)

1.5.1.B. Receipt Requirements

1. Shipping Container Types.

(1) The MRS Facility shall be capable of receiving cask shipments by rail and truck and shall be capable of receiving, unloading, loading, and shipping all standard rail and truck spent fuel and HLW and RHTRU shipping casks.

(2) The MRS Facility must be capable of receiving, storing, and shipping sealed transportable metal storage (dual-purpose) casks.

(3) The MRS Facility shall be capable of receiving and shipping spent fuel and HLW in shipping casks weighing up to 125 tons, including transportable metal storage casks (dual-purpose casks).

(4) The reference transportation casks and containers shall be as noted in Table 1.5-1.

2. Fuel and Waste Package Types and Characteristics.

(1) The MRS Facility shall have the capability to routinely receive, handle, and store spent fuel assemblies. Spent fuel may be received fully assembled, either encapsulated or bare, or disassembled and consolidated in canisters.

(2) The MRS Facility shall be cabable of receiving, handling, and storing canisters of HLW, canisters of compacted fuel hulls and nonfuel-bearing components from dismantled spent fuel assemblies, and canisters and drums of remotely handled transuranic waste (RHTRU).

(3) The sizes and weights of the reference fuel and waste packages to be received and handled are as defined in Table 1.5-2.

(4) Reference heat generation rates and levels of radioactivity expected in the normal operation (90%) of spent fuel and reprocessed waste packages that shall be received, handled, and shipped or stored in the MRS Facility are listed in Table 1.5-3. Design of the facility should address the values given.

(5) As much as 10% of the spent fuel received shall be considered fuel 5 years out of reactor and/or 10-year-old spent fuel with burnups as high as 55,000 MWD/MTU.

(6) The MRS Facility must be capable of handling canisters up to 16 ft-0 in. long containing intact fuel assemblies.

Table 1.5-1 - Reference Casks and Containers

Material	Shipping Mode	Shipping Container	Assemblies/Canisters per Shipment
Spent fuel	Truck	NLI-1/2[a]	2 PWR or 5 BWR[a]
	Rail	TN-12	12 PWR or 32 BWR
High-level wastes	Truck	NLI-1/2	1 canister
	Rail	TN-12	5 to 8 canisters
RHTRU special canister	Truck	HLW-T[b]	1 canister
	Rail[c]	HLW-R[b]	5 canisters
RHTRU drums <5 R/hr	Truck	CNS 14-170[d]	14 drums
	Rail[c]	CNS 14-170[d]	42 drums
RHTRU drums >5 R/hr	Truck	CNS 7-100[d]	7 drums
	Rail[c]	CNS 7-100[d]	21 drums
CHTRU wastes	Truck	TRUPACT	36 drums or 2 boxes
	Rail[e]	TRUPACT	72 drums or 4 boxes

[a]Not yet approved for this loading. Assume new cask configuration shall be similar to existing configuration.
[b]Not yet built.
[c]Assumes three shipping containers transported per railcar.
[d]Only for use for material of low specific activity.
[e]Assumes two truck TRUPACT versions transported per railcar.

Table 1.5-2 - Reference Fuel and Waste Package Sizes and Weights to be Received at an MRS Facility

Fuel Cycle Material	Dimensions (ft-in.)	Volume (ft^3)	Maximum Expected Weight Loaded (lb)
Spent fuel:			
PWR assembly	9" sq x 12'-6" to 14'-10"	7.0 to 8.5	1,600
BWR assembly	6" sq x 14'-1" to 14'-11"	3.5 to 3.7	625
Solidified high-level waste canisters	1'd x 10' to 15'	8 to 12	2,300 to 3,500
	2.5'd x 15'	74	16,000
RHTRU wastes[a]			
Hulls and hardware canisters	2'd x 15'	47	11,000
55-gal drum	2'd x 3'	9	1,400
CHTRU wastes[a]			
55-gal drum	2'd x 3'	9	1,400
80-gal drum	2'-6"d x 2'-8"	13	2,000
Metal box	7'-6"L x 4'-6"W x 4'-6"H	141	11,000
WV HLW[b] canisters (first few years of operation)	2'd x 10' long		6,000

[a]For the first 10 yr of operation, no canisters or drums of RHTRU or CHTRU are expected to be received from offsite sources.

[b]West Valley high-level waste.

Table 1.5-3 - 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[g]
Consolidated PWR (3:1)	6×10^4	6×10^8	1,650
BWR assembly[b]	1×10^4	1×10^8	180
Consolidated BWR (7:1)	6×10^4	6×10^8	1,260
HLW canister (1' d x 10' to 15' l)[c]	1×10^5	5×10^8	2,200 to 3,300[d]
HLW canister[c] (2.5' d x 15' l)	1×10^5	5×10^8	3,300[d]
Hulls canister[e]	1×10^3	5×10^6	---
Hardware drum[f]	3×10^4	---	---
WV HLW[h] canister (first few years of operation)	3×10^3	1.3 mrem/hr	220

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[a]0.462 MT initial U; 33,000 MWD/MTU; 10 years out of reactor.

[b]0.186 MT initial U; 28,000 MWD/MTU; 10 years out of reactor.

[c]2.28 MT initial U processed (60% PWR - 40% BWR); 10 years out of reactor.

[d]Based on a heat-generation rate of 220 W per foot of length.

[e]Hulls from 4.4 MTU, 0.5% loss; 10 years out of reactor.

[f]Hardware from 3.2 MTU; 10 years out of reactor.

[g]ANSI/ANS 57.9, Appendix B, uses a decay-heat generation rate of 573 W for a comparable PWR assembly. The 573-W value is a peak heat generation rate; the 550-W value is an average rate commonly used in the nuclear industry.

[h]West Valley high-level waste.

(7) For at least the first few years of operation of the MRS Facility, the only HLW is from the West Valley. HLW canisters (having a gamma surface dose rate on the order of 3×10^3 R/hr and a neutron dose rate of 1.3 mrem/hr) are anticipated. The estimated maximum heat generation of these canisters is 220 W/canister.

(8) No offsite-generated canisters or drums of hulls, hardware, or RHTRU are expected to be received at the MRS Facility for at least the first 20 years of operation.

(9) The MRS Facility must be capable of handling fuel assemblies up to 15 ft-0 in. long with cross sections up to 9 by 9 in.

(10) It must be capable of handling canisters of HLW, compacted fuel hulls, and RHTRU, up to 15 ft long and from 1.0 to 2.5 ft in diameter, and weighing as much as 16,000 lb.

(11) The MRS Facility shall be capable of placing defective packages or noncompliant fuel or waste packages, received from offsite or storage, in a suitable canister.

3. Throughput Rates.

(1) The MRS Facility shall be designed to receive for shipment offsite or storage onsite a minimum of 3,600 metric tons of uranium (MTU) per year primarily as spent fuel and a small amount as HLW. It shall have in-building lag storage capacity for 1,000 metric tons of spent fuel in canisters, plus an outdoor storage capacity for 15,000 MTU of spent fuel and a small amount (less than 300 canisters) of HLW. Design shall assume a spent-fuel mix of 60% PWR/40% BWR by weight, based on 0.462 MTU per PWR assembly and 0.186 MTU per BWR assembly.

(2) The MRS Facility must also be capable of retrieval and shipment of at least 3,600 MTU or equivalent per year of canistered spent fuel and waste to a geologic repository for disposal. Receiving and shipping shall be concurrent.

(3) The design throughput capability shall be 3,600 MTU per year as all spent fuel.

(4) Throughput capacities should be based on 3 shifts-per-day, 7 days-per-week, year-round operation.

(5) Surge capacity shall be included in the design of receiving, handling, and storing systems to obviate the impacts of credible offsite and onsite disruptions of spent fuel, waste, and material flows.

(6) The MRS Facility design shall assume that spent fuel is received 70 weight percent by rail and 30 weight percent by truck.

(7) All spent fuel and waste shall most likely be shipped from the MRS Facility via rail.

(8) The MRS Facility shall be designed to retrieve canisters from lag storage, sealed storage casks or field drywells, and load them into shipping casks for shipment offsite.

1.5.1.C. Facility Requirements

1. General.

(1) The MRS Facility shall have in-building lag storage capacity for 1,000 metric tons of spent fuel in canisters, plus an outdoor storage capacity for 15,000 MTU of spent fuel and a small amount (less than 300 canisters) of HLW. The storage facility shall store spent fuel, HLW, and RHTRU.

(2) Radioactive waste treatment facilities shall also be included for treatment, solidification, storage, and shipment for disposal of low-level radioactive wastes generated at the MRS Facility.

2. Design Life. The design life of the R&H Building shall be 50 years, maintainable or replaceable to at least 100 years, irrespective of licensing requirements. The design life of the storage facilities shall be 100 years. The design life of supporting facilities shall be 30 years, except for exterior finishes that may require periodic maintenance to satisfy the 30-year requirement.

1.5.1.D. Processing Requirements

(1) The MRS Facility shall have the capability to routinely receive, inspect, repackage, consolidate (spent fuel only) and package, ship out, place in in-building lag storage, and/or store, and retrieve for subsequent shipment, spent fuel, solidified HLW, and RHTRU that has been out of reactor 10 years.

(2) The MRS Facility shall be capable of receiving, inspecting, and decontaminating sealed transportable metal storage (dual-purpose) casks and transferring them to the storage facility.

(3) The MRS Facility shall be capable of safely storing for offsite disposal all low-level radioactive wastes resulting from operations at the facility while handling spent fuel, HLW, and TRU.

(4) The MRS Facility shall be capable of receiving, inspecting, identifying, overpacking or repairing, decontaminating, labeling, and storing packages of TRU.

(5) The MRS Facility shall be capable of routinely monitoring and/or inspecting both the stored waste packages and the storage system to ensure the safety of the public, operating personnel, the environment, and the facility.

(6) Provisions shall be made for identifying, quantifying, labeling, and recording all spent fuel, HLW, and TRU wastes and for periodically performing physical inventories to confirm the presence of accountable materials. For receipt and inventory verification, provisions shall be included to account for the quantity, type, and history of the material stored in the facility.

(7) The MRS Facility shall be capable of loading and unloading shipping casks and containers; decontaminating shipping cask exteriors, shipping containers, and vehicles; and treating washwater and other wastes for disposal.

(8) The MRS Facility shall be capable of receiving, identifying, decontaminating, and checking for leakage, canisters of HLW; overpacking defective canisters; and labeling and storing canisters as required.

(9) The MRS Facility shall be capable of placing canisters of spent fuel in lag storage to await shipment or storage.

1.5.1.E. Equipment Requirements

The MRS Facility shall include mechanized and automated remote handling equipment where feasible to permit rapid and economic handling of spent fuel and wastes.

1.5.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.5.1, the following criteria shall be used.

Spent-fuel storage, radioactive waste storage, and other systems that contain or handle radioactive materials associated with spent fuel shall be designed to ensure adequate safety under normal and accident conditions. Systems and components that are important to safety shall be designed to permit inspection, maintenance, and testing.

1.5.2.A. Codes, Standards, Regulations, and Specifications

In addition to the codes, standards, regulations, and specifications listed in Section 1.5.1.A, the following shall also be used:

1. Standards. American National Standards Institute (ANSI):

   ANSI B30-0, Safety Standards for cableways, cranes, derricks, hoists, hooks, jacks, and sling

2. Nuclear Regulatory Commission (NRC) Regulatory Guides.

   (1) Appendix A, Applicable Regulatory Guides

   (2) Appendix B, Potentially Applicable Regulatory Guides

1.5.2.B. Requirements

Refer to Drawing No. H-3-56715, Material Handling Flow Diagram, which forms the basis for design.

The material handling, maintenance, and remote systems Basis for Design is described in each of the building sections that follows. Each of the major design criteria topics noted below is addressed, as applicable, in the Basis for Design sections for each building.

(1) Codes, Standards, and Regulations
(2) Receipt Requirements
(3) Facility Requirements
(4) Processing Requirements
(5) Equipment Requirements
(6) Natural Phenomena-Related Requirements

The individual building sections describe the limits, sizes, rates, interfaces, engineering interpretation of criteria, codes, standards, etc., required to perform design activities for that building.

1.5.2.C. Decommissioning

Provisions shall be made to facilitate decontamination of structures and equipment, minimize the quantity of radioactive waste and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated materials.

1.5.3 ALARA REQUIREMENTS FOR MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

1.5.3.A. Minimize Time of Exposure

Equipment, systems, and components that will be used in remote operations shall have high reliability, and shall have features that minimize in-service inspection, calibration, and testing. Modular design shall be considered for rapid and easy replacement of routinely maintained equipment. Components shall be provided with features that shall facilitate maintenance operations. Equipment, systems, and components shall be arranged for ease of access to components or system for remote or manual maintenance. Equipment, systems, and components in high radiation and contamination zones shall be designed for remote maintenance. Remote maintenance equipment and special tools shall be provided to minimize exposure to radiation and contamination. The equipment or system layout shall permit adequate working space. Operations and maintenance (O&M) manuals shall be provided with sufficient details for good maintenance planning and training purposes.

1.5.3.B. Shielding

Equipment, systems, and components that require frequent maintenance shall be located in lower radiation areas whenever possible. Equipment, systems,

and components shall be located for maximum distance between radioactive sources and work locations, and shall be arranged for minimum radiation impact from adjacent sources. Components susceptible to radiatin degradation shall be provided with shielding enclosures to reduce frequency of maintenance. Equipment, systems, and components shall be designed to permit use of shielding between sources and work locations. Locally shielded components shall have minimum streaming and scattering of radiation to work locations.

1.5.3.C. Decontamination

Equipment located in high radiation and/or contaminated areas (Areas 6 and 7) shall be fabricated of materials that shall have slow deterioration under high radiation and shall withstand decontamination solutions. Stainless steel shall be considered as the primary material of construction for equipment. Carbon steel with epoxy protective coatings shall be considered for economic tradeoff when the equipment is located in lesser radiation and contamination zones. The protective coatings shall comply with the specifications contained in American National Standards Institute Standard N512-1974, Protective Coatings for Nuclear Industry. Equipment shall be designed to have smooth surfaces, free of cracks and crevices, to facilitate decontamination. Sharp corners shall be avoided to minimize buildup of contamination. Equipment shall be provided with features that shall minimize contamination spread. In situ decontamination of equipment and components shall be provided whenever possible. Equipment and components shall be designed for rapid disassembly and removal to a decontamination area. Special maintenance cells and glove boxes shall be provided for decontamination and maintenance of failed equipment. Modular design shall be considered for equipment exposed to very high radiation and/or contamination to facilitate disposal in sealed and shielded containers. Special equipment and tools shall be provided to disassemble, disintegrate, and compact equipment and components in sealed and shielded containers.

1.6 PROCESS (RADWASTE TREATMENT)

The process design of the MRS Facility shall conform with the following design criteria and basis for design.

1.6.1 DESIGN CRITERIA

1.6.1.A. Orders, Regulations, Guides, and Standards

The MRS Facility design shall comply with appropriate requirements of the latest edition of the following codes, orders, regulations, and standards.

1. Codes.

   (1) American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section VIII

(2) American National Standards Institute (ANSI)

- ANSI B31.1, Power Piping
- ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

2. Specifications. American Society for Testing Materials (ASTM)

3. Federal and State Standards.

Other federal and state standards, permits, and licenses

4. DOE Orders. The applicable portions of the following DOE Orders shall be applied to the design of this facility:

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5700.6, Quality Assurance

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

5. Federal Regulations.

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

(2) 10 CFR 50, Appendix B (Quality Assurance) and Appendix E (Emergency Planning)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories

(5) 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Wastes

(6) 10 CFR 71, Packaging of Radioactive Materials for Transport

(7) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(8) 29 CFR 1910, Occupational Safety and Health Standards

(9) 40 CFR 61, National Emission Standards for Hazardous Air Pollutants; Standards for Radionuclides (Subpart H)

(10) 40 CFR 122, National Pollutant Discharge Elimination System

6. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

7. Federal Specifications. As applicable.

1.6.2 BASIS FOR DESIGN

Systems and components important to safety shall be designed to withstand design basis natural events.

1.6.2.A. Standards

In addition to the codes, standards, and specifications listed in Section 1.6.1, mechanical engineering and design shall be in accordance with the latest edition of the following, except as shown otherwise.

1. American National Standards Institute (ANSI).

(1) ANSI B16.5 - 1981, Steel Pipe Flanges and Flanged Fittings

(2) ANSI B73.1 - 1977, Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process

(3) ANSI B73.2 - 1975, Specification for Vertical In-line Centrifugal Pumps for Chemical Process

(4) ANSI Z358.1 - 1981, Personnel Protection

(5) ANSI/ANS 55.1 - 1979, Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants

(6) ANSI/ANS 55.6 - 1979, Liquid Radioactive Waste Processing System for Light Water Cooled Reactor Plants

2. Instrument Society of America (ISA).

(1) Standards and Practices for Instrumentation

(2) ISA S5.1 - 1981, Instrumentation Symbols and Identification

3. American Petroleum Institute (API).

(1) API RP 520 - 1976, Recommended Practice for the Design and Installation of Pressure Relieving Systems in Refineries (Part 1 - Design, Part 2 - Installation)

(2) API RP 521 - 1969, Guide for Pressure Relief and Depressurizing Systems

(3) API 661 - 1978, Air Coolers

4. Federal Regulations.

10 CFR 70, Domestic Licensing of Special Nuclear Material

1.6.2.P. Specific Requirements

The process system shall consist of a liquid radwaste facility and a solid radwaste facility. Both facilities shall be housed in the R&H Building. All of the liquid and solid radwaste generated in the MRS Facility shall be collected and treated by these facilities.

This section covers general items related to both radwaste systems.

The design basis for each system is discussed in Section 2.6.2.

1.6.3 ALARA REQUIREMENTS FOR PROCESS (RADWASTE TREATMENT)

(1) Ion exchange shall be added on evaporator condensate.

(2) Hydraulic fill and removal of ion exchange resin shall be used.

(3) Evaporation shall be used instead of reverse osmosis for concentration of radwaste.

(4) Ejectors shall be used where possible rather than pumps (reduces contamination and maintenance).

(5) 304L stainless steel shall be used for equipment handling radwaste.

(6) Cooling water pressure shall be higher than process pressure so that water will leak into the process.

(7) Suitable systems and instrumentation, such as the following, shall be used:

- Effluent monitors
- Protection systems
- Redundancy
- Warning systems

(8) Steam and condensate pressure shall be higher than process pressure so that leaks shall be into the process. In case of failure or shutdown, the evaporator steam jacket internal pressure is maintained above the process pressure by pressurizing the evaporator steam jacket with air.

(9) All lines and equipment that contain contaminated fluids shall be isolated from noncontaminated areas.

(10) Vent lines shall be routed to the HVAC exhaust system. Inadvertent transfer of fluids into the ventilation systems shall be prevented.

(11) Conical bottoms, sloped vessels, and pipes shall be used to prevent accumulation of radioactive material when decommissioning.

1.7 MECHANICAL PROCESS

The mechanical process design of the MRS Facility shall conform with the following design criteria and basis for design.

1.7.1 DESIGN CRITERIA

The MRS Facility shall be designed with utilities and process systems to provide a complete and operable facility capable of satisfying the functional requirements.

1.7.1.A. Codes and Standards

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes and standards.

1. Codes.

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

(2) American National Standards Institute (ANSI)

- ANSI B31.1, Power Piping
- ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

2. Specifications.

(1) American Petroleum Institute (API)

- API 620, Recommended Rules for Design and Construction of Large Welded Low-Pressure Storage Tanks
- API 650, Welded Steel Tanks for Oil Storage

(2) American Society for Testing Materials (ASTM)

(3) National Electrical Manufacturer's Association (NEMA) Standards

3. Standards.

Other federal and state standards, permits, and licenses

4. DOE Orders. The applicable portions of the following DOE Orders shall be applied to the design of this facility:

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5700.6, Quality Assurance

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

5. Federal Regulations.

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

(2) 10 CFR 50, Appendix B (Quality Assurance) and Appendix E (Emergency Planning)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories

(5) 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Wastes

(6) 10 CFR 71, Packaging of Radioactive Materials for Transport

(7) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(8) 29 CFR 1910, Occupational Safety and Health Standards

(9) 40 CFR 122, National Pollutant Discharge Eliminating System

(10) 40 CFR 141, National Interim Primary Drinking Water Regulations

6. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appenidx B, Potentially Applicable Regulatory Guides

7. Federal Specifications. As applicable.

1.7.2 BASIS FOR DESIGN

Systems and components important to safety shall be designed to withstand design basis natural events.

Mechanical process equipment shall be provided for the services described in Section 1.7.1 to support the various operating functions of the MRS Facility. Also included shall be the following:

- Water treatment systems
- Fuel systems
- Hot water boiler systems
- Welding station cleaning and testing system

Refer to Drawings H-3-56709, Decon Solution Makeup System Flow Diagram; H-3-56710, Water Treatment System Flow Diagram; H-3-56711, Steam/Condensate System Flow Diagram; H-3-56712, Air, Gas, and Solvent Systems Flow Diagram; H-3-56713, Sewer and Drain Systems Flow Diagram; and H-3-56714, Hot Water Boiler, Standby Generator, and Fuel Oil Systems Flow Diagram, which form the basis for design for these systems.

The specific basis for design for each system is given in subsequent sections of this document.

1.7.2.A. Codes, Standards, and Specifications

In addition to the codes, standards, and specifications listed in Section 1.7.1, mechanical engineering and design shall be in accordance with the latest edition of the following, except as shown otherwise.

1. Codes.

   - NFPA No. 214, Water Cooling Towers

2. Standards.

   (1) American Society of Mechanical Engineers (ASME)

   ASME Boiler and Pressure Vessel Code - 1980, Sections I and IV, Power Boilers

   (2) American National Standards Institute (ANSI)

   - ANSI B16.5 - 1981, Steel Pipe Flanges and Flanged Fittings

   - ANSI B73.1 - 1977, Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process

- ANSI B73.2 - 1975, Specification for Vertical In-line Centrifugal Pumps for Chemical Process

- ANSI Z358.1 - 1981, Personnel Protection

- 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

(3) Instrument Society of America (ISA)

Standards and Practices for Instrumentation: ISA S5.1-1981, Instrumentation Symbols and Identification

(4) American Petroleum Institute (API)

- API RP 520 - 1976, Recommended Practice for the Design and Installation of Pressure Relieving Systems in Refineries (Part 1 - Design, Part 2 - Installation)

- API RP 521 - 1969, Guide for Pressure Relief and Depressurizing Systems

- API 618 - 1974, Reciprocating Compressors for General Refinery Service

- API 661 - 1978, Air Coolers

- API RP 2000 - 1973, Guide for Venting Atmospheric and Low Pressure Storage Tanks

3. Specifications.

Compressed Gas Association, Bulletin G7.1

4. Federal Regulations.

10 CFR 70, Domestic Licensing of Special Nuclear Material

1.7.2.B. Engineering Units

Units to be used in design shall be:

- Pressure = psig
- Temperature = ^{o}F
- Liquid rate = gpm and/or lb/hr
- Steam rate = lb/hr
- Gas flow rate = scfm @ 60^{o}F and 14.7 psia and/or lb-mole/hr
- Line size = inch

1.7.2.C. Line Sizing

The preliminary basis to be used for selecting pipe sizes within plant limits shall be friction loss and horsepower considerations. In some situations, however, the size may be selected on the basis of maximum (or minimum) velocity criteria and/or stability of two-phase flow. Minimum size of process lines shall be 1/2 in. except when there is a process or operating reason for a smaller size.

1.7.2.D. Relief Equipment Sizing

1. Equipment Applications. Generally, pressure-relieving devices shall be provided for all equipment to meet code requirements, to ensure safe operation, and to prevent damage to equipment. Some special considerations are listed and illustrated below:

Equipment	Considerations
Vessels in vapor operation only	Fire is not considered.
Vessels, exchangers, filters, furnace coils	No relief valve shall be required if adequate escape paths are available through piping containing no block valves.
Vessels with upstream control valve	Control valve upstream of vessel shall not be a positive shutoff. Relief valve shall be sized for failure of upstream control valve.
Reciprocating compressors	On interstage and final discharge piping, relief valves shall be provided that are adequate to prevent overpressuring under both normal and abnormal conditions; viz., inadvertent opening of bypass valves when machine is shut down or during other operating modes.
Centrifugal compressors	PSV shall be provided on discharge if surge pressure is greater than casing or downstream equipment design pressure.
Exchangers	Thermal relief shall be provided if colder side can be blocked in while hot side is onstream. System shall be checked for necessity of relieving protection in case of a split tube if design pressure of higher side is greater than 1-1/2

Equipment	Considerations
	times the lower. If an exchanger with liquid on the shell can be blocked in and is less than 25 ft above grade, a PSV sized for fire shall be required. All coolers using water shall have a pressure relief valve on cooling water return line between cooler and block valve.
Piping	Thermal reliefs shall be provided for lines designed to be blocked at both ends while full of liquid (if required). Set pressure of thermal relief valve shall not be greater than design pressure of section to be protected.

2. Safety Relief Systems

(a) All relief valves on in-cell equipment shall discharge into a "closed" system. All vapors will discharge into the appropriate radioactive offgas system originating within the cell. All liquids shall discharge into an in-cell drainage collection system.

(b) All relief valves on out-of-cell equipment that are potentially radioactively contaminated shall discharge into a waste collection system capable of being monitored and/or analyzed before release.

(c) All other relief valves shall have discharges in accordance with the following:

- All relief valves on equipment that may discharge hydrocarbon liquid, hazardous vapors, and all hydrocarbon vapors shall discharge into a closed system (or be routed to the stack).

- Relief valves discharging only steam, water, nitrogen, or air shall discharge to a safe location through a 1-in. minimum diameter tailpipe to the atmosphere. The atmosphere vent shall be checked for dispersion and condensation. A 1/4-in. minimum diameter weephole shall be provided on the discharge pipe. Weepholes in the steam safety valve discharge tailpipes shall be manifolded and piped to the process sewer.

(d) To prevent valve chatter, the pressure drop in the line from the tie-in point to the relief valve shall be checked (maximum allowed by the code, P = 3% of set pressure). The quantity relieved shall be based on the worst possible condition causing the relief requirement. The inlet line shall be at least the size of the valve inlet nozzle.

3. Heat Input From Fire (Out-of-Cell Only). In general, combined fire loads for closed system header sizing shall be based upon vessels in a circle having a radius of 40 ft. The surface area of a vessel exposed to fire shall be based on 100% of the total surface within a height of 25 ft above grade for liquid-full vessels; 50% of the total surface for surge drums; and a portion of the area based on the liquid level for knockout drums (see API RP 520, page 16).

The wetted area of tanks shall be calculated on the basis of 55% of the total exposed area of a sphere or spheroid; 75% of the total exposed area of a horizontal tank; and the first 30 ft above grade of the exposed shell area of a vertical tank.

Credit shall be taken for insulation thickness on vessels when determining the heat input from fire. Heat absorbed by a tank or pressure vessel shall be based upon an environmental factor of F = 0.0403 for 1-in.-thick insulations (see API RP 520, page 18).

1.7.2.E. Equipment Design

The following criteria specify the minimum design pressure and temperature requirements.

1. Pressure Vessels

- Mechanical Design Pressure: The design pressure shall be the maximum operating pressure (psig) plus 15 psi or 10%, whichever is greater, with a minimum of 50 psig.

- Temperatures:

Operating Temperature (OT)	Design Temperature (DT)
Below -20°F	Lowest OT
-20° to 1,000°F	OT + 25°F
Above 1,000°F	OT + 20°F
Boiling water service	Saturation temperature at design pressure

2. Exchangers

- Mechanical Design Pressure: These design pressures shall be the maximum operating pressures plus 30 psi or 10%, whichever is greater.

- Temperatures:

Operating Temperature (OT)	Design Temperature (DT)
-20° to 650°F	OT + 50°F
Above 650°F	OT + 25°F
Boiling water service	Saturation temperature at design pressure

1.7.2.F. Piping Design

1. Design Pressure. The design pressure for piping shall be the maximum determined on the basis of the following:

- Maximum continuous operating pressure as defined by process requirements, but not less than 15 psig.

- Vapor pressure of the commodity in the pipe at maximum design temperature, unless protected by a pressure-relieving device.

- Set pressure of the relieving device that protects the pipe. The pressure setting shall include short-term pressure variations allowed by the applicable code.

- Maximum pump shutoff, or blocked-in discharge pressure, adjusted for short-term variations from design pressure as allowed by the applicable code.

- Short-term variations in pressure allowed by ANSI B31.1 and ASME Section I codes.

2. Design Temperature. Same as for pressure vessels.

1.7.2.G. In-Cell and Cell-Penetration Valving

All cell penetrations shall be provided with cell isolation valves on the "cold" side of the penetration. The use of manually operated valves in-cell shall be avoided. In-cell process control shall be implemented with remotely operated and removable valves.

1.7.2.H. Instrument Details

The P&ID shall show the required instrumentation by instrument symbols with all required root valves and any accompanying drain valves. Other details shall be shown on the instrumentation drawings.

Instrument symbols and identification letters for all units shall be based on the Instrument Society of America's Standard ISA S5.1, Instrumentation Symbols and Identification, 1981 edition.

1.7.2.I. Design Considerations for Pump Circuits

Equipment in a pump discharge circuit with a downstream block valve shall have a design pressure at least as high as the shutoff or minimum flow discharge pressure of the pump at the normal operating suction pressure. This criterion applies even if a relief valve has been installed in the pump discharge circuit. For preliminary shutoff pressure determinations on motor-driven centrifugal pumps, the sum of the suction pressure and the pump differential pressure multiplied by 1.25 shall be used. The suction pressure shall be the sum of the vessel vapor space operating pressure and the maximum liquid static head.

1.7.2.J. Insulation

Out-of-cell lines and equipment with surface temperature at 125°F and above, within reach of accessways and platforms, shall be insulated for personnel protection where not insulated for heat conservation. In-cell lines where external equipment decontamination capability is provided shall not normally be insulated. Where insulation is required on in-cell lines, it shall be fitted with stainless steel jacketing.

1.7.2.K. Tracing/Jacketing

Out-of-cell pipe tracing or jacketing shall be provided to maintain liquid temperature at required levels, to prevent line freezing, or to prevent condensation. An operating temperature at least 10°F above the liquid pour temperature or freezing point, but below the bubble point, shall be selected. Where condensation is to be avoided, the jacket temperature shall be controlled to maintain the internal vapor temperature.

1.7.2.L. Utility Stations

Stations for steam, water, and air shall be provided throughout the building at all operating locations.

1.7.2.M. Utility Systems

In addition to utilities listed in Part IV (Section 19, Electrical Distribution System; Section 20, Water Distribution System; Section 21, Sanitary Sewer System; Section 22, Process Sewer System; Section 23, Fuel Distribution System; and Section 24, Oily Sewer System), the following utilities shall be provided:

(1) Hot Water Boiler Systems. Hot water boiler systems shall be provided for building heating during winter for each of the following buildings: Administration, Security, Site Services, Vehicle Maintenance, Fire Station, and Cask Manufacturing Facility. Each system shall be a closed water heating loop consisting of the fuel oil day tank and fuel oil supply pump, the boiler, expansion tank, burner blower, controls, hot water supply pump, and the air heating coils.

(2) Compressed Air Systems. Two categories of compressed air systems shall be provided in the MRS Facility: breathing air and plant and instrument air.

1.7.3 ALARA REQUIREMENTS FOR MECHANICAL PROCESS

1.7.3.A. Decontamination System

Shipping casks shall be checked and monitored for contamination before and after unloading of fuel assemblies or canisters. The cask exterior shall be decontaminated when required.

The hot cells shall be vacuumed on a regular basis to prevent the buildup of radioactivity in the cells. Full decontamination of hot cells shall be done only when manned access is required.

Storage canisters leaving the welding station shall be checked and monitored remotely for radioactive contamination. Canisters shall be cleaned in the canister air-lock cover before they are unloaded for subsequent shipment to storage.

Drums of immobilized waste shall also be decontaminated when required.

In the maintenance cell, equipment to be repaired shall be decontaminated for safe manual handling; otherwise, equipment for disposal shall be loaded in drums, sealed, and decontaminated before the containers are sent to storage. Decon provisions shall be provided for the contaminated process equipment.

1.7.3.B. Cooling Water System

The cooling water supply and return system shall operate at a higher pressure than the process side in heat-exchanger equipment to limit contamination of the water system. The cooling water return lines shall be monitored for contamination and instrumented to prevent contamination of the downstream system.

The water supply system shall use backflow preventers.

1.7.3.C. Steam and Condensate Systems

The steam and condensate systems shall operate at a higher pressure than the process side in heat-exchanger equipment to limit contamination of the condensate side. The condensate line shall be monitored for contamination and instrumented to prevent contamination of the downstream system.

1.7.3.D. Breathing Air System

Breathing air shall be supplied to all zones of contamination potential. Hose couplings and manifolds shall be designed to preclude connection of respiratory protective equipment to any system other than the breathing air system.

1.7.3.E. Drain Systems

Drains from Ventilation Zone 1 shall be connected to the high-activity waste remotely handled transuranic waste (HAW/RHTRU) drain system.

Drains from Ventilation Zones 2 and 3 shall be connected to the low-level liquid radwaste drain system.

Drains from Ventilation Zone 4 shall normally be connected to the process or sanitary sewers, the oily sewer system, or the low-level liquid radwaste drain system, as appropriate.

Except in the analytical laboratory, the radwaste drain systems shall use ejectors rather than pumps for sump drainage, reducing exposure to maintenance workers.

Stainless steel shall be used for radwaste system piping and equipment to ensure that smooth, nonporous, corrosion-resistant materials are in contact with contaminated liquids.

The CHTRU Facility drain system shall have provision for liquid sample removal from each cell sump to determine the source of contamination.

Contaminated water runoff (from the anticipated credible fire-sprinkler discharge) shall drain to the radwaste drain sumps and then to the liquid radwaste system. These sumps and the liquid radwaste collection tanks shall not, however, be designed to accommodate this rapid runoff. As a result, considerable flooding of the facility shall occur, limited by 4-in.-high curbs. Fire-sprinkler systems shall not be located in any of the hot cells.

In the HAW/RHTRU radwaste drain system, sumps shall collect drains from the equipment maintenance room, the hot cells, the remote handling air filtration cell, and the crane maintenance cells. Steam-jet ejectors shall transfer the contents of these sumps to the HAW liquid collection vessel.

1.7.3.F. Washdown System

The washdown sump shall be monitored and cleaned regularly to prevent accumulation of possibly contaminated sludge.

The volume of liquid required for washdown of vehicles shall be minimized.

1.8 INSTRUMENTATION AND CONTROL

1.8.1 DESIGN CRITERIA

The MRS Facility design must permit continual monitoring, management, and maintenance of the spent fuel and wastes for as long as they shall remain at the MRS Facility.

The MRS Facility shall include, in addition to the required processing and storage facilities, those supporting facilities required to provide a complete and operable installation:

- Security
- Environmental surveillance
- Inventory

- Waste disposal
- Utilities and communication systems
- Administration
- Maintenance
- Safeguards

1.8.1.A. Codes, Orders, Regulations, Standards, and Specifications

1. Codes.

(1) American National Standards Institute (ANSI)

- ANSI N8.3, Criticality Accident Alarm, 1979
- ANSI N2.3, Immediate Evacuation Signal for Use in Industrial Installations Where Radiation Exposure May Occur
- ANSI N13.1, Sampling Airborne Radioactive Materials in Nuclear Facilities
- ANSI N13.3, Dosimetry for Criticality Accidents
- ANSI N13.10, Onsite Instrumentation for Continuously Monitoring Radioactive Effluents (superseded by ANSI N42.18-1980)
- ANSI N16.1, Safety Standards for Operations with Fissionable Materials Outside Reactors
- ANSI N16.2, Criticality Accident Alarm

(2) American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code, Section VIII

(3) National Fire Codes

All as applicable.

2. Department of Energy (DOE Orders).

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5630.2, Control and Accountability of Nuclear Materials, Basic Principles

(3) DOE 5632.2, Physical Protection of Special Nuclear Materials

(4) DOE 6430.1, General Design Criteria

(5) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

3. Federal Regulations.

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

(2) 10 CFR 51 - 7602 Part 51, Licensing and Regulatory Policy and Procedures for Environmental Protection (8/1/73)

(3) 10 CFR 71, Packaging of Radioactive Materials for Transport

(4) 10 CFR 72 - 9201 Part 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (7/26/82)

(5) 10 CFR 73, Physical Protection of Plants and Materials (3/9/69)

(6) 40 CFR 191 (latest draft), U.S. Environmental Protection Agency - 1984, Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

(7) 40 CFR 61, National Emission Standards for Hazardous Air Pollutants; Standards for Radionuclides (Subpart H)

(8) 40 CFR 122, National Pollutant Discharge Elimination System

4. Federal and State Standards.

Other federal and state standards, permits, and licenses

5. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides
(2) Appendix B, Potentially Applicable Regulatory Guides

1.8.1.B. Requirements

The MRS Facility must satisfy the following requirements:

(1) Capable of performing the following operations on spent fuel before shipping offsite or storing onsite:

- Examine and identify fuel.

- Place intact fuel assemblies in canisters, backfill with inert gas, seal-weld, leak test, ultrasonic test weld, decontaminate, and label canisters.

- Disassemble fuel assemblies, consolidate fuel rods in canisters, fill canister with inert gas, seal-weld, leak test, ultrasonic test weld, decontaminate, and label canisters.

- Densify fuel assembly hardware, place in canisters or drums, seal-weld, leak test, decontaminate, and label canisters or drums.

(2) Capable of receiving, identifying, decontaminating, and checking for leakage, canisters of HLW; placing defective canisters in a suitable canister; and labeling and storing canisters as required.

(3) Capable of receiving, inspecting, identifying, overpacking or repairing, decontaminating, labeling, and storing packages of TRU.

(4) Capable of routinely monitoring both the stored waste packages and the storage systems to ensure the safety of the public, operating personnel, the environment, and the facility.

The MRS Facility shall be designed to prevent any nuclear criticality events.

The storage facilities shall be capable of confining packages of radioactive material within the storage container (cask, drywell, etc.) during the entire storage period and shall have a monitoring system capable of detecting releases to the environs of radioactive material in excess of 1/10 of 10 CFR 20 Appendix A, Table II.

For receipt and inventory verification, provisions shall be included to account for the quantity, type, and history of the material stored in the facility.

Security, surveillance, and physical protection of the waste containers shall be provided for the facility, including the designation of vital areas, in accordance with federal regulations.

Radiation exposures shall be kept as low as reasonably achievable (ALARA). The facility shall be designed and constructed to protect operating personnel and the public from the radiation emitted from operating facilities and stored materials. They should also 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 in excess of those defined in 10 CFR 20, 10 CFR 191 (draft), 10 CFR 72, and other applicable federal regulations.

1.8.2 BASIS FOR DESIGN

1.8.2.A. Codes, Regulations, and Guides

In addition to the requirements of Section 1.8.1.B, the following shall also be used.

1. Codes.

(1) American National Standards Institute (ANSI)

- ANSI NFPA 70-1984, National Electrical Code

- ANSI N18.5-1982, Earthquake Instrumentation Criteria
- ANSI B40.1-1974, Gages - Pressure (and Vacuum) Indicating Type - Elastic Element
- ANSI B16.10-1973, Face-to-Face and End-to-End Dimensions of Ferrous Valves
- ANSI B16.5-1981, Pipe Flanges and Flange Fittings, Steel Nickel Alloy and Other Special Alloys
- ANSI MC96.1-1982, Temperature Measurement Thermocouple
- ANSI C39.5-1974, Electrical Safety Requirements for Measuring and Controlling Instrumentation
- ANSI/UL478-1979, Electronic Data Processing Units and Systems
- ANSI N42.18-1980, Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents, Institute of Electrical and Electronic Engineers
- ANSI N13.4, Specification of Protable X- or Gamma Radiation Survey Instruments, 1971
- ANSI N323, Radiation Protection Instrumentation Test and Calibration, 1978

(2) Electronic Industries Association (EIA)

(EIA) RS-232-C-1981, Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange

(3) Institute of Electrical and Electronic Engineers (IEEE)

IEEE 472-1974, Guide to Surge Withstand Capability (SWC Test)

(4) Instrument Society of America (ISA), Standards and Practices for Instrumentation:

- ISA S5.1-1981, Instrumentation Symbols and Identification
- ISA S5.3-1982, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems
- ISA S5.4-1981, Instrument Loop Diagrams
- ISA S12.4-1970, Instrument Purging
- ISA S75.01-1977, Control Valve Sizing

- ISA S51.1-1979, Process Instrumentation Terminology

- ISA S61.1-1977, Industrial Computer Systems

- ISA S75.03-1975, Uniform Face-to-Face Dimensions for Flanged Control Valve Bodies

(5) National Electrical Manufacturer's Association (NEMA)

- NEMA ICS6-1983, Enclosures (General Standards for Industrial Control and System)

- NEMA 151.1, Enclosures

(6) National Council on Radiation Protection and Measurements (NCRP) Reports

NCRP 57, Instrumentation and Monitoring Methods for Radiation Protection

(7) Scientific Apparatus Makers Association

STD RC-17-10-1963, Thermowells

(8) Factory Mutual (FM)

Engineering Association Standards
Factory Mutual Data Sheets

2. Nuclear Regulatory Commission (NRC) Regulations.

(1) NUREG 0700, Section 3.4: Safety Functions

(2) NUREG 0800-1981, Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants, Chapter 3.7.4: Seismic Instrumentation; Chapter 7: Instrumentation and Controls

3. Federal Acts and Regulations.

(1) Nuclear Waste Policy Act of 1982

(2) Code of Federal Regulations, Title 10, Energy, Part 70, Domestic Licensing of Special Nuclear Material

(3) Code of Federal Regulations, Title 40, Part 60, Standards of Performance for New Stationary Sources, Gas Turbines

4. Federal Reports.

43 F.R. 47707-1978, Executive Order No. 12088, Federal Compliance with Pollution Control Standards, U.S. Government Printing Office, Washington, D.C.

5. Department of Energy (DOE Orders).

(1) DOE 5484.1, 1981b, Environmental Protection, Safety, and Health Protection Information Reporting Requirements

(2) DOE/EP-0023-1981C, A Guide for Environmental Radiological Surveillance at DOE Installations

(3) DOE/EV/1830-T5, 1980, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

(4) DOE/EP-0096-1983, A Guide for Effluent Radiological Measurements at DOE Installations

1.8.2.B. Instrumentation

Instrumentation and control systems shall be provided to monitor and test systems that are important to safety over anticipated ranges for normal operation and off-normal operation. Those instruments and control systems that must remain operational under accident conditions shall be identified in the conceptual design and shall be designed and located so that they can continue to perform their safety functions under credible fire and explosion exposure conditions.

Regulations NRC 3.2 and NRC 3.22 are examples of documents that shall be referenced in designing HVAC filter-testing systems and protection system actuation testing, respectively.

All of the centralized process and utility monitoring, control, and alarm systems shall be contained in two redundant, distributed control systems (DCSs). The control consoles and CCTV monitors for the primary system shall be located in the R&H Building control room. The identical equipment for the redundant DCS shall be 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 shall be configured to assume control of all plant operations automatically when initiated by a self-diagnostic command, or by manual switchover.

Instrumentation shall be provided for the various operating functions of the MRS Facility that shall allow for safe and efficient operation. Because the MRS Facility is divided into Category I and Non-Category I subgroups, instrumentation shall be provided as appropriate for each category, and shall be designed to provide for safe shutdown integrity. Instrumentation shall also be provided for the redundant and continuous monitoring of radiation levels in all areas of the MRS Facility where the potential exists for radiation exposure to personnel, in HVAC ductwork, in the stack, in liquid effluent waste lines, storage areas, process cells, sumps, and other process and material handling locations as required for plant operation and alarming functions. This type of instrumentation shall be capable of transmitting radiation-level information to remote locations within the MRS Facility.

Portable, noncontinuous, nontransmitting radiation monitors shall be provided. Nuclear criticality detection and alarm instrumentation shall also be provided that will read out into the continuously manned redundant radiation monitoring system.

A series of particulate air monitors shall be located at the outer edge of the protected area to determine patterns and trends of radioactive particulate emissions from the MRS Facility.

At the R&H Building, a conventional gas analyzer system shall monitor the boiler stack offgases. A pair of redundant particulate iodine and noble gas analyzers shall be used to monitor for gas emissions and radioactivity in the HVAC exhaust gas stack. The particulate stack sampling and monitoring systems shall be designed in accordance with the requirements of the following regulations: NRC 1.21, 3.32, and 4.16; and ANSI Code N13.1.

Instrumentation shall be 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 shall be 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, LLW, HAW, and CHTRU drums; and waste-containing metal boxes) shall be recorded. These records shall be used to perform periodic physical inventories to confirm the presence of all accountable materials.

Other instrumentation shall be provided as follows:

(1) MRS Facility intrusion alarms

(2) Vital area(s) door tamper alarms

(3) Process monitoring control and alarms

(4) Centralized alarm monitoring stations in the Protected Area Gatehouse and the Security Building

(5) Emergency exit door alarms

(6) Unoccupied vital area(s) movement detectors

(7) Closed-circuit television (CCTV) surveillance system, including remote-controlled cameras and cathode-ray tube (CRT) monitors for the MRS Facility perimeter

(8) Effluent radiation monitoring and sampling systems for the R&H Building and the CHTRU Facility

(9) MRS Facility seismic monitors

(10) Meteorological monitoring equipment

1.8.3 ALARA REQUIREMENTS FOR INSTRUMENTATION AND CONTROL

1.8.3.A. Minimum Time of Exposure

Stationary radiation monitoring and criticality alarm systems shall include both visual and audible alarms locally and in the continuously manned DCS console in the control room.

Portable radiation monitors shall include audible alarms and visual display of radiation level.

The stationary radiation monitoring and criticality alarm systems shall be read out simultaneously from two redundant locations.

1.8.3.B. Contamination Control

Portable radiation monitors for personnel survey shall be provided at exit(s) from the R&H Building.

Portable radiation monitors for incoming vehicle cask inspection shall be provided at the Inspection Gatehouse.

Area radiation monitors shall be located in the MRS Facility storage area among the sealed storage casks (drywells).

Gas grab samples, taken from the sealed storage casks (drywells), shall be analyzed by the analytical laboratory as an aid in determining canister integrity.

Radiation counting instrumentation calibration equipment and low-level counting systems shall be provided in the Site Services Building.

1.8.3.C. Decommissioning Considerations

Radiation and criticality monitoring system components located in high radiation zones shall be designed for remote maintenance and replacement. This feature will also aid in the timely removal of these components during decommissioning of the MRS Facility.

1.8.3.D. Remote Versus Contact Maintenance

Radiation and criticality monitors located in the shielded process cells shall be located so as to be accessible to remote manipulators.

1.8.3.E. Confinement Consideration

Portable radiation meters shall be located in all air locks in the R&H Building.

Radiation monitors shall be located at the first stage of testable HEPA filters from the shielded process cells in the R&H Building. Air sampling

capability shall be provided in each leg of the exhaust systems by means of test ports. The exhaust air particulate distribution shall be determined, in this manner, by laboratory analysis of these samples. Test ports shall be located before and after the prefilter, and for each stage of the HEPA filters. Continuous particulate iodine and noble gas monitoring of the offgases shall be provided in each leg of the HVAC exhaust system. A representative sample shall be provided in each system by means of a near-isokinetic flow sampling system.

1.8.3.F. Maintenance Consideration

All radiation and criticality monitors shall audibly and visually alarm locally upon unit failure.

All radiation and criticality monitor units, upon failure, shall transmit a unit failure signal that shall be simultaneously displayed by the redundant distributed control system CRT monitors.

1.8.3.G. Isolation of Radwaste From Clean Area

Radiation monitors shall be provided in the radwaste rooms in the R&H Building.

1.9 PIPING

1.9.1 DESIGN CRITERIA

The design criteria for piping are given in the paragraphs that follow.

1.9.1.A. Codes, Standards, Specifications, Orders, Regulations, and Guides

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, DOE Orders, Federal regulations, and guides.

1. Codes.

(1) American National Standards Institute (ANSI)

- ANSI B31.1, Power Piping
- ANSI/ANS 57.9, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)
- ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

(2) American Society of Mechanical Engineers (ASME)

ASME Boiler and Pressure Vessel Code, Section VIII

(3) Uniform Building Code (UBC)

(4) Uniform Plumbing Code (UPC)

2. Specifications.

(1) American Society for Testing Materials (ASTM)

(2) American Water Works Association (AWWA) Standards for water pipe and water storage tanks

(3) American Welding Society (AWS)

3. DOE Orders. Department of Energy (DOE)

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5700.6, Quality Assurance

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable

4. Federal Regulations. Title 10, Code of Federal Regulations (10 CFR)

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

(2) 10 CFR 50, Appendix B (Quality Assurance)

(3) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(4) 29 CFR 1910, Occupational Safety and Health Standards

(5) 40 CFR 122, National Pollutant Discharge Elimination System

(6) 40 CFR 141, National Interim Primary Drinking Water Regulations

5. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

6. Federal and State Standards.

Other Federal and state standards, permits, and licenses

7. Federal Specifications. As applicable.

1.9.1.B. Specific Design Requirements

Refer to Sections 2.9.1, 4.9.1, 5.9.1, and 15.9.1 for specific design criteria.

1.9.1.C. Occupational and Environmental Safety

Occupational and environmental safety considerations for the MRS Facility are as follows.

1. Fire Protection. Fire safety requirements shall meet the NFPA codes and shall include the following:

- Fire-resistant bottled gas storage facilities with separate compartments for flammable and oxidizing gases. Inert and noncombustible gases may be placed in either compartment.

- Outside manifolds for gas supplies in the buildings.

- Use of noncombustible materials in construction.

2. Industrial Health and Safety. The buildings, systems, and equipment shall be designed to comply with all pertinent OSHA standards and to comply with the intent of state and local safety standards. Special safety features shall include:

- Safety showers and eyewash stations
- Adequate drains and flushing systems in chemical makeup areas
- Separation of drain systems - sanitary, process, and liquid radwaste
- Noncompatibility of connectors on gas systems
- Thermal protection on piping, tanks, etc.
- Isolation of potable and process water systems
- Breathing air system separated from plant air systems

1.9.2 BASIS FOR DESIGN

1.9.2.A. Codes, Standards, and Specifications

In addition to the requirements of Section 1.9.1.A, the piping and plumbing design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, DOE Orders, federal regulations, and guides.

1. Codes.

(1) American National Standards Institute (ANSI)

- ANSI A13.1-1981, Scheme for the Identification of Piping Systems
- ANSI B2.1-1968, Pipe Threads (except Dryseal)
- ANSI B16.3-1977, Malleable Iron Screwed Fittings 150 lb and 300 lb
- ANSI B16.5-1981, Steel Pipe Flanges, Flanged Valves, and Fittings
- ANSI B16.9-1978 and 1981a, Factory-Made Wrought Steel Buttwelding Flanges
- ANSI B16.10-1973, Face-to-Face and End-to-End Dimensions of Ferrous Valves
- ANSI B16.11-1980, Forged Steel Fittings, Socket-Welding and Threaded
- ANSI B16.18-1984, Cast Bronze Solder Joint Pressure Fittings
- ANSI B16.21-1978, Nonmetallic Flat Gaskets for Pipe Flanges
- ANSI B16.22-1980, Wrought Copper and Bronze Solder Joint Pressure Fittings
- ANSI B16.25-1979, Buttwelding Ends
- ANSI B31.1-1983, Power Piping
- ANSI B31.8-1982, Gas Transmission and Distribution Piping Systems
- ANSI B36.10-1979, Welded and Seamless Wrought Steel Pipe
- ANSI B36.19-1976, Stainless Steel Pipe
- ANSI Z358.1-1981, Emergency Eyewash and Shower Equipment
- ANSI/ASME NQA-1-1983, Quality Assurance Program Requirements for Nuclear Facilities
- 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

(2) 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

(3) National Fire Protection Association (NFPA)

- NFPA 30-1981, Flammable and Combustible Liquids Code
- NFPA 58-1983, Storage and Handling Liquefied Petroleum Gases
- NFPA 90A-1981, Air Conditioning and Ventilation Systems

(4) Uniform Plumbing Code (UPC), 1982

2. Specifications.

(1) American Society for Testing Materials (ASTM)

- ASTM A47-1977, Malleable Iron Castings
- ASTM A53-1982, Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
- ASTM A105-1982a, Forgings, Carbon Steel for Piping Components
- ASTM A106-1982, Pipe, Seamless Carbon Steel for High Temperature Service
- ASTM A120-1976 (1981), Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
- ASTM A126-1973 (1979), Gray Iron Castings for Valves, Flanges and Pipe Fittings
- ASTM A182-1982a, Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A193-1982, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- ASTM A194-1982a, Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
- ASTM A197-1979, Cupola Malleable Iron
- ASTM A216-1982, Carbon Steel Castings Suitable for Fusion Welding for High-Temperature Service

- ASTM A234-1982a, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- ASTM A269-1982, Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- ASTM A307-1982a, Carbon Steel Externally Threaded Standard Fasteners
- ASTM A312-1982, Seamless and Welded Austenitic Stainless Steel Pipe
- ASTM A351-1982, Austenitic Steel Casting for High-Temperature Service
- ASTM A403-1982a, Wrought Austenitic Stainless Steel Piping Fittings
- ASTM B61-1982a, Steam or Valve Bronze Castings
- ASTM B62-1982a, Composition Bronze or Bronze Metal Castings
- ASTM B88-1983, Seamless Copper Water Tube
- ASTM B209-1983, Aluminum and Aluminum-Alloy Sheet and Plate
- ASTM C177-1976, Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate
- ASTM C518-1976, Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter
- ASTM C564-1970 (1982), Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- ASTM C585-1976 (1982), Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing
- ASTM C692-1977, Influence of Wicking-Type Thermal Insulations on the Stress Corrosions Cracking Tendency of Austenitic Stainless Steel
- ASTM C795-1977, Wicking-Type Thermal Insulation for Use Over Austenitic Stainless Steel
- ASTM E84-1981a, Test for Surface Burning Characteristics of Building Materials
- ASTM E662-1983, Test for Specific Optical Density of Smoke Generated by Solid Materials

(2) American Water Works Association (AWWA)

- AWWA C506-1978, Standard for Backflow Prevention Devices
- AWWA C601-1981, Standard for Disinfecting Water Mains

(3) American Welding Society (AWS)

- AWS D1.1-1983, Structural Welding Code
- AWS A5.4-1981, Corrosion-Resisting Chromium and Chromium-Nickel Steel-Covered Welding Electrodes

(4) American Society of Non-Destructive Testing (ASNT)

SNT-TC-1A-1980, Personnel Qualifications and Certification in Non-Destructive Testing

3. Federal Specifications (FS).

FS SS-C-160A(1), Cements, Insulation, Thermal

4. Manufacturers' Standard Practices.

Manufacturers' Standardization Society of the Valve and Fittings Industry (MSS)

(1) MSS SP58-1975, Pipe Hangers and Supports - Materials and Design
(2) MSS SP69-1976, Pipe Hanger and Supports - Selection and Application

5. Miscellaneous Requirements.

(1) Factory Mutual Data Sheets
(2) Kemper Insurance
(3) Industrial Risk Insurers
(4) Underwriters' Laboratories (UL)

1.9.2.B. Plumbing

1. Potable Water System.

(1) Potable water shall be supplied at 100 psig from the MRS Facility potable water distribution system. Process water, where required, shall be supplied from the potable water system at 80 psig. Meters shall be provided at each building to monitor potable water usage.

(2) Location and types of fixtures shall meet the applicable requirements for the physically handicapped, where allowed.

(3) The potable water system shall supply cold and/or hot water to the points of potable water usage, such as lavatories, sinks, toilets, electric (drinking) water coolers, kitchen units, vending machines, and fire-protection systems.

(4) The potable water system shall be separated by reduced-pressure principal backflow preventers from process water provided to other users in order to prevent any possibility of contamination of potable water supplies. The backflow preventers shall meet AWWA C506 requirements.

(5) Pressure regulators shall maintain the hot and cold potable water system pressure at 80 psig to comply with DOE 6430.1, Chapter V, Section 15C(1)c. The hot water temperature shall be maintained at 110°F to comply with DOE 6430.1, Chapter V, Section 15C(3). Special requirements for water hotter than 110°F shall be provided by independent boosters. Circulating hot water systems shall be installed, where justified. The hot and cold water piping shall be insulated.

2. Sanitary Sewer System.

(1) Sanitary drains from lavatories, sinks, toilets, floor drains, electric (drinking) water coolers, kitchen units, and vending machines shall be collected and connected to the MRS Facility sanitary sewer system.

(2) Valves, fixtures, and equipment shall be readily accessible for operation, inspection, and maintenance.

(3) Potable water and sanitary drainage piping shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior plumbing and exterior sewage and water piping.

3. Pipe Supports. Pipe hangers and supports shall be provided for all plumbing systems as required by MSS SP69, the provisions of which shall apply in total, regardless of whether stipulations contained therein are directed or recommended. The hangers and supports shall be designed so that thermal expansion and contraction shall occur in the direction desired. Pipe support spacing shall be at sufficiently close intervals to maintain pipe alignment, prevent grade reversals, and prevent sagging of more than 0.1 in.

4. Roof Drainage. The roof drainage system shall discharge into the site storm drainage system.

1.9.2.C. Piping

1. Components.

(1) The components of the piping systems to be provided shall be shown on the final design Piping and Instrument Diagrams (P&IDs). These

documents shall show pipeline schematics, process equipment, valves, instrumentation, and pipeline numbers defining the line size, service (commodity) code, pipe classification, and line number. Other features (such as insulation, specialty items, and heat tracing) shall be identified, as applicable.

(2) Piping component design shall be based on pressure and temperature conditions and the commodity conveyed, in accordance with ANSI B31.1.

2. Fuel Piping Systems. Liquid and/or gaseous fuel piping systems shall be designed in accordance with ANSI B31.1 and B31.8, and to the NFPA Standards, Factory Mutual, Kemper Insurance, and Industrial Risk Insurers requirements.

3. Color Coding. Piping identification shall be color coded in accordance with ANSI A13.1. The piping contents and flow of material in all piping shall be indicated by adhesive markers.

4. Arrangement. Piping shall be arranged so that piping containing fluids (process or utility) shall be located below electrical conduit, where possible, and also provide clear overhead access to equipment.

5. Loading and Support.

(1) Piping shall be designed to resist the various loads and load combinations, using design and analytical methods, allowable stresses, and nondestructive testing methods required by the applicable codes and standards.

(2) Pipe hangers and supports shall be provided for all piping systems as required by MSS SP69, the provisions of which shall apply in total, regardless of whether stipulations contained therein are directed or recommended. The pipe hangers and supports shall be designed so that thermal expansion and contraction shall occur in the direction desired and so as to permit adjustment after installation while supporting the load. Pipe support spacing shall be at sufficiently close intervals to maintain pipe alignment, prevent grade reversals, and prevent sagging of more than 0.1 in.

(3) Springs used in variable- or constant-effort-type supports shall be designed in accordance with MSS SP58.

6. Pipe Insulation.

(1) The piping system shall be required to 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 the ambient air, and for the protection of personnel (safety).

(2) Insulation (coverings and linings) shall conform to the requirements of NFPA 90A.

(3) Insulation (coverings and linings) shall have a flame-spread rating not to exceed 25 when tested in accordance with ASTM E84 and fuel contributed and smoke developed under 50 when tested in accordance with ASTM E662.

(4) All insulation materials shall be 100% asbestos-free.

(5) Insulation materials shall be calcium silicate, expanded Perlite, or mineral wool for heat conservation and/or process control and personnel protection. Fiberglass 25 All Service Jacket (ASJ) material shall be used for anticondensation insulation. Elastomeric insulation shall be used for refrigerant piping insulation.

(6) All insulation surface exposed areas shall be fitted with aluminum jacketing. Insulation and jacket, covering an area or component that requires periodic inspection and/or servicing, shall be installed to permit rapid removal and reassembly of the insulation and jacket.

7. Safety. Structures, systems, and components important to safety shall be designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions.

1.9.2.D. Buried Piping

Buried pipelines shall include pipes laid underground between buildings, pump pits, tank vaults, valve boxes, or other enclosures. Buried pipelines shall include lines for transfer of radioactive waste, lines for nonradioactive waste, and lines for utilities.

Metallic pipelines and encasements shall be protected from underground corrosion. A cathodic-protection system shall be provided if required for the selected site.

Materials shall be selected in accordance with the system requirements.

Consideration shall be given to consequences of leaks, release of radioactive solution to the environment, and the corrosiveness of the commodity to be conveyed.

Protection and confinement of the primary conveying pipeline shall be provided with stainless steel pipe encasement.

The encasement pipe shall be protected from underground corrosion.

The encasement pipe and the primary pipeline shall meet the appropriate earthquake criteria.

The primary pipeline and the encasement pipe shall be separated by stainless steel spacers.

The encasement pipe shall slope to a collection point to provide drainage for leaks from the primary line, and shall have provisions for monitoring the primary line for leaks.

Pipelines shall be designed for lateral movement of the primary piping caused by thermal expansion and contraction.

1.9.3 ALARA REQUIREMENTS FOR PIPING SYSTEMS

1.9.3.A. Minimum Time of Exposure

To meet the ALARA requirements, piping systems shall be designed based on the considerations stated herein.

Pipe sleeves shall generally be provided when piping passes through masonry, concrete walls, floors, and roofs, except shielding walls. Sleeves shall be sloped to drain toward process areas. The space between the pipe and the sleeve shall be packed and sealed with suitable caulking compound.

Pipe passing through concrete shielding walls shall be embedded in the concrete without sleeves. The pipe shall be fabricated with necessary offsets to prevent the streaming of radiation through the penetration.

The contaminated systems shall be constructed of corrosion-resistant materials and shall be located for easy accessibility. The contaminated piping systems shall be designed to allow collection of effluents from leaks in the system without releasing the effluents into personnel access areas or the environment.

Piping designated to carry contaminated solutions shall not be permitted to be "field run."

Process system vessel vents shall be connected to the HVAC exhaust system upstream of second-stage HEPA filters. Vessel vent lines shall be designed so that inadvertent transfer of solutions or slurries into the ventilation systems shall be prevented.

All valves not functionally required to operate directly on nuclear material shall be located outside the cell and/or contamination areas.

Utilities such as steam, air, and water shall not be valved in-cell.

In general, contaminated piping shall not be located underground. If underground piping is required, it shall be double-contained. Leak detection shall be provided in the secondary encasing pipe to monitor leaks in the original pipe.

1.9.3.B. Contamination Control

Piping systems used for conveying radioactive and corrosive materials shall be of welded construction whenever practicable. Flanges shall be used only at equipment nozzles when necessary for servicing.

All in-cell and/or contamination area piping shall be of stainless steel to facilitate decontamination.

In-cell and/or contamination areas process valves shall be selected for leakproof construction, optimum corrosion resistance, flow characteristics, fail-safe characteristics, and ease of maintenance and decontamination. When selecting materials, consideration shall be given to process and decontamination solution resistance and the ability of the component parts of valves to withstand radiation.

In-cell and/or contamination area valves shall be of the welded, all-metal, packless type and employ a metal bellows seal. The design shall provide for the installation of air-operated valves that shall allow free drainage.

All valves shall be selected on the basis of corrosion resistance and flow characteristics.

Valves shall be installed in the stem-up orientation. Care shall be taken in locating valves to minimize the consequences of contamination from leaks.

Every pipe entering or exiting a process cell and/or contamination area shall be equipped with a block valve.

Piping that conveys contaminated process solutions shall be equipped with a packless (bellow seal) block valve immediately outside the cell wall.

Piping that conveys contaminated process solutions in a normally pressurized system may require a check valve in addition to the packless block valve to prevent backflow.

Piping that does not convey process solutions in normal operation may be equipped with a ball valve.

Piping that shall not convey contaminated process solutions except by failure of a pressure-boundary component may be equipped with a gate valve.

In every case, the primary block valve and/or check valve shall be of equivalent corrosion-resistant material to the associated piping in the in-cell and/or contamination areas.

Contaminated process piping systems shall be designed so that pockets or traps are eliminated wherever possible, and piping can be flushed and drained except where loop seals are required. Floor drains shall have loop seals.

Notches, cracks, crevices, and/or rough surfaces that might retain radioactive materials shall be avoided in the design of radioactive process piping systems.

Reduction in pipeline size in contaminated process piping systems shall be made with eccentric reducers installed with flat side down to avoid formation of traps.

Changes in direction of process piping shall be made with long-radius elbows or bends. Bends shall be preferred, where practicable, except for solids transport lines, where blinded tees or laterals have proved to prevent erosion.

Piping located on or near floors including pipe supports shall be configured so as not to impede rapid cleaning of floors; e.g., removing solids deposits and flushing or otherwise moving slurries toward floor drains.

Care shall be taken in locating flanges to minimize the consequences of contamination from leaks.

Grafoil by Union Carbide or equivalent shall be the preferred material for flange gaskets in process piping systems.

Teflon shall not be used for flange gasket material in contaminated process piping systems, or as a component part of any valve or other piece of equipment subject to radiation.

Utility service piping shall be kept to a minimum in the operating areas and arranged to facilitate decontamination.

Curbs shall be installed around equipment or groups of equipment that handles liquid radwaste in order to minimize cleanup areas if there is a leak or spill.

1.9.3.C. Decommissioning Consideration

Contaminated drain collection headers shall not be routed in floor slabs.

Floor sumps, sized to preclude criticality probability if required, shall be used in contaminated or possible contaminated areas in lieu of conventional floor drains.

Liquid collected in these sumps shall be pumped by use of ejectors, and the discharge piping and collection headers shall be routed through service galleries and pipe chases so as to be exposed.

Cleanout and backflush connections shall be provided in contaminated lines to permit decontamination.

Piping containing contamination solutions shall be kept to a minimum.

1.9.3.D. Remote Versus Contact Maintenance

All piping that must be located within enclosure systems shall be designed to allow for in-place maintenance and/or replacement.

Connections suitable for remote handling shall be used in Ventilation Zone 1 areas.

1.9.3.E. Confinement Consideration

Drains from Ventilation Zone 1 (highly contaminated areas and restricted access areas) shall be connected to the HAW/RHTRU drain system.

Drains from Ventilation Zone 2 (potentially contaminated areas, except crane maintenance room drains, remote-handled HEPA filter room drains, and the HAW/RHTRU drum decon room drain) shall be connected to the low-level liquid radwaste drain system.

Drains from Ventilation Zone 3 (not normally contaminated areas, except canistered fuel lag storage vault drains) shall be connected to the low-level liquid radwaste drain system.

Crane maintenance room drains, remote-handled HEPA filter room drains, the HAW-RHTRU drum decon room drain, and the canistered fuel lag storage vault drains shall be connected to the high-activity waste collection system.

Drains from Ventilation Zone 4 areas that contain chemicals harmful to the sanitary sewer system shall be connected to the process sewer. Incoming air-control vestibule (receipt and washdown area) drains shall be monitored before release to the process sewer or, if concentrations of radioisotopes exceed 10 CFR 20 or DOE Order 5480.1A limits, the effluent shall be diverted to the low-level liquid radwaste drain system. Drains that contain oil shall be connected to the oily sewer system. Sanitary drains shall be connected to the sanitary sewer system.

Drains from shielded process cells, personnel decontamination sinks and showers, and other radioactive waste drains shall be routed through doubly encased lines, when required, to avoid unnecessary contamination where the piping is normally inaccessible for routine inspection and maintenance.

Protection and confinement of the primary conveying pipeline shall be provided with stainless steel pipe encasement. The encasement pipe and the primary pipeline shall meet the appropriate earthquake criteria, and the primary pipeline and the encasement pipe shall be separated by stainless steel spacers. The encasement pipe shall slope to a collection point to provide drainage for leaks from the primary line, and shall have provisions for monitoring the primary line for leaks.

Pipelines shall be designed for lateral movement of the primary piping caused by thermal expansion and contraction.

1.9.3.F. Maintenance Considerations

Maintenance shall be a primary consideration in the design of process systems. Systems shall be designed to minimize exposure of maintenance personnel to radiation.

Equipment, valves, and instruments requiring frequent servicing shall be located in areas of the lowest expected radiation levels.

Contaminated piping systems shall be designed to take advantage of gravity flow or the use of jets or airlifts to reduce potential contamination problems and reduce the maintenance requirements associated with pumping.

Prevention of pipe plugging and clearing of plugs shall be considered during design of process piping systems.

Sufficient separation shall be provided in equipment and piping layouts to facilitate removal, maintenance, and criticality requirements, when applicable. Whenever redundancy is a requirement, sufficient separation shall be employed so that systems or equipment cannot both be damaged by a single accident.

Breathing air shall be supplied to all air locks at the entryway to zones of high contamination potential. Hose couplings and manifolds shall be designed to preclude connection of respiratory protective equipment to any system other than the breathing air system.

Pipe insulation and jacketing that are required to be removed for periodic inspection or servicing shall be designed to permit rapid removal and reassembly of the insulation and jacketing.

1.9.3.G. Isolation of Radwaste From Clean Area

All piping systems that contain contaminated gases or liquids shall be isolated from noncontaminated systems.

1.9.3.H. Safety

Piping shall be arranged in arrays to comply with criticality design, if required.

Pipe size (bore diameter) shall comply with criticality design, if required.

Floor drains shall require special precautions for handling contaminated water runoff (from sprinklers) and for avoiding potential water-induced criticality.

A fire-protection sprinkler system shall not be used in the process hot cells to prevent potential nuclear criticality. Also, decontamination systems in the hot cells shall be designed to require placement of a pipe section to complete hookup.

Piping systems shall be designed to withstand the effects of natural phenomena (such as earthquakes, tornadoes, and lightning) so as not to impair their capability to perform safety functions. Dampening values used in seismic analysis shall be taken from Regulatory Guide 1.61.

Noncombustible and heat-resistant materials shall be used wherever practicable, particularly in locations vital to the control of radioactive materials and to the maintenance of safety control functions.

Utility service systems important to safety shall include redundancy to the extent necessary to maintain the ability to perform safety functions, assuming an active single failure.

1.10 ELECTRICAL

1.10.1 DESIGN CRITERIA

The electrical design criteria are given in the paragraphs that follow.

1.10.1.A. Codes, Standards, and Specifications

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, DOE Orders, federal regulations, and guides.

1. Codes.

   (1) American National Standards Institute (ANSI)

   - ANSI C2, National Institute of Electrical and Electronic Engineers (IEEE), Motor Control Centers and Transformers
   - ANSI N2.3, Immediate Evacuation Signal for Use in Industrial Installations Where Radiation Exposure May Occur
   - ANSI ANS8.3, Criticality Accident Alarm System

   (2) National Fire Code

   - NFPA No. 101, Life Safety Code
   - ANSI/NFPA No. 70, National Electric Code (NEC), 1984 issue

   (3) National Electrical Manufacturer's Association (NEMA) Standards

   (4) Uniform Building Code (UBC)

2. Specifications.

   (1) American Society for Testing Materials (ASTM)

   (2) Illuminating Engineering Society (IES), The Standard Lighting Guide

3. DOE Orders. The applicable portions of the following DOE Orders shall be applied to the design of this facility:

   (1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5632.2, Physical Protection of Special Nuclear Materials

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal Regulations

(1) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(2) 10 CFR 73, Physical Protection of Plants and Materials

(3) 29 CFR 1910, Occupational Safety and Health Administration

5. Federal and State Standards.

Other federal and state standards, permits, and licenses, as applicable

6. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.10.1.B. Specific Design Requirements

No specific design criteria are indicated for the following electrical items and subjects:

- Wiring and installation methods
- Feeders
- Voltage drop
- Branch circuits
- Motors and motor control
- Transformers
- Panelboards
- Power and convenience outlets
- Standby power system
- Grounding systems and lightning protection

1.10.2 BASIS FOR DESIGN

1.10.2.A. Codes, Standards, and Specifications

In addition to the requirements of Section 1.10.1.A, the electrical design shall comply with the following codes and standards. ANSI C1 shall govern, unless a deviation is authorized by DOE.

1. Codes.

(1) American National Standards Institute (ANSI)

- ANSI C1, National Electrical Safety Code
- ANSI A85.1, American Standard Practice for Protective Lighting
- ANSI N2.3, Immediate Evacuation Signal for Use in Industrial Installations Where Radiation Exposure May Occur - 1967

(2) Lightning Protection Institute

LPI 175

(3) National Fire Protection Association (NFPA)

- NFPA 72A-1979, Signaling Systems - Local Protective
- NFPA 72D-1979, Signaling Systems - Proprietary
- NFPA 72E-1982, Automatic Fire Detectors
- NFPA 78-1983, Lightning Protection Code

(4) Underwriters' Laboratories, Inc. (UL)

Fire Protection Equipment Directory

2. General Electrical Design Requirements. The MRS Facility electrical designs important to safety shall be planned and located so they can continue to perform their safety functions effectively under fire and explosion exposure conditions. Provisions shall be included in the electrical design for future decommissioning. Systems and components important to safety shall be designed to withstand design basis natural events.

1.10.2.B. Wiring and Installation Methods

1. Raceways.

(1) In general, raceways below floor or underground and conduit exposed to weather shall be hot-dipped, galvanized, rigid-steel or intermediate-steel conduit with a factory-applied PVC coating. EMT shall be acceptable for lighting system raceways above switch height in furred spaces or other locations where mechanical and/or corrosion protection is not required. Flexible conduit shall be used for short connections to vibrating and rotating equipment; in wet locations, flexible conduit shall be neoprene-jacketed.

(2) PVC Schedule 40 heavy wall conduit may be used below floor slab in contact with earth, or underground, in lieu of rigid-steel galvanized conduit. PVC 40 conduit shall not be run in the floor slab. PVC conduit shall be terminated below the floor slab with a

rigid-steel conduit adapter, and the exposed conduits above floor slab in contact with earth shall be of rigid steel. A separate grounding conductor shall be installed in the PVC conduit. All underground feeder conduit runs shall be completely encased in concrete. This encasement shall be a minimum of 3 in., and shall be reinforced when heavy loads are to be encountered.

2. Concealed Raceways and Outlet Boxes. Concealed raceways and outlet boxes shall be used in all cases where practicable. Conduits shall not be smaller than 3/4 in. for light, power, and instrumentation, and 1/2 in. for control. Outlet boxes, conduit fittings, and pull boxes shall be provided as required by Code.

3. Conductors.

(1) Conductors for branch circuits shall be, in general, not less than No. 12 AWG and provided with 20-A overload protection. Larger conductors shall be used for branch circuits where loads exceed that permitted on 20-A circuits or where it is required that the voltage drop be maintained within the described limits. Conductors for feeder shall be designed in accordance with the connected load to which a suitable demand factor is applied and allowance is made for possible future increase in load. The voltage drop on medium-length and long feeders shall be checked to ensure that the described limits are not greatly exceeded. The demand factor for any particular feeder shall be determined by the type of load served and the probability of simultaneous operation of its various components. In general, conductors No. 4/0 AWG and larger for 480-volt service and below shall have 600-volt insulation, be rated at 90°C, and shall be heat- and moisture-resistant Type XHHW. Conductors smaller than No. 4/0 AWG shall be rated at 90°C and shall have THHN insulation.

(2) When special conditions exist, higher-grade insulation suitable for the application shall be specified. No. 10 AWG and smaller conductors shall be solid copper, except where stranded wire is required to provide flexibility. No. 8 AWG and larger conductors shall be stranded. All conductors shall be of copper, and shall be color-coded per Article 210 of the NEC.

(3) All wiring, single or multiconductor, within contaminated areas and through shielding walls shall be No. 12 AWG minimum, Class IE, 600-volt wire rated for 10^9 R minimum total integrated dosage; braided sheath is optional. Wiring inside the hot-cell areas shall be multiconductor with a special chlorosulfonated, polyethylene overall jacket suitable for decontamination with water, nitric acid, oxalic acid, and Turco No. 4324 NP.

4. Outlet Boxes. Outlet boxes shall not be less than 4 in., square or octagon, and (for exposed work in rigid or metallic tubing) shall be of the screw-hub type.

5. Conduit and Fittings. Conduit and fittings, including junction and outlet boxes, shall have either sheradized or galvanized finish. Electrical metallic tubing (EMT) fittings shall be of the compression-gasket type. Indentor-screw types are not permitted.

6. Supports and Fasteners. Standard practices for conduit system supports and fasteners shall be used as prescribed by the NEC. Designs subject to seismic events shall be in accordance with the seismic requirements of the structure.

1.10.2.C. Feeders

Feeders shall be sized in accordance with the NEC. Feeder circuits shall be run in rigid conduit or electrical metallic tubing. Feeder circuits requiring No. 4 AWG or larger conductors shall have heat-resistant insulation.

1. Motor Feeder Circuits. Motor circuits for special duty and other motors shall conform with the applicable requirements of the NEC; in no case shall the recommended rating or setting of overcurrent devices be exceeded.

2. Feeder Overcurrent Devices. The feeder overcurrent devices shall be rated or set at approximately 125% of the demand load to ensure against unnecessary feeder outages caused by high ambient temperatures within panelboards and similar nonventilated enclosures. Allowance shall be made for long, continuous loads in accordance with NEC Article 220.

3. Power Factor Correction. A requirement for capacitors to improve load power factor shall be considered during final design.

1.10.2.D. Voltage Drop

The combined voltage drop of feeders and branch circuits for wiring systems within buildings shall not exceed 5%. Approximately 3% drop shall be apportioned to the feeders and 2% to the branch circuits. The voltage drop shall not be more than 5% for the complete secondary circuit. (The calculations shall show the voltage on the secondary circuit and the voltage drop on each feeder and subfeeder and the total voltage drop at the end of the feeder.) When equipment that requires a very close voltage control for successful operation is installed, consideration shall be given to the use of constant-voltage transformers located immediately adjacent to the equipment.

1.10.2.E. Branch Circuits

1. Lighting and Appliance Branch Circuits

(1) These circuits shall be supplied from a panelboard with mains not exceeding 225 A. The voltage drop shall not exceed 2%. Circuits shall be rated at not less than 20 A, except that 15-A circuits may be used when required by specific loads. Loads of lighting and

general-purpose branch circuits in the Administration Building shall not exceed 16 A. Special-purpose circuits shall be designed to meet load requirements.

(2) Design of branch circuits shall be such as to employ to full advantage the three- or four-wire distribution system by combining single-phase loads on common neutrals and installing conductors in common raceways. Circuits shall be loaded to within 70% (minimum) of rated capacity if permissible voltage drop can be maintained. Circuit breakers shall not be loaded to more than 80% of trip rating. (This may be increased if ambient-compensated breakers are specified.)

(3) Branch circuits for data processing and computer equipment shall be provided with line, neutral, and ground conductor from panelboard to each receptacle or equipment connection.

2. Motor Circuits. Several small motors shall be serviced directly by one branch circuit, provided it is not rated higher than 20 A.

3. Services for Other Equipment. Electric service to equipment furnished and installed under other sections of the specifications shall include all necessary disconnect switches and power and control wiring. (Controllers and factory-wired control wiring shall be furnished with equipment in conformance with the appropriate section of the specification.)

1.10.2.F. Motors and Motor Control

Motors of less than 1/2 hp shall be rated 120 volts, single phase, 60 Hz. Motors 1/2 hp to 200 hp shall be rated 460 volts, three phase, 60 Hz. Motors located outdoors will be totally enclosed and fan-cooled. All other motors shall be standard drip-proof.

1. Control. In general, motor starters and controllers shall be equipped with start/stop pushbuttons or selector switches and indicating lights. In addition, selected motors shall be provided with start/stop devices and indication lights at the motor location. Motor control circuits shall be 120 volts.

2. Motor Control Centers. Motor control centers (MCCs) shall be provided for three-phase motors. The MCCs shall be rated 480 volts, three phase, 60 Hz. Starters for motors shall be of the combination motor-circuit-protector, across-the-line type. All starters shall be equipped with three overload relays. MCCs shall be NEMA Class II, Type B, with copper bus braced to withstand available short-circuit current. An individual control transformer shall be provided for each motor starter.

3. Motor Control. Motors 200 hp and above shall be of the 5-kV voltage class; they shall be controlled with limit ampere fused contactors in 5-kV MCCs.

1.10.2.G. Transformers (1,500 kVA and Smaller)

Transformers shall be of the general-purpose, dry type for indoor use or nonflammable, liquid-filled for outdoor use, conforming to NEMA Standard ST 1. The kilovolt-ampere rating, primary and secondary voltages, number of phases, and type of connection shall be specified in final design. Insulation shall be Class H, with 80°C temperature rise, for all transformers. Transformers shall have two 2.5% taps above and below normal rated voltage. Transformers installed outdoors shall be in weatherproof enclosures suitable for outdoor installation. Transformer impedance shall be specified during design, and shall limit available short-circuit current.

1.10.2.H. Panelboards

Lighting and power-distribution panelboards shall be provided in accordance with area load requirements. Lighting panels shall be of the dead-front type, and shall be mounted flush wherever possible. Power-distribution panelboards shall be of the free-standing type.

Protective devices shall be circuit breakers with magnetic short-circuit and thermal overcurrent trip devices. The 480-volt distribution and lighting panels shall be rated 480Y/277 volts, three phase, four wire, with separate neutral and ground bus.

Lighting and power panels shall have a minimum of 15% spare spaces for future additions, complete with main bus sized for the future breakers and mounting hardware.

1.10.2.I. Load Center Panelboard

Load center panelboards shall be constructed to UL-891 and NEMA PB2 standards; they shall consist of the required number of vertical sections, bolted together to form one metal-enclosed, rigid load center equipment item. Load centers shall include all protective devices and equipment, as shown on the respective single-line diagrams. Buses shall be of copper material; shall be mounted on supports of high-impact, nontracking, insulating material; and shall be braced to withstand the mechanical forces during a short-circuit condition of the indicated short-circuit current.

All control and interlock wiring, necessary fuses, and terminal blocks within the load center shall be furnished when required. All control wires leaving the load center shall be terminated in a terminal block. The load center equipment shall be furnished with a copper ground bus, secured to each vertical section structure, and shall extend the entire length of the structure.

An A-B-C bus arrangement (left-to-right, top-to-bottom, and front-to-rear) shall be used throughout to ensure convenient and safe testing and maintenance.

Molded-case circuit breakers with thermal magnetic trips or magnetic-only trips shall provide manual switching capabilities and automatic operation under overload and short-circuit conditions. The mechanism shall be trip-free and trip-indicating, and shall operate all poles of a multipole device simultaneously during open, close, and trip operations.

Where indicated, the load center panelboards shall be provided with metering or instrumentation as required.

1.10.2.J. Unit Substations

Unit substation arrangements shall be as shown on the electrical single-line diagrams and as described herein.

1. General. Unit substations shall be a single- or double-ended, close-coupled, coordinated, integral, indoor, metal-enclosed, self-supporting, factory-assembled structure consisting of the incoming section, the transformer section, and the outgoing low-voltage-distribution section.

2. Incoming Section. The primary main air switch section shall have provisions to terminate the incoming primary feeder cable. The air-interrupter switch shall be a nonfusible, two-position, gang-operated unit with stored energy operating mechanism.

3. Transformer Section. The transformer shall be an air-cooled, dry-type unit with a rating indicated on the electrical single-line drawings. The transformer shall have four approximately 2-1/2% kVA taps, two above and two below the rated primary voltage. The transformer shall be insulated with 220°C insulation materials and rated at 80°C rise above 40°C maximum ambient.

4. Low-Voltage Distribution Section. The low-voltage distribution section shall terminate all outgoing feeder cables and contain the circuit-protective devices and auxiliary components, as shown on the electrical single-line diagrams. The low-voltage distribution section shall be constructed to applicable NEMA and ANSI standards. The bussing shall be copper with silver-plated connection points. The circuit breakers shall be of the air-drawout type, manually or electrically operated, and shall be mounted in a self-aligning drawout mechanism with "connected," "test," "disconnected," and "remove" positions. The circuit-breaker trip device shall be of solid-state design and shall be provided with an adjustable long-time delay, instantaneous, and short-time delay-overcurrent/short-circuit protection, including ground-fault protection.

1.10.2.K. Transformers, Liquid Filled

Each transformer shall be a self-cooled, liquid-insulated, weather- and tamperproof unit, suitable for outdoor, pad-mounted installation. Transformer ratings shall be as indicated on the electrical single-line drawings. The transformers shall have four approximately 2-1/2% kVA taps, two above and two below the rated primary voltage.

1.10.2.L. Primary Switch, Oil-Filled, Fused

A low-profile, pad-mounted oil switch shall be used for load-interrupting switching and overcurrent and short-circuit protection. The switch shall be manually operated and shall be totally enclosed, suitable for outdoor installation.

1.10.2.M. Power and Convenience Outlets

All areas shall be provided with receptacles, spaced at 15 ft on centers, with the proper characteristics, unless otherwise required. In normally wet or damp locations (such as on building exteriors), with concrete floors on-grade, receptacles shall be polarized with one pole effectively grounded.

1. General-Purpose Convenience Receptacles. These receptacles shall be of the duplex, two-wire, three-pole, grounding type, rated 15 A, 125 volts, unless otherwise noted. The third grounding pole shall be connected to the grounding yoke by means of a separate, green-colored grounding conductor. Convenience outlets shall be installed at convenient intervals in corridors and large rooms for the operation of maintenance equipment. In areas where a relatively large number of outlets are required along a wall or bench line, consideration shall be given to the installation of wiring channels with single receptacles mounted therein.

2. Clock Outlets. Clock outlets shall be provided in office areas, corridors, lobbies, etc., as determined during the final design phase.

1.10.2.N. Grounding Systems

1. Building Ground System. A No. 4/0 SDBC ground loop, with ground rods, shall be installed around the building. The ground resistance shall not exceed 5 ohms. The power system ground shall be connected to the ground loop. All electric motor frames, metal frames of switchboards, motor control centers, lighting panels, and the transformer frame shall be grounded to the electrical building ground loop by means of a separate, insulated, green-colored ground conductor.

2. Neutral Conductor. The neutral conductor of the 480Y/277-volt service shall be grounded at the substation transformer and the power service equipment in the main substation. The neutral conductor of 480-208/120-volt transformers shall be grounded at the transformer.

3. Transformer Neutral. The transformer neutral and the grounding conductor shall be connected to the nearest available, effectively grounded metal water pipe and the building ground system. The ground resistance of ground rods shall not exceed 5 ohms.

4. Electric Motor Frame. The electric motor frame ground terminals of special-purpose receptacles shall be grounded by means of a separate grounding conductor, installed in the conduit enclosing the branch circuit conductor serving the motor or receptacle. Metal frames of switchboards,

motor control centers, lighting panel cabinets, and the transformer frame shall be grounded via a separate grounding conductor and connected to the effectively grounded, metallic, cold-water line and the building grounding system.

5. Instrumentation, Computer Ground. A separate and insulated grounding system, with a single-point connection to the electrical power grounding system, shall be provided.

6. Lightning Protection. Lightning protection shall be provided for all larger buildings, and shall conform to NFPA 78 Standards and NEC. The lightning protection system shall bear the Underwriters' Master Label after installation. The lightning protection system shall be connected to the building ground loop. All exposed, large metal equipment and materials, as well as metal structural frames, shall be bonded to the building system ground loop.

1.10.3 ALARA REQUIREMENTS FOR ELECTRICAL DESIGN

Conduit penetrations from a zone of lower radiation risk to a zone of higher radiation risk shall be located as high as possible, preferably above normal accessibility recommendations. The conduit through the shielding shall be offset by an amount calculated to reduce any possible radiation to acceptable limits. All penetrating conduits shall be sealed to prevent the passage of air between the zones.

Conduit within high radiation areas, such as the hot cells, shall be the minimum possible. Where it is unavoidable, the conduit shall be spaced away from all surfaces on which dust could collect. All conduits in such areas shall contain 50% spare wires. Conduit material shall be rigid steel with smooth outside surface. Finish shall be radiation-resistant.

Lighting "fixtures" in high radiation areas shall be designed to be removable from hot cells for relamping or other maintenance activities. Handling shall be by means of remote-controlled manipulators.

Standby power shall be provided for the exhaust fans and any other equipment necessary to maintain the integrity of pressure differential between zones. An uninterruptible power supply (UPS) shall be provided for all radiation-monitoring devices and instrumentation, as well as for all security and access control devices, to ensure power supply redundancy in critical areas.

1.11 HVAC

1.11.1 DESIGN CRITERIA

The design criteria for HVAC are given in the paragraphs that follow.

1.11.1.A. Codes, Standards, Specifications, and Orders

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, and DOE Orders.

1. Codes and Standards.

(1) Air Moving and Conditioning Association, Inc. (AMCA)

(2) American National Standards Institute (ANSI)

- ANSI/NFPA No. 70 - National Electrical Code (NEC)

(3) American Refrigeration Institute (ARI)

(4) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - Standards for Heating, Ventilating and Air Conditioning

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

(6) National Fire Codes - All as applicable

(7) National Electrical Manufacturer's Association (NEMA) Standards

(8) Uniform Building Code (UBC)

2. Specifications.

(1) American Society for Testing Materials (ASTM)

(2) American Welding Society (AWS)

3. DOE Orders. The applicable portions of the following DOE Orders shall be applied to the design of this facility:

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5700.6, Quality Assurance

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal and State Standards.

Other federal and state standards, permits, and licenses

5. Federal Regulations.

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

(2) 10 CFR 50, Appendix B (Quality Assurance)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(5) 20 CFR 1910, Occupational Safety and Health Standards

(6) 40 CFR 61, National Emission Standards for Hazardous Air Pollutants; Standards for Radionuclides (Subpart H)

(7) 40 CFR 122, National Pollutant Discharge Elimination System

6. Nuclear Regulatory Commission (NRC) Regulatory Guides

Appendix A, Applicable Regulatory Guides
Appendix B, Potentially Applicable Regulatory Guides

1.11.1.B. Site Considerations and Outside Design Conditions

1. Site. The design values herein are intended to encompass the specific design values for the three proposed sites. Where the specific design values are readily available, they shall be used for the conceptual design. The MRS Facility shal be designed to minimize the impact on the site.

(1) Seismic risk zone: Seismic risk as defined by the International Conference of Building Officials Zone 2 or less for Non-Category I installations. For Category I installations, see Section 1.3.1.D.

(2) Maximum wind:	Highest wind speed at 10 m height with an annual probability at 0.02 For tornado requirements, see Section 1.3.1.D.	100 mph
(3) Ground thermal conductivity:	Ability of ground to conduct heat	1.2 W/m/°K

2. Outside Design Conditions (HVAC).

Summer design temperature:	ASHRAE recommended	95°F DB, 75°F WB
Winter design temperature:	ASHRAE recommended	2°F
Heating loads:	Amount of building heating required per year	4,000 degree-days

1.11.1.C. Heat Transfer Coefficients

Not established at this time.

1.11.1.D. Energy Conservation

Where justified by life-cycle cost analyses, heat recovery systems shall be provided. Use of automatic control and surveillance systems shall be considered for monitoring and controlling operating systems.

An overall energy conservation plan shall be prepared, which should include all design and operating considerations necessary for optimal energy conservation. In addition, alternative energy sources shall be considered.

1.11.1.E. Heating System

Consideration shall be given to a central powerhouse equipped with steam boilers to provide steam for heating and for process uses.

1.11.1.F. Cooling System

No specific requirements established.

1.11.1.G. Occupational and Environmental Safety

Occupational and environmental safety considerations for the MRS Facility are as follows:

1. Fire Protection. Fire safety requirements shall include fire dampers in ventilation ducts at appropriate locations.

2. Industrial Health and Safety. The buildings, systems, and equipment shall be designed to comply with all pertinent OSHA standards and with the intent of state and local safety standards. Special safety features shall include:

(1) Special exhausters at sources of various vapors or particulates
(2) Sound reduction where needed to ensure 80 dbA maximum
(3) Fail-safe systems design

1.11.2 BASIS FOR DESIGN

The heating, ventilating, and air-conditioning (HVAC) systems shall maintain the temperature, humidity, ventilation, and contamination control environments within the buildings in accordance with the criteria requirements. Temperature and humidity shall be controlled as required for the processes being performed and for efficient personnel function.

1.11.2.A. Codes, Standards, Specifications, and Orders

In addition to those listed in Section 1.11.1.A, the following codes, standards, specifications, regulations, and guides shall be used in the design of the HVAC systems for the MRS Facility.

1. Codes and Standards.

(1) Air Moving and Conditioning Association, Inc. (AMCA)

- AMCA 210-1974, Laboratory Methods of Testing Fans for Rating Purposes
- AMCA 500-1983, Test Method for Louvers, Dampers and Shutters

(2) American Conference of Governmental Industrial Hygienists (ACGIH)

Industrial Ventilation, A Manual of Recommended Practice, 1982

(3) American National Standards Institute (ANSI)

- ANSI/ASHRAE 15-1978, Safety Code for Mechanical Refrigeration
- ANSI B16.5-1981, Pipe Flanges and Flanged Fittings, Steel-Nickel Alloys and Other Special Alloys
- ANSI B16.25-1974, Buttwelding Ends
- ANSI B31.5-1974, Refrigeration Piping
- ANSI N509-1980, Nuclear Power Plant Air Cleaning Units and Components
- ANSI N510-1980, Standard for Testing of Nuclear Air Cleaning Systems
- ANSI S1.2-1962, Method for the Physical Measurement of Sound
- ANSI S1.4-1983, Specification for Sound Level Meters
- ANSI S2.19-1975, Balance Quality of Rotating Rigid Bodies

(4) American Refrigeration Institute (ARI)

ARI 410-1972, Standard for Forced-Circulation Air Cooling and Air Heating Coils

(5) American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

- ASHRAE 52-1976, Methods for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter

- ASHRAE 90-75, 1980, Energy Conservation in New Building Design

- ASHRAE Handbooks and Data Books, latest editions

(6) American Society of Mechanical Engineers (ASME)

- Section V, Nondestructive Examination
- Section VIII, Division 1, Pressure Vessels
- Section IX, Welding and Brazing Qualifications

(7) Associated Air Balance Council (AABC)

National Standards for Field Measurements and Instrumentations, Total System Balance, Second Edition, 1974

(8) Energy Research and Development Administration (ERDA)

- ERDA 76/21-1976, Nuclear Air Cleaning Handbook

- ERDA 76/130-1976, Life-Cycle Costing Emphasizing Energy Conservation

(9) International Conference of Building Officials (ICBO)

- UBC-1982, Uniform Building Code
- UMC-1982, Uniform Mechanical Code

(10) National Electrical Manufacturer's Association (NEMA)

- NEMA Part ICS 6-1978, Enclosures for Industrial Controls and Systems

- NEMA 151.1, Enclosures

(11) National Fire Protection Association (NFPA)

- NFPA 70-1984, National Electric Code (NEC)

- NFPA 90A-1981, Air Conditioning and Ventilating Systems

- NFPA 90B-1980, Installation of Warm Air Heating and Air Conditioning Systems

- NFPA 91-1983, Blower and Exhaust Systems

(12) Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

- Low-Pressure Duct Construction Standards, Fifth Edition, 1976

- High-Pressure Duct Construction Standards, Third Edition, 1975

- Rectangular Industrial Duct Construction Standards, 1980
- Round Industrial Duct Construction Standards, 1977
- Guidelines for Welding Sheet Metal, 1977
- Guidelines for Seismic Restraints of Mechanical Systems and Piping Systems, 1982

(13) Underwriters' Laboratories, Inc. (UL)

- UL 586-1977, Safety Standard for High Efficiency Particulate, Air Filter Units
- UL 900-1982, Safety Standard for Air Filter Units

(14) Uniform Mechanical Code (UMC)

2. Specifications.

(1) American Society for Testing and Materials (ASTM)

- ASTM A108-1981, Specification for Steel Bar, Carbon, Cold Finished, Standard Quality
- ASTM A6-1982, General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use
- ASTM A182-1982a, Specification for Forced or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- ASTM A216-1982, Specification for Carbon Steel Casting, Suitable for Fusions Welding for High Temperature Service
- ASTM A240-1982c, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
- ASTM A312-1982, Specification for Seamless and Welded Austenitic Stainless Steel Pipe
- ASTM A403-1982a, Specification for Wrought Austenitic Stainless Steel Piping Fittings
- ASTM A525-1981, General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process
- ASTM A527-1980, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Lock Forming Quality

- ASTM B88-1983, Specification for Seamless Copper Water Tubing
- ASTM D1056-1978, Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

(2) American Welding Society (AWS)

- AWS A5.1-1981, Specification for Carbon Steel Covered Arc Welding Electrodes
- AWS A5.4-1981, Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes
- AWS A5.9-1981, Corrosion-Resisting Chromium and Chromium-Nickel Bare and Composite Metal Cored and Stranded Arc Welding Electrodes and Welding Rods
- AWS A5.22-1980, Specification for Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes
- AWS D1.1-1983, Structural Welding Code - Steel
- AWS D9.1-1980, Welding of Sheet Metal

3. DOE Orders. The HVAC design shall comply with all of the latest editions of the DOE Orders specified in the design criteria.

4. Federal Specifications. TT-S-00230C-1970, Sealing Compound, Elastomeric Type, Single Component (for Caulking, Sealing and Glazing in Building and Other Structures)

5. Military Specifications and Standards (MIL).

(1) MIL-F-51068E-1981, Filter, Particulate, High Efficiency, Fire Resistant

(2) MIL-F-51079C-1980, Filter Medium, Fire Resistant, High Efficiency

(3) MIL-STD-282-1956, Filter Units, Protective Gas Mask Components and Related Products

1.11.2.B. Site Considerations and Outside Design Conditions

1. Site. The eventual location of the MRS Facility may have some effect on the HVAC design. Until the actual location is determined, the general site conditions specified in the Design Criteria shall be followed.

After the actual site is determined, some aspects of the HVAC design (such as cooling loads, heating loads, equipment sizes, and energy usage) may change to accommodate the new conditions.

2. Outside Design Conditions (HVAC). Until the final MRS site is determined, for the purposes of HVAC calculations, the following design conditions shall be assumed to approximate weather conditions:

Summer design: 95°F DB, 75°F WB
Winter design: 2°F/4,000 degree days

1.11.2.C. Heat-Transfer Coefficients

Final overall heat-transfer coefficients (U-values) shall be determined after the MRS site is decided upon, in accordance with the methods outlined in DOE Order 6430.1 and ASHRAE Standard 90A. However, until such values can be determined, a U-value of 0.07 Btu/hr/ft^2/°F (for walls) and 0.05 Btu/hr/ ft^2/°F (for roof or roof/ceiling combinations) shall be used.

1.11.2.D. Energy Conservation

The energy-conservation methods (heat recovery, recirculation, etc.) used in the various buildings are described under the Basis for Design for the respective buildings.

The HVAC input for the overall energy-conservation plan shall be provided, as required for each building, after final HVAC systems have been determined.

1.11.2.E. Heating System

Localized hot water boilers shall be used in all buildings with heating loads of 150,000 Btu/hr or more. Electric heating shall be used for buildings with heating loads less than 150,000 Btu/hr to minimize capital cost (refer to P-PNL-095, August 2, 1984, for central steam plant evaluation).

1.11.2.F. Cooling System

In the Basis for Design, it shall be assumed that a centralized chilled water system will not be used.

1.11.2.G. Occupational and Environmental Safety

1. Fire Protection. Fire dampers and smoke detectors shall be provided in all HVAC ducts and housings as required by the applicable NFPA codes.

2. Industrial Health and Safety. All pertinent OSHA, state, and local safety standards shall be followed in the design of the HVAC systems.

(1) Special exhausters shall be installed as required by applicable codes and standards.

(2) Sound reduction shall be used to ensure the 80-db maximum sound levels in most areas. Some areas, such as offices, shall be below 80 db to provide a reasonable working environment. However, the

sound levels in some other areas (such as mechanical equipment rooms and rooms with large rotating equipment) may be higher, but they shall not exceed the OSHA limit of 90 db for an 8-hr exposure.

(3) To the maximum extent possible, the HVAC system shall have a fail-safe design.

1.11.3. ALARA REQUIREMENTS FOR HVAC

To satisfy ALARA requirements in the R&H Building, the safety items described below shall be incorporated into the HVAC design.

1.11.3.A. Minimum Time of Exposure

The HVAC system shall be designed to reduce airborne contaminants and the internal deposition that can result from abnormal conditions or from accidents that generate airborne radioactive materials.

1.11.3.B. Contamination Control

The HVAC system shall be a once-through, cascading system. Ventilation zoning and differential airflow control shall ensure flow of air from areas of lower contamination potential to areas of higher potential. The HVAC system shall be designed to adequately diffuse the air in order to minimize resuspension.

1.11.3.C. Confinement Considerations

Confinement of contamination shall be controlled by the HVAC system with the following essential features: pressure differentials, high-efficiency particulate air (HEPA) filtration, and isolation and control of accidental contamination.

1. Pressure Differentials. The HVAC system shall provide a zone differential pressure control system that shall ensure the differences in pressure between ventilation zones, as shown in Section 2.11.2.C. Highly contaminated and restricted access zones shall be maintained at a minimum of 0.5 in. w.g. lower pressure than the surrounding areas. The differential pressures shall be maintained at all times, including during maintenance of fans and filters.

The supply system shall be interlocked with the exhaust to ensure the maintenance of required pressures in the contaminated or potentially contaminated areas.

2. HEPA Filtration. Single-stage HEPA filters shall be provided at all penetrations entering and leaving Ventilation Zone 1 barriers, inside hot cells, and at barriers between Ventilation Zones 2 and 3. In addition, final exhaust filter systems shall be provided to remove gaseous and airborne particulate effluents before release to the environs. The final exhaust filter system shall contain two-stage HEPA filters for Ventilation Zones 1 and 2 and single-stage HEPA filters for Ventilation Zones 3 and 4.

With the exception of the HEPA filters located inside the hot cells, all exhaust filter systems shall be designed to permit in-place aerosol testing.

All final HEPA exhaust filters shall be located outside the area being exhausted.

The filtration system shall remain operational during changeout operation. The final filter system shall be protected against adverse conditions, such as fire, smoke, tornado, and earthquake.

3. Isolation and Control. The HVAC system shall be provided with automatic controls with manual overrides to provide operational flexibility. Automatic and manual isolation valves shall be provided to isolate portions of the HVAC system in order to limit the spread of contaminants if there is a spill. Backflow preventers shall be provided at all zone barriers. In addition, exhaust systems for Ventilation Zones 3 and 4 shall be separated from those for Ventilation Zones 1 and 2. Exhaust fans shall be located outside the zone being exhausted.

1.11.3.D. Equipment Reliability

The final exhaust systems shall be designed to provide 50% redundancy of both fans and filters for the exhaust of Ventilation Zones 3 and 4 and 50% redundancy of filters and 100% redundancy of fans for Ventilation Zones 1 and 2 exhaust.

All normally operating final exhaust fans shall be provided with standby power during loss of normal power.

1.11.3.E. Maintenance Considerations

The HVAC system shall be designed to provide for easy and safe servicing of all equipment and components. Filter rooms shall be separated from the exhaust fan room in order to isolate the filter room in case of a spill during filter changeout.

HEPA filters inside the hot cells and the first-stage exhaust filters leaving the hot cells shall be designed for remote replacement. All other HEPA filters shall be bag-in/bag-out, manually replaceable filters.

1.12 FIRE PROTECTION

1.12.1 DESIGN CRITERIA

Fire safety requirements shall include the following:

- Wet-pipe sprinkler systems in all buildings and in HVAC ducts as appropriate
- Hand-held portable fire extinguishers

- Central Fire Station at the site
- Fire alarms and pullboxes in all buildings tied into the MRS Fire Station and Security Building
- Fire hydrants around the facilities
- Explosionproof electrical fixtures in manifold areas
- Fire-resistant bottled gas storage facilities with separate compartments for flammable and oxidizing gases. Inert and noncombustible gases may be placed in either compartment.
- Use of Halon in selected locations
- Fire dampers in ventilation ducts at appropriate locations
- Use of noncombustible materials in construction
- Separation of paint shop and solvent storage facilities from other facilities and use of explosionproof fixtures

1.12.1.A. Codes, Standards, Specifications, and Orders

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, standards, specifications, and orders.

1. Codes and Standards.

(1) American National Standards Institute (ANSI)

ANSI B31.1, Power Piping

(2) National Fire Codes

- NFPA No. 101, Life Safety Code
- NFPA No. 70, National Electric Code (NEC)

(3) Uniform Building Code (UBC)

2. Specifications.

(1) American Society for Testing Materials (ASTM)

(2) American Water Works Association (AWWA) Standards for Water Pipe and Water Storage Tanks

(3) American Welding Society (AWS)

3. DOE Orders. The applicable portions of the following DOE Orders shall be applied to the design of this facility:

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 5700.6, Quality Assurance

(3) DOE 6430.1, General Design Criteria

(4) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Federal and State Standards.

Other federal and state standards, permits, and licenses

5. Federal Regulations.

(1) 29 CFR 1910, Occupational Safety and Health Standards

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

6. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.12.1.B. Fire Protection

No specific requirements established.

1.12.1.C. Fire Protection Water Supply

Water may be provided by deep wells at the site. If a local supply of sufficient reliability and capacity is available, a pipeline from the offsite source shall also be provided. Water from the source shall be treated in an MRS Facility water treatment plant. After treatment, the water shall be pumped to a water storage tank sized to accommodate both the facility process use and maximum credible firewater demand. The water shall be distributed to all facilities via an underground system. The distribution system shall provide sanitary, process, and fire-protection water for all facilities at the site. The distribution pressure shall be a minimum of 100 psi under normal operating conditions. The water system shall be looped and sectioned with valves installed at appropriate locations to provide system reliability and flexibility.

1.12.2 BASIS FOR DESIGN

Fire-protection systems shall be in accordance with the criteria requirements.

1.12.2.A. Codes, Standards, Specifications, and Orders

The design, installation, construction and nonconstruction elements, and testing of the fire-protection materials, systems, and equipment shall be required to be in compliance with the latest edition of applicable portions of codes, standards, and recommendations of nationally recognized agencies. In addition to those listed in Section 1.12.1.A, all relevant codes, standards, and recommended practices of the organizations listed below form a part of this Basis for Design within the indicated subject areas.

1. Codes and Standards.

(1) American National Standards Institute (ANSI)

- 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 lb 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 B31.1-1983, Power Piping
- ANSI B36.10-1979, Wrought Steel and Wrought Iron Pipe
- ANSI B36.19-1976, Stainless Steel Pipe

(2) Factory Mutual Corporation (FM)

- Approval Guide, 1982
- Loss Prevention Data Sheets, 1982 (Rev)

(3) International Conference of Building Officials (ICBO)

- UBC-1982, Chapter 23 and 38 - Uniform Building Code
- UFC-1982, Uniform Fire Code

(4) 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 80A-1981, Protection From Exposure Fires
- 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

(5) Underwriters' Laboratories, Inc. (UL)

Fire Protection Equipment Directory

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 Uses, Specifications 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 and 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

3. DOE Orders. DOE 4320.1, Site Development and Facility Utilization Planning, Department of Energy (DOE).

4. Federal Regulations.

29 CFR-1910-1982, Occupational Safety and Health Administration, 1981 (revised)

5. Federal and State Standards.

No other federal and state standards shall be used at this time.

6. Federal Specifications. As applicable.

1.12.2.B. Fire Protection

Fire protection shall be provided throughout the MRS buildings in accordance with design criteria, applicable codes, and standards.

An automatic fire-protection sprinkler system shall be provided throughout the buildings with some exceptions; e.g., hot cells, electrical equipment rooms, small gate stations, and other areas as described in other sections. The systems shall be designed in accordance with the NFPA and DOE Order 6430.1, CH. X. In areas where water is unacceptable, a Halon system or other acceptable system may be substituted.

1.12.2.C. Fire Protection Water Supply

Fire-protection water supply for MRS buildings shall be provided as described in the design criteria.

1.13 INDUSTRIAL HEALTH AND SAFETY

1.13.1 DESIGN CRITERIA

The design criteria for industrial health and safety are given in the paragraphs that follow.

1.13.1.A. Codes, Standards, Specifications, Orders, Regulations, and Guides

The MRS Facility design shall comply with the appropriate requirements of the latest edition of the following codes, specifications, orders, and standards.

1. Codes.

(1) Air Moving and Conditioning Association, Inc. (AMCA)

(2) American National Standards Institute (ANSI)

- ANSI A58.1, Minimum Design Loads for Buildings and Other Structures

- ANSI/NFPA No. 70, National Electric Code (NEC)

(3) National Fire Codes

- All as applicable

(4) National Electrical Manufacturer's Association (NEMA) Standards

(5) Uniform Building Code (UBC)

(6) Uniform Plumbing Code (UPC)

(7) AEC-ERDA RDT Standards for F8-6T, Hoisting and Rigging of Critical Components and Related Equipment

2. Specifications. Crane Manufacturer's Association of America (CMAA), Specification No. 70.

3. DOE Orders.

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE 6430.1, General Design Criteria

1.13.1.B. Safety Requirements

The buildings, systems, and equipment shall be designed to comply with all pertinent OSHA standards and comply with the intent of state and local safety standards. Special safety features shall include:

- Special exhausters at sources of various vapors

- Safety showers and eyewash stations

- Plastic strip curtains with ultraviolet protection around welding stations
- Dust collection systems for plastics and carpentry shops
- Laser-beam system isolation from operating personnel, controlled with appropriate interlocks and safety devices
- Adequate drains and flushing systems in chemical makeup areas
- Noncompatibility of connectors on gas systems
- Thermal protection on piping, tanks, etc.
- Ground-fault interrupters on receptacles, as appropriate
- Isolation of potable and process water systems
- Breathing air system separated from plant air systems
- Sound reduction where needed to ensure 80 dbA maximum
- Nonskid surfaces in wet areas
- Emergency lighting and yard lighting
- Fail-safe systems design
- Personnel protection on rotating equipment

1.13.2 BASIS FOR DESIGN

Structures, systems, and components important to safety shall be designed to withstand design basis natural events. Natural phenomena existing in the region of the proposed site shall be identified and assessed according to their potential effects on the safe operation of the MRS Facility.

1.13.2.A. Codes, Standards, and Regulations

In addition to the codes and specifications listed in Section 1.13.1.A, the following Federal Regulation shall be used: 29 CFR 1910, Occupational Safety and Health Administration, 1981 (revised).

1.13.2.B. Requirements

1. Safety Showers and Eyewash Stations. Safety showers and eyewash stations shall be provided in areas where personnel are exposed to chemicals. They shall be connected to the sanitary cold water system. Drainage for these facilities shall be connected to the sanitary waste system or radioactive waste system, depending on the potential hazard of the waste solution.

2. Ultraviolet Protection. Curtains shall be provided around welding stations for ultraviolet-ray eye protection.

3. Dust. Dust-collection systems shall be provided for the plastics, glass, and carpentry shops.

4. Sound. Sound reduction shall be provided where needed to ensure 80 dbA maximum.

5. Walking Surfaces. Floors subject to wetting shall be treated with nonskid materials or otherwise constructed of nonskid materials.

6. Emergency Lighting. Emergency and standby lighting shall be provided to illuminate indoor exit ways from facilities in case of electric power outage. Standby lighting shall include yard (exterior) lighting.

7. System or Control Malfunction. A fail-safe philosophy shall be applied in the design of the facilities. Failure or malfunction of any system or component shall not initiate a failure that could result in injury to personnel or damage to the surrounding environment.

8. First Aid. The plant facility shall include provisions for plant emergency and industrial first aid. Space shall be provided for a heliport for emergency medical air evacuation from the facility.

9. Cranes. Cranes shall be accessible for inspection and maintenance.

10. Chemicals. Process reagents and decontamination solutions (such as acids and caustics, metal salt solutions, and oxidizing solutions) shall be stored and handled in accordance with chemical plant standards. Face shields and protective clothing shall be provided as needed during chemical handling.

11. Ventilation. The R&H Building shall be divided into ventilation zones. Their basis will be relating potential for exposure of personnel to airborne radionuclides. Exhaust systems shall be provided at welding stations and for certain pieces of equipment.

12. Storage. Storage facilities shall be provided in the area of use for all reagents, chemicals, protective clothing, first-aid and safety supplies, and breathing equipment.

13. Breathing Air. Breathing air shall be differentiated from the plant air system and protected from irradiated and nonirradiated contaminants.

14. Grounding. All buildings shall be grounded to a site grounding grid. All instruments shall be attached to a separate grounding loop that is connected at a single point to the site grounding grid. Ground-fault interrupters shall be installed as specified in the NEC.

15. Vacuum Systems. Vacuum systems serving contaminated zones shall be HEPA filtered before discharge. The filters shall be upstream of the vacuum pump.

16. Sanitation. Sanitary facilities shall be provided in accordance with DOE Order 5480.1A, Chapter XII, OSHA Standards, the UBC, and the UPC.

1.13.2.C Decommissioning.

The MRS Facility shall be designed for decommissioning. Provisions shall be made to facilitate decontamination of structures and equipment, minimize the quantity of radioactive wastes and contaminated equipment, and facilitate the removal of radioactive and contaminated materials.

1.14 NUCLEAR CRITICALITY AND SAFETY

1.14.1 DESIGN CRITERIA

The design criteria for nuclear criticality and safety are given in the paragraphs that follow.

1.14.1.A. Standards and Regulations

1. Standards.

American National Standards Institute (ANSI)

(1) ANSI N13.1-1969, (revised 1981), American National Standard Dosimetry for Criticality Accidents

(2) ANSI N16.1, Safety Standards for Operations with Fissionable Materials Outside Reactors

(3) ANSI/ANS-8.3-1979, American National Standard for Criticality Accident Alarm System

(4) ANSI/ANS 57.9, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)

(5) ANSI/ANS-N2.3-1979, American National Standard Evacuation Signal for Use in Industrial Installations

2. Regulations.

(1) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI)

(2) 10 CFR 73, Physical Protection of Plant and Material

3. DOE Orders

DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

4. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.14.1.B. Requirements

The MRS Facility shall be designed to prevent nuclear criticality events.

1.14.2 BASIS FOR DESIGN

1.14.2.A. Codes, Standards, and Regulations

No additional codes, standards, or regulations shall be used.

1.14.2.B. Requirements

Spent-fuel handling, transfer, and storage systems shall be designed to be maintained subcritical and to prevent a nuclear criticality accident. The design of handling, transfer, and storage systems shall include margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the handling, transfer, and storage conditions; in the data and methods used in calculations; and in the nature of the immediate environment under accident conditions.

Specifically, the design shall comply with the requirements of ANSI N16.1-1975, recognizing that a rigorous criticality analysis is required for each potential configuration of fissionable material.

The design of the MRS Facility shall be based on either favorable geometry (spacing) or permanently fixed, neutron-absorbing materials (poisons). Where solid, neutron-absorbing materials are used, the design shall provide for positive means to verify their continued efficacy.

Unless it can be shown (considering all potential failure modes) that water can be precluded or, alternatively, ensured to be present, the criticality of each permanent or temporary storage location shall be evaluated by considering both a dry condition and a water-flooded condition.

1.15 RADIATION PROTECTION AND SHIELDING

1.15.1 DESIGN CRITERIA

The design criteria for radiation protection and shielding are given in the paragraphs that follow.

1.15.1.A. Codes, Standards, Specifications, Orders, Regulations, and Guides

The MRS Facility design shall comply with appropriate requirements of the latest edition of the following orders and regulations.

1. Codes

ANSI N13.3, Dosimetry for Criticality Accidents

2. DOE Orders

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

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

(3) 40 CFR 191 (latest edition as of January 1985), Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

(4) 40 CFR 61, National Emmissions Standards for Hazardous Air Pollutants; Standards for Radionuclides (Subpart H)

(5) 40 CFR 122, National Pollutant Discharge Elimination System

4. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.15.1.B. Radiation Protection

Radiation protection features shall include the following:

(1) Shielding and facility orientation to reduce radiation dose rates to as low as reasonably achievable (ALARA) and to conform to the requirements of 10 CFR 20, 10 CFR 72, DOE Order 5480.1A, and other applicable federal regulations and NRC regulatory guides.

(2) Ventilation zoning to ensure flow of air from areas of lower contamination potential to areas of higher potential.

(3) Maintenance of ventilation flow rates into areas of high contamination potential at levels that preclude air escape into lower potential areas through openings.

(4) Filtration of gaseous and airborne particulate effluents from contaminated or potentially contaminated areas before release to the environs to comply with 10 CFR 20 and DOE Order 5480.1A release limits.

(5) Redundancy of HEPA filter banks and exhaust fans to ensure protection during maintenance.

(6) Standby power to exhaust fans, radiation protection devices, and other essential systems during loss of normal power.

(7) Monitoring of liquid effluent streams to ensure that releases to the environs are below those prescribed by 10 CFR 20 and DOE Order 5480.1A or are detected and corrected.

(8) Monitoring of gamma dose rates in areas where there is a potential for exposure rates above preset thresholds.

(9) Monitoring and sampling of gaseous effluents and storage area atmosphere to ensure that releases to the environs are below 10 CFR 20 and DOE Order 5480.1A limits.

(10) Monitoring and sampling of the air in potentially contaminated work areas to ensure that operating personnel exposures are below the maximum limits prescribed in 10 CFR 20 and DOE Order 5480.1A for occupied areas.

(11) Personnel survey stations at exits from potentially contaminated areas to detect personnel contamination.

(12) Personnel decontamination facilities.

(13) Criticality alarms and critically safe design parameters.

(14) Operational restrictions shall be established to meet As Low As Reasonably Achievable (ALARA) objectives for radioactive materials in effluents and direct radiation levels associated with the MRS Facility operations.

(15) The fuel cladding shall be protected against degradation and gross ruptures.

(16) Radiation protection systems shall be provided for all areas and operations where onsite personnel may be exposed to radiation or airborne radioactive materials.

The applicable portions of 10 CFR 20, 10 CFR 72, Nuclear Regulatory Guides, DOE Orders, and ANSI Standards shall be applied to the above-listed radiation protection features.

1.15.1.C. Heat Generation and Radiation Intensity

Reference heat generation rates and levels of radioactivity in the majority (90%) of spent fuel and reprocessed waste packages that will be stored in the MRS Facility are listed in Table 1.5-3. Design of the facility should address the values given.

1.15.1.D. Containers Reference Dimensions

The reference dimensions of containers to be received at the MRS Facility are defined in Table 1.5-2.

For at least the first few years of operation, the only HLW expected is from West Valley waste processing. The West Valley HLW canister dimensions are 2 ft dia x 10 ft long, and it weighs as much as 6,000 lb. For at least the first 20 years of operation, no canisters or drums of RHTRU or CHTRU are expected to be received from offsite sources.

1.15.1.E. Design Surface Radiation Levels

The maximum design surface radiation levels for spent fuel assemblies and HLW canisters shall be 1×10^5 R/hr.

1.15.2 BASIS FOR DESIGN

All shielding bases for design, as listed herein for conceptual design, were obtained by consulting the design criteria, applicable standards, data from PNL, and the conceptual facility layout. Final shielding confirmation calculations will be performed in the design phase when firm equipment and layout details are available. In the conceptual design phase, the QAD-P5A code was used to generate shielding curves for the gamma sources and the ANISN-ORNL code was used to evaluate neutron attenuation through the shield. The Origen-II code was used to generate the basic fuel burnup source data.

The following tables provide the basis for shielding design:

- Table 1.15-1 - The PWR Spent Fuel Assembly Gamma Source Spectrum
- Table 1.15-2 - The BWR Spent Fuel Assembly Gamma Source Spectrum
- Table 1.15-3 - The PWR Spent Fuel Assembly (Alpha, N) Neutron Source
- Table 1.15-4 - The PWR Spent Fuel Assembly Spontaneous Fission Neutron Source
- Table 1.15-5 - The BWR Spent Fuel Assembly (Alpha, N) Neutron Source

Table 1.15-1 - The PWR Spent Fuel Assembly*
Gamma Source Spectrum

(GAMMA /SEC)

	Dose Conv Factor	33000 MWD/MTU		55000 MWD/MTU	
Mev	mR/hr/(r/cm^2 sec)	5 Year cool	10 Year cool	5 Year cool	1 0 Year cool
0.05	2.9042E-4	2.152 E+15	1.301 E+15	3.234 E+15	2.085 E+15
0.0575	2.6869E-4	2.875 E+14	1.765 E+14	4.278 E+14	2.798 E+14
0.085	2.6463E-4	1.857 E+14	1.035 E+14	2.813 E+14	1.680 E+14
0.125	3.2605E-4	1.877 E+14	9.725 E+13	2.971 E+14	1.706 E+14
0.225	5.6582E-4	1.571 E+14	8.570 E+13	2.315 E+14	1.373 E+14
0.375	9.3319E-4	9.439 E+13	4.195 E+13	1.332 E+14	6.445 E+13
0.575	1.3149E-3	2.308 E+15	1.518 E+15	4.023 E+15	2.526 E+15
0.850	1.7587E-3	4.883 E+14	1.206 E+14	1.028 E+15	2.514 E+14
1.250	2.3199E-3	3.169 E+14	1.606 E+14	4.712 E+14	2.392 E+14
1.750	2.9299E-3	3.627 E+12	1.425 E+12	6.158 E+12	2.820 E+12
2.250	3.4707E-3	2.017 E+12	3.264 E+10	2.175 E+12	3.747 E+10
2.750	3.9612E-3	6.260 E+10	2.124 E+09	8.265 E+10	3.071 E+09
3.500	4.6268E-3	7.993 E+09	2.652 E+08	1.063 E+10	3.834 E+08
5.000	5.8010E-3	4.560 E+06	3.783 E+06	2.265 E+07	1.875 E+07
7.000	7.2943E-3	5.258 E+05	4.360 E+05	2.612 E+06	2.162 E+06
10.00	9.5146E-3	7.165 E+04	5.941 E+04	3.560 E+05	2.947 E+05

* Initial Uranium Loading Is 0.462 MT with Homogenized Density 3.3043 g/cc
Fuel Assembly Dimension IS 9" x 9" x 12'-6"

PARSONS

Table 1.15-2 - The BWR Spent Fuel Assembly*
Gamma Source Spectrum

(GAMMA /SEC)

Mev	Dose Conv Factor mR/hr/(r/cm^2 sec)	28000 MWD/MTU 5 Year cool	28000 MWD/MTU 10 Year cool	48000 MWD/MTU 5 Year cool	48000 MWD/MTU 10 Year cool
0.05	2.9042E-4	6.807 E+14	4.254 E+14	1.040 E+15	7.022 E+14
0.0575	2.6869E-4	9.094 E+13	5.820 E+13	1.373 E+14	9.440 E+13
0.085	2.6463E-4	5.842 E+13	3.376 E+13	8.952 E+13	5.623 E+13
0.125	3.2605E-4	5.902 E+13	3.212 E+13	9.525 E+13	5.757 E+13
0.225	5.6582E-4	4.927 E+13	2.788 E+13	7.369 E+13	4.611 E+13
0.375	9.3319E-4	2.978 E+13	1.361 E+13	4.165 E+13	2.132 E+13
0.575	1.3149E-3	7.548 E+14	5.091 E+14	1.301 E+15	8.549 E+14
0.850	1.7587E-3	1.495 E+14	3.796 E+13	3.015 E+14	7.674 E+13
1.250	2.3199E-3	6.716 E+13	3.411 E+13	1.094 E+14	5.634 E+13
1.750	2.9299E-3	1.173 E+12	4.810 E+11	1.983 E+12	9.588 E+11
2.250	3.4707E-3	5.461 E+11	9.108 E+09	5.666 E+11	1.002 E+10
2.750	3.9612E-3	1.931 E+10	6.477 E+08	2.377 E+10	8.694 E+08
3.500	4.6268E-3	2.476 E+09	8.275 E+07	3.065 E+09	1.135 E+08
5.000	5.8010E-3	1.726 E+06	1.432 E+06	8.095 E+06	6.702 E+06
7.000	7.2943E-3	1.990 E+05	1.650 E+05	9.335 E+05	7.728 E+05
10.00	9.5146E-3	2.712 E+04	2.249 E+04	1.273 E+05	1.053 E+05

* Initial Uranium Loading is 0.186 MT with Homogenized Density 2.7058 g/cc.

Fuel Assembly Dimension IS 6" x 6" x 14'-1"

Table 1.15-3 - The PWR Spent Fuel Assembly
(Alpha, N) Neutron Source (neutrons/sec)

Basis: Metric Ton Uranium Metal as Initially Loaded

Nuclide	33 GWD/MTU		55 GWD/MTU	
	5 yr Cooled	10 yr Cooled	5 yr Cooled	10 yr Cooled
PU 238	2.305 E+6	2.216 E+6	6.481 E+6	6.230 E+6
PU 239	2.277 E+5	2.277 E+5	2.660 E+5	2.659 E+5
PU 240	3.999 E+5	4.003 E+5	4.936 E+5	4.963 E+5
AM 241	9.702 E+5	1.633 E+6	1.504 E+6	2.480 E+6
AM 243	1.457 E+4	1.457 E+4	4.396 E+4	4.394 E+4
CM 242	3.345 E+4	8.042 E+3	7.222 E+4	1.710 E+4
CM 243	2.232 E+4	1.976 E+4	7.715 E+4	6.832 E+4
CM 244	1.824 E+6	1.506 E+6	9.136 E+6	7.544 E+6
Total	5.799 E+6	6.028 E+6	1.808 E+7	1.715 E+7

Table 1.15-4 - The PWR Spent Fuel Assembly
Spontaneous Fission Neutron Source (neutrons/sec)

Basis: Metric Ton Uranium Metal as Initially Loaded

Nuclide	33 GWD/MTU		55 GWD/MTU	
	5 yr Cooled	10 yr Cooled	5 yr Cooled	10 yr Cooled
U-238	1.198 E+4	1.198 E+4		
PU 238	3.760 E+5	3.615 E+5	1.057 E+6	1.016 E+6
PU 240	2.108 E+6	2.110 E+6	2.602 E+6	2.616 E+6
PU 242	7.627 E+5	7.627 E+5	1.632 E+6	1.632 E+6
CM 242	1.623 E+5	3.902 E+4	3.504 E+5	8.299 E+4
CM 244	2.196 E+8	1.813 E+8	1.100 E+9	9.084 E+8
CM 246	9.122 E+5	9.115 E+5	9.678 E+6	9.671 E+6
CM 248			5.338 E+4	5.339 E+4
CF 252			7.716 E+5	2.074 E+5
Total	2.239 E+8	1.855 E+8	1.116 E+9	9.237 E+8

Table 1.15-5 - The BWR Spent Fuel Assembly
(Alpha, N) Neutron Source (neutrons/sec)

Basis: Metric Ton Uranium Metal as Initially Loaded

Nuclide	28 GWD/MTU		48 GWD/MTU	
	5 yr Cooled	10 yr Cooled	5 yr Cooled	10 yr Cooled
PU 238	1.972 E+6	1.896 E+6	5.793 E+6	5.570 E+6
PU 239	2.205 E+5	2.204 E+5	2.236 E+5	2.236 E+5
PU 240	3.779 E+5	3.783 E+5	4.561 E+5	4.585 E+5
AM 241	9.834 E+5	1.623 E+6	1.368 E+6	2.226 E+6
AM 243	1.410 E+4	1.410 E+4	4.179 E+4	4.177 E+4
CM 242	3.712 E+4	1.067 E+4	6.961 E+4	1.848 E+4
CM 243	2.346 E+4	2.077 E+4	6.699 E+4	5.932 E+4
CM 244	1.715 E+6	1.416 E+6	8.112 E+6	6.699 E+6
Total	5.344 E+6	5.580 E+6	1.613 E+7	1.530 E+7

Table 1.15-6 - The BWR Spent Fuel Assembly
Spontaneous Fission Neutron Source (neutrons/sec)

Basis: Metric Ton Uranium Metal as Initially Loaded

Nuclide	28 GWD/MTU		48 GWD/MTU	
	5 yr Cooled	10 yr Cooled	5 yr Cooled	10 yr Cooled
U-238	1.209 E+4	1.209 E+4		
PU 238	3.215 E+5	3.091 E+5	9.448 E+5	9.083 E+5
PU 240	1.992 E+6	1.994 E+6	2.404 E+6	2.417 E+6
PU 242	7.424 E+5	7.424 E+5	1.495 E+6	1.495 E+6
CM 242	1.801 E+5	5.178 E+4	3.378 E+5	8.966 E+4
CM 244	2.064 E+8	1.705 E+8	9.766 E+8	8.065 E+8
CM 246	8.204 E+5	8.198 E+5	8.416 E+6	8.410 E+6
CM 248			4.498 E+4	4.498 E+4
CF 252			6.436 E+5	1.730 E+5
Total	2.105 E+8	1.744 E+8	9.910 E+8	8.201 E+8

Table 1.15-7 - Neutron Group Structure, Source Spectrum, and Flux-to-Dose Conversion Factors

Neutron Group	Upper Energy (eV)	Source Spectrum (neutron/sec)	Flux-to-Dose Conversion Factor [(mrem/hr)/n/cm^2/sec]
1	1.492 E+7	0.4653 E-3	2.088 E-1
2	1.220 E+7	0.1883 E-2	1.656 E-1
3	1.000 E+7	0.5756 E-2	1.476 E-1
4	8.180 E+6	0.1924 E-1	1.476 E-1
5	6.360 E+6	0.4000 E-1	1.404 E-1
6	4.960 E+6	0.5174 E-1	1.332 E-1
7	4.060 E+6	0.1094 E+0	1.296 E-1
8	3.010 E+6	0.8804 E-1	1.260 E-1
9	2.460 E+6	0.2088 E-1	1.260 E-1
10	2.350 E+6	0.1156 E+0	1.296 E-1
11	1.830 E+6	0.2089 E+0	1.332 E-1
12	1.110 E+6	0.1920 E+7	1.188 E-1
13	5.500 E+5	0.1327 E+0	5.400 E-2
14	1.110 E+5	0.1345 E-1	6.480 E-3
15	3.350 E+3	0.0	4.320 E-3
16	5.830 E+2	0.0	4.680 E-3
17	1.010 E+2	0.0	4.680 E-3
18	2.900 E+1	0.0	4.500 E-3
19	1.010 E+1	0.0	4.320 E-3
20	3.060 E+0	0.0	4.140 E-3
21	1.120 E+0	0.0	3.960 E-3
22	4.140 E-1	0.0	3.780 E-3
	1.000 E-2		

- Table 1.15-6 - The BWR Spent Fuel Assembly Spontaneous Fission Neutron Source

- Table 1.15-7 - Neutron Group Structure, Source Spectrum, and Flux-to-Dose Conversion Factors

The facility shall be designed for ease of maintenance, to minimize personnel radiation exposure, and to meet the ALARA requirements.

1.15.2.A. Receiving and Handling (R&H) Building

The R&H Building shall include four shielded process cells and two shielded canyon cells. Each process cell shall be equipped with shielding windows, manipulators, and a remote-operated crane to facilitate the spent-fuel handling and rod consolidation operation and the skeleton shredding operation.

1. Shielding Basis for Process Cells.

(1) Maximum number of spent fuel assemblies exposed in the cell operation shall be 7 PWR or 15 BWR. They are as follows:

Three PWR or seven BWR assemblies at the upender
Three PWR or seven BWR assemblies at the SF disassembly station
One PWR or BWR assembly in transit from/to lag storage

(2) For the spent fuel disassembly station, the minimum distance from a fuel assembly to the inner side of the cell wall shall be 3 ft.

The radiation sources shall include the radiation source in one 55-gal drum containing nine shredded fuel assembly skeletons.

Another source shall be the radioactive source from accumulation of chips/dust, spent fuel disassembly, and consolidation operations.

(3) The cells can be used for either BWR or PWR consolidation with a change of attachments. Likewise, the lag storage can accommodate BWR or PWR assemblies.

(4) Only one port shall be used in handling incoming fuel assemblies at one time. Personnel access to the cell shall not be allowed unless all sources are removed from cells and proper decontamination has been accomplished.

2. Shielding Basis for Lag Storage Vaults in Shielded Canyon Cells.

The shielded canyon cells provide lag storage vaults for canistered fuel amounting to at least 1,000 MTU and divided 60%/40% PWR/BWR. There is a welding station for each pair of process cells. There can be three canisters at each of the two welding and decon stations. This area also includes the waste handling, canister overpacking, and loadout facilities.

1.15.2.B. SF, HLW, and HAW/RHTRU Storage Facilities

1. Shielding Basis for Concrete Casks.

(1) Maximum number of spent-fuel canisters stored in a cask shall be 12.

(2) Maximum number of 55-gal drums that contain nonfuel-bearing components (NFBC) from fuel assemblies stored in a cask shall be 15.

(3) Maximum number of HLW canisters stored in a cask shall be as follows:

- West Valley HLW canisters (2 ft dia): 5
- Commercial HLW canisters (1 ft dia): 9
- Commercial HLW canisters (2.5 ft dia): 1

(4) Maximum number of 55-gal drums of HAW/RHTRU, hulls, or hardware stored in a cask shall be 45.

2. Shielding Basis for Field Drywells and Transfer Shield.

(1) Maximum number of canisters (SF, HLW, HAW/RHTRU, hulls, or hardware) stored in a drywell shall be one.

(2) Maximum number of 55-gal drums (NFBC, HAW/RHTRU, or HAW) stored in a drywell shall be five.

1.15.3 ALARA REQUIREMENTS FOR RADIATION SHIELDING

All operation/transfers with respect to the spent-fuel assembly shall be conducted in a shielded hot cell or shall use a shielding cask.

The design dose rate for shielding design shall conform to requirements of FDC, 10 CFR 20, 10 CFR 72, and DOE 5480.1A.

The shielding design for the MRS Facility shall be based on the following:

(1) The worst-case radioactive sources according to the FDC. Both neutron and gamma radiation shall be considered to determine the appropriate shielding thickness.

(2) A radiation zoning table that is based upon the occupancy requirements of each area of the facility for maintenance and operation. Design dose rate for each area shall be assigned to ensure the radiation exposure to the facility personnel and the public to be ALARA.

(3) Shielding curves for the major radioactive sources shall be generated for the sizing of the shielding structure thickness. Multiple-source contribution shall be included in the assessment.

(4) A shielding basis of design shall be generated to document radioactive source data, shielding material data, design dose rates at various areas in the facility, and the methodology used in the assessment.

(5) All penetrations through the shielding structure shall be designed to minimize radiation streaming.

(6) Shielding guides shall be issued to the Parsons engineering disciplines to ensure that ALARA requirements are considered in the design.

1.16 CONTAMINATION CONTROL

1.16.1 DESIGN CRITERIA

The design criteria for contamination control are given in the paragraphs that follow.

1.16.1.A. Codes, Standards, Specifications, Orders, Regulations, and Guides

The MRS Facility design shall comply with appropriate requirements of the latest edition of the following codes, orders, and regulations.

1. Codes.

(1) Air Moving and Conditioning Association, Inc. (AMCA)

(2) American National Standards Institute (ANSI)

- ANSI N13.1, Sampling Radioactive Materials in Nuclear Facilities
- ANSI N13.10, Onsite Instrumentation for Continuously Monitoring Radioactive Effluents
- ANSI N16.1, Safety Standards for Operations with Fissionable Materials Outside Reactors

(3) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), Standards for Heating, Ventilating and Air Conditioning

2. DOE Orders.

(1) DOE 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations

(2) DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

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

(3) 40 CFR 122, National Pollutant Discharge Elimination System

4. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.16.1.B. Licensing

The MRS Facility shall be licensed by the Nuclear Regulatory Commission (NRC). Those portions of Title 10, Code of Federal Regulations (10 CFR), and Regulatory Guides pertaining to the control of radioactive materials shall be followed.

1.16.1.C. Radioactive Materials Containment

The storage facilities shall be capable of containing radioactive material within the storage package during the entire storage period and shall have a monitoring system capable of detecting releases of radioactive material in excess of 0.1 of 10 CFR 20 Appendix B, Table II. Operating personnel and the public shall 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 in excess of those defined in 10 CFR 20, 10 CFR 72, and other applicable federal regulations.

The fuel cladding shall be protected against degradation and gross failures.

Operational restrictions shall be established to meet ALARA objectives for radioactive materials in effluents and direct radiation levels associated with MRS Facility operations.

1.16.1.D. Washdown and Decontamination Areas

A washdown area shall be designed as a confinement, washdown, and inspection area and shall be separated from the cask receiving and preparation area by a wall.

1.16.1.E. Ventilation

All areas containing radioactive materials, except for casks in the storage facility, shall be equipped with a ventilation system designed to maintain internal air pressure negative with respect to atmospheric pressure. These systems shall be equipped with high-efficiency particulate air (HEPA)

filters. Release of contaminants to the environment at the point of release shall be 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 shall 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 shall be provided to separate ventilation control zones from each other. Redundant filters shall be provided for the air exhausted from the heavily contaminated radiation zones. This will help to control the spread of contamination during upset conditions.

Total volumes of air supplied and exhausted in the R&H Building shall be those required both for conditioning and contamination control. The infiltration of outside air shall be limited by providing tight-fitting doors and air-control vestibules, as appropriate, at the entrances to the building.

In addition to providing the normal air-conditioning functions, the ventilation system shall be designed to complement the building layout. It shall remain functional or fail safely during all operational modes and credible accident conditions. Failure of any single ventilation system component shall not jeopardize the ability of the system to adequately confine radioactive materials and adequately restrict their release to the environment.

1.16.1.F. Drains

Drains from the shielded process cells, shielded canyon cells, and other radioactive waste streams, where not exposed, shall be routed through doubly encased lines (original line inside a secondary encasing line) to the radwaste facilities for processing and disposition. Personnel decontamination sinks and showers and other similar streams shall be connected to the radwaste system.

1.16.1.G. Radiation Monitors

Area radiation monitors shall be located appropriately throughout the storage facility to alert operations personnel to unusual radiation levels. An audible and visual alarm shall be activated at the storage site and the R&H Building control room. Air monitors and samplers shall be provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from leaking storage receptacles.

All monitoring systems shall 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.

A gatehouse at the entrance to the storage facility shall be provided with personnel monitoring equipment to check all personnel for contamination upon leaving the storage facility

A monitoring system shall be provided to monitor:

- Loss of canister integrity
- Loss of storage system containment integrity
- Storage system operating conditions
- Degradation of storage system radiation shielding

1.16.1.H. Decommissioning

Provisions shall be made to facilitate decontamination of structures and equipment and to minimize the quantity of radioactive wastes and contaminated equipment resulting from decommissioning. It shall also be designed to facilitate the removal of radioactive wastes and contaminated materials at the time of permanent decommissioning.

1.16.2 BASIS FOR DESIGN

Compliance with the design criteria listed in Section 1.16.1 shall be the basis for design. A liquid detection monitor shall be provided to detect leakage into the doubly encased lines.

1.17 SECURITY AND SAFEGUARDS

1.17.1 DESIGN CRITERIA

The design criteria for security and safeguards are given in the paragraphs that follow.

1.17.1.A. Codes, Standards, Specifications, Orders, Regulations, and Guides

The MRS Facility design for security and safeguards shall comply with the appropriate requirements of the latest edition as of January 1985 of the orders, regulations, and guides listed herein.

1. DOE Orders.

   (1) DOE 5630.2, Control and Accountability of Nuclear Materials, Basic Principles

   (2) DOE 5632.2, Physical Protection of Special Nuclear Materials

2. Federal Regulations.

   (1) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

   (2) 10 CFR 73, Physical Protection of Plants and Materials

3. Nuclear Regulatory Commission (NRC) Regulatory Guides.

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.17.1.B. General Requirements

The MRS Facility shall be designed to include all facilities and equipment required to receive, unload, consolidate, canister, and ship to a geologic repository, receive and temporarily store onsite, or retrieve from storage and ship, spent fuel, HLW, and TRU, and to label, monitor, and store spent fuel assemblies.

Each intact or previously canistered spent fuel assembly, HLW, or RHTRU canister removed from a cask shall be identified for inventory or accountability. Canisters of consolidated fuel rods shall be inspected, recanistered or overpacked as appropriate, and labeled. All fuel rods from a fuel assembly shall be consolidated into the same canister. Nonfuel-bearing components of the assemblies shall be reduced in volume and placed in drums or canisters. Security, surveillance, and physical protection of the spent fuel and waste containers shall be provided, including the designation of vital areas in accordance with federal regulations.

The R&H Building, Storage Facilities, the vehicle lag storage area, the nonstandard or off-normal vehicle storage areas, and other vital areas shall be enclosed within a protected area perimeter. Physical protection features for these areas shall comply with 10 CFR 73.50 and DOE Order 5632.2. Fences and street lighting shall be included to allow visual and CCTV surveillance.

1.17.1.C. Safeguards

Site security shall be established to prevent unauthorized access to or removal of items of security interest. Design basis threats for an MRS Facility are:

- Sabotage of the facility or nuclear material, resulting in dispersion of radioactivity into the local environment.

- Theft of material for release or threat of release into the environment elsewhere.

- Theft of material for the purpose of retrieving special nuclear materials.

1.17.1.D. Security

Site security shall provide physical protection and access controls to deter, assess, and respond to the above threats. A site security fence shall be provided around the entire developed area of the MRS Facility. (This is

not necessarily the site boundary. The site boundary may be located a substantial distance away from the operational MRS Facility. The site boundary shall be identified by a 3-strand barbed wire fence.)

The site security fence provides the boundary to the "Limited Area" as described in DOE Order 5632, Chapter III (draft) for DOE facilities. All MRS facilities - including such nonprocess buildings as the Administration, Site Services, Warehouse, Security, Fire Station, and similar buildings - shall be located in the limited area.

A "Protected Area" per DOE Order 5632.2 (see also 10 CFR 73.2.g) shall be established. This area shall contain the R&H Building; the Spent Fuel, HLW, and RHTRU Storage Facilities; the CHTRU Facility; the radioactive shipment lag storage area; nonstandard/off-normal vehicle storage areas; and any other process support facilities considered vital to safe operation of these facilities.

All "Vital Area(s)" [DOE Order 5632, Chapter III (draft), and 10 CFR 73.2.h] and "Material Access Area(s)" [DOE Order 5632, Chapter III (draft), and 10 CFR 73.2.j] for the MRS Facility shall be located within the protected area.

The protected area shall be enclosed within two physical barriers (fences) as described in DOE 5632.2.g (10 CFR 73.2.f). An "Isolation Zone" (10 CFR 73.2.k) shall be established around the buildings or facilities within the protected area. The minimum distance from the spent fuel handling and storage facilities to the nearest boundary of the protected area outer fence shall be at least 100 meters (10 CFR 72.68). The isolation zone described above may be included within the 100 meters. An alarm zone, nominally 100 ft wide, shall be provided between the fences. The alarm zone shall be monitored by two independent and dissimilar intrusion alarm systems (10 CFR 73.2.l) that complement each other. The protected area perimeter shall be equipped with closed circuit television (CCTV) to provide surveillance of the alarm zone. Protected area (including alarm zone) lighting shall be provided to assure visual/CCTV surveillance. A patrol road shall be located to facilitate routine surveillance and alarm response. Where appropriate, the outer barrier of the protected area may be part of the limited access site security fence line (i.e., three site security fences are not necessary).

Access to the protected area shall be controlled by manned security checkpoints. Access to the R&H Building and material storage areas shall be controlled by an access control system. All exterior doors and critical interior doors shall be locked and monitored by an alarm system during unoccupied periods.

All security alarms, fire alarms, evacuation alarms, or any other alarm that would require a security force response shall annunciate at the Protected Area Gatehouse as the primary location and at the Security Building as the backup or redundant location. These alarm stations shall be hardened (per criteria in UL 752), controlled access buildings with capabilities to communicate to all security personnel and offsite law enforcement agencies.

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions, including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas.

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements. The Protected Area Gatehouse shall be a hardened, controlled access building.

1.17.1.E. Material Control and Accountability

Provisions shall be made for identifying, quantifying, labeling, and recording all spent fuel, HLW, and TRU wastes and for periodically performing physical inventories to confirm the presence of accountable materials.

1.17.2 BASIS FOR DESIGN

Compliance with the design criteria given in Section 1.17.1 shall be the basis for design.

The design of all security areas and devices shall comply with NFPA 101, Life Safety Code, Section 5, "Means of Egress," including 5-7, "Discharge from Exits." Gatehouses shall be furnished with instrumentation and equipment required to monitor those entering and leaving the facility. Facilities shall be provided for the control of special nuclear material as outlined in 10 CFR 70. Provisions shall be made for inspection and monitoring of the spent fuel in storage.

"Controlled areas" shall be established around the spent fuel handling and storage facilities.

All alarms, essential surveillance and access control equipment, and instrumentation and emergency lighting systems shall be connected to the UPS system.

The planned procedure for MRS Facility site security access control includes the following:

(1) All MRS assigned personnel, visitors, and site vehicle access to the limited area shall be by way of the Main Gate/Badgehouse through the building and through electrically operated traffic gates, fully controlled 24 hours per day by security personnel, as further described in Section 7.4.2.

(2) All rail and transport vehicles bearing radioactive shipments shall enter the protected area at the Inspection Gatehouse through the security fenced inspection area. Electrically operated access gates shall be controlled by security inspectors on an as-needed basis, as described in Section 8.4.2.

(3) MRS personnel and site vehicle access, including monitoring, between the limited area and the protected area, shall occur at the Protected Area Gatehouse through electrically controlled turnstiles and traffic gates, all fully controlled by 24-hour-per-day security personnel, as described in Section 9.4.2.

(4) Personnel entry into the R&H Building shall be by individually issued magnetic card keys.

(5) Located near the Inspection Gatehouse shall be a locked gate to be used only for previously inspected, radioactive shipments by rail and transport vehicles, which shall be escorted by security personnel from the Inspection Gatehouse into the protected area. Gate control shall be on a frequent, as-needed basis.

(6) The sealed storage cask transporter vehicle/drywell transporter vehicle gate into the SF, HLW, and HAW/RHTRU Storage Facilities shall be controlled by operating personnel using magnetic key cards. The perimeter security road gates shall be locked and opened by security personnel only.

(7) The Cask Manufacturing Facility is considered a separate entity for security considerations, as the plant may be operated by an independent contractor. All personnel, motor vehicles, and rail access gates shall be controlled by the manufacturing facility contractor. The concrete cask transporter vehicle access gate into the protected area shall be locked and controlled by MRS security personnel on an infrequent, as-needed basis.

1.18 DECONTAMINATION/DECOMMISSIONING

1.18.1 DESIGN CRITERIA

The MRS Facility shall be designed for decommissioning. Provisions shall be made to facilitate decontamination of structures and equipment, and to minimize the quantity of radioactive wastes and contaminated equipment resulting from decommissioning. It shall also be designed to facilitate the removal of radioactive wastes and contaminated materials at the time of permanent decommissioning.

A plan that addresses both the technical and financial aspects must be prepared for decommissioning the MRS Facility. The plan must include sufficient information on proposed decontamination procedures and methods of radioactive waste disposal to provide reasonable assurance that the health and safety of the public will be protected at the termination of the MRS Facility.

All facilities must be decommissioned after all spent fuel and waste packages have been removed. However, complete removal of all structures, particularly the R&H Building, is unwarranted. The R&H Building shall be

designed to facilitate decontamination. Following thorough decontamination of the R&H Building, permanent decommissioning shall be accomplished by disposal of the major equipment that is not contaminated, which shall effectively decommission the building.

1.18.1.A. Codes, Standards, and Regulations

1. Federal Regulations

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

(2) 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories

(3) 10 CFR 71, Packaging of Radioactive Materials for Transport

(4) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(5) 40 CFR 191 (latest draft), Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level Transuranic Radioactive Wastes

2. DOE Orders

DOE/EV/1830-T5, A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)

3. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

1.18.1.B. Decontamination/Decommissioning Requirements

The R&H Building shall be designed to facilitate decontamination of structures and equipment, minimize the quantity of radioactive wastes and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated equipment when the MRS Facility is permanently decommissioned.

Radioactive waste treatment facilities shall be included for treatment, solidification, storage, and shipment for disposal of low-level radioactive wastes generated at the MRS Facility.

The shielded hot cells shall be lined inside with stainless steel.

When required, the spent fuel or waste canisters/containers shall be retrieved and repaired or retrieved and loaded into shipping casks for shipment offsite.

All spent fuel and waste shall most likely be shipped from the MRS Facility via rail.

1.18.2 BASIS FOR DESIGN

1.18.2.A. Codes, Standards, and Regulations

Compliance with those listed in Section 1.18.1 shall be the basis for design.

1.18.2.B. Decontamination

All surfaces expected to be normally in contact with solid radwaste shall be of stainless steel for ease of decontamination and minimum maintenance. Other surfaces shall be coated with decontaminable epoxy coatings. Design of all transfer ports and methods of transfer shall prevent contamination spread before, during, and after transfer. Dry or damp methods shall be used for decontamination. Consideration shall be given to decontamination techniques that will minimize secondary waste streams. Equipment shall be designed with a "replace-and-throw-away-failed-components" approach to modular design. Modular design shall be considered to facilitate disassembly of components for replacement and maintenance.

1.18.2.C. Decommissioning

The equipment shall be designed and arranged to facilitate eventual decommissioning of the facility. Provisions shall be made to minimize the quantity of radioactive waste and contaminated equipment resulting from decommissioning.

1.19 QUALITY ASSURANCE

1.19.1 DESIGN CRITERIA

The MRS Facility must be licensed by NRC to the requirements of 10 CFR 72 or other appropriate regulations. A quality assurance program shall be established in accordance with the requirements of 10 CFR 72.80 and documented in a quality assurance plan.

The MRS Facility quality assurance (QA) plan shall be prepared and implemented in accordance with the Basic Requirements and Supplements of ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities. The QA program shall address the conceptual and advanced conceptual designs of the MRS Facility.

A quality assurance program shall be planned, implemented, and maintained. This program shall include consideration of the technical aspects of the activities affecting quality and provide control over these activities to the extent consistent with their importance.

Specific quality assurance requirements shall be established based on regulatory requirements and on the degree of risk to the public, the environs, plant operating personnel, and critical facilities resulting from failure of a component or system.

The firm(s) selected to perform design shall prepare a quality assurance plan that specifies the requirements and details the procedures necessary to ensure the quality of design. The firm(s) shall prepare a quality assurance plan defining the requirements and procedures required to ensure the quality of design. The firm shall maintain a drawing and specification control list for the designs. The list shall be kept current and distributed when requested by PNL. The list shall include drawing number, drawing title, latest revision number, and current status (i.e., in design, out for comment, out for approval, or approved). Formal design reviews shall be held at appropriate times during design. Particular attention shall be given to shielding, ventilation systems, maintainability, remote handling systems, material transfer interfaces, storage receptacles, and material transport designs.

1.19.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.19.1, the following criteria shall be used.

The quality assurance program shall establish the quality requirements for design work to be performed on the Monitored Retrievable Storage Facility by The Ralph M. Parsons Company. The program shall conform to the Basic Requirements of ANSI/ASME NQA-1 and supplements, and fulfill the requirements identified in the Statement of Work for Architect-Engineer Services (MRS Facility Project D-360) and Functional Design Criteria. The scope of the program shall extend to activities related to the design of structures, systems, and components identified as Quality Assurance Classification Levels I and II.

The requirements and scope of the quality assurance program shall be delineated in the Quality Assurance Program Plan, the Quality Assurance Procedures, and the Project Management Procedures Manual (PMPM).

Subcontractors' quality programs, as approved by Parsons, shall, as a minimum, comply with these requirements and the requirements of NQA-1 as applicable to their scope of work. Subcontractors shall also comply with the Parsons PMPM, as applicable to their scope of work, to provide traceability of the transfer of procedure responsibility.

Control of quality shall be achieved and maintained by the discipline engineers who have been assigned the responsibility of design of structures, systems, and components.

This plan shall assign the verification of quality achievement to the Project Quality Assurance Engineer (PQAE). The PQAE shall be independent of the organizations responsible for performing the design activity. Quality

assurance classification levels of systems and structures, components, and design characteristics are as defined below.

(1) Level I

Projects, physical systems, components, structures, or portions thereof whose failure could:

(a) Cause undue risk to the health or safety of the general public or plant personnel, such as allowing or increasing the severity of a release of hazardous or toxic material to the environs.

(b) Inhibit the detection of releases to the environs of hazardous or toxic materials that could cause undue risk to the health and safety of the public.

(c) Prevent the safe shutdown or isolation of a process or system creating an undue risk to the health and safety of the public.

(2) Level II

Projects, physical systems, components, structures, or portions thereof whose failure could:

(a) Cause a serious hazard to the health or safety of plant personnel.

(b) Cause an unacceptable operational delay.

(3) Level III

Any structure, system, or component that is not classified as Level I or II for which standard industry quality requirements apply.

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SECTION 2

RECEIVING AND HANDLING (R&H) BUILDING

2.1 INTRODUCTION

2.1.1 DESIGN CRITERIA

The R&H Building is the primary operating building of the MRS Facility. It shall be designed to physically contain and control all radioactive or toxic materials being handled or generated by process operations. The systems, equipment, and operations shall be designed to minimize the quantity of radioactive waste generated during operations. It shall include spaces and equipment for remote receiving, monitoring, identifying, dissassembling, consolidating, and packaging spent fuel; and densifying, packaging, and handling spent fuel hardware and site-generated wastes. Spaces and equipment shall also be designed to receive and handle canisters of HLW and RHTRU, and to ship these materials offsite and/or load them out for onsite storage. It will include mechanized and automated remote handling equipment where feasible to permit rapid and economic handling of spent fuel and wastes. These operations are predicated on spent fuel, HLW, and RHTRU arriving in a dry gaseous environment and shipping casks being unloaded in air.

The R&H Building shall be designed to permit external cleaning, decontamination, and inspection of transportable metal (dual purpose) casks. The facility shall be capable of unloading the casks from shipping vehicles and delivering the cask to the storage facility.

Radioactive waste treatment facilities shall also be included for treatment, solidification, storage, and shipment for disposal of low-level radioactive wastes generated at the MRS Facility. Transuranic wastes and high-activity wastes (HAW)[1] generated onsite shall be treated, packaged, and stored onsite. All potentially contaminated effluent streams shall be monitored and treated in accordance with environmental standards listed in Section 1.0 before release.

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[1]High-activity waste consists of highly radioactive wastes generated during operations at the MRS Facility. These wastes may or may not contain transuranic materials. Because the waste may contain transuranic material and because the radioactivity intensity is high, the wastes are treated similar to (and are sometimes called) RHTRU.

2.1.2 BASIS FOR DESIGN

The R&H Building shall provide for all functions required for a facility capable of receiving and processing spent fuel, high-level waste, and high-activity waste/remotely handled transuranic waste (HAW/RHTRU) for storage onsite and/or shipping offsite. All support functions, systems, equipment, services, and utilities necessary for a fully operational facility, including decontamination, shall be provided.

2.2 CIVIL AND SITE DEVELOPMENT

2.2.1 DESIGN CRITERIA

No specific design criteria are cited.

2.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2, the following criteria shall be used in design.

2.2.2.A. Parking

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

2.2.2.B. Landscaping

The area around the administration area of the R&H Building shall be landscaped.

2.3 STRUCTURAL

2.3.1 DESIGN CRITERIA

The R&H Building shall be designed to conform to all the design requirements described in Section 1.3.1. The various parts of the building shall be designated Category I and Non-Category I and shall be designed accordingly. The Category I elements should be constructed of reinforced concrete designed for containment and for maintaining radiation exposures of operating personnel within the design objectives of DOE Order 5480.1A and other applicable regulations, including application of ALARA principles to facility operating philosophies.

2.3.2 BASIS FOR DESIGN

The R&H Building shall be a reinforced concrete, box-system building of monolithic, poured-in-place construction, except that a braced steel

structure will be used for Non-Category I structures. Areas containing radiation sources shall be enclosed by sufficient concrete thicknesses to attenuate radiation to acceptable levels.

2.3.2.A. Classification

The R&H Building shall have a dual classification. Portions of the building shall be designated as Category I. These portions, along with the overall structure encompassing these portions, shall be designed as a Category I structure. Contiguous areas not requiring Category I design (such as receiving areas, administration area, low-level radwaste areas, and the electrical rooms, except standby/UPS/battery) shall be designed as Non-Category I structures.

2.3.2.B. Design Loads

The design loads shall comply with applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Loads		Reference Subsection of Section 1.3.2.D
1. Dead Load		1
30 psf as dead load shall be used to include piping, ductwork, conduits, fixtures for roof, and all floors of Category I structures.		
When identified, loads resulting from fixed equipment, or that stored in laydown areas, shall be included as dead loads.		
2. Live Load		2
(1) Roof: 20 psf or 2,000-lb concentrated load		
(2) Floor:		
- Hot cells, control rooms Crane maintenance rooms	250 psf	
- Storage and maintenance areas	400 psf	
- Office, stairways, platforms	100 psf	
- Operating gallery, service gallery, access corridor	200 psf or 10 tons on 5- x 5-ft area	
- Transfer corridor, loadout and decontamination rooms	600 psf or 315-ton transporter loads	

Design Loads		Reference Subsection of Section 1.3.2.D
- Lag storage areas	700 psf	
- All others	200 psf	

3. Vehicle Loads — 3

(1)	Forklift	5 tons
(2)	Truck and cargo	48 tons
(3)	Cask transfer cart and load	180 tons
(4)	Railcar and cargo	220 tons
(5)	Cask transporter and load	315 tons
(6)	Drywell transporter and load	92 tons
(7)	Transportable cask trailer and load	170 tons
(8)	Mobile crane	20 tons

The weight of the vehicle shall be added to the above loads.

4. Snow Loads (ground snow = 25 psf) — 4

5. Impact Loads — 5

		Increase of Moving Load (%)
(1)	Elevator supports	100
(2)	Light machinery	20
(3)	Reciprocating machinery	50
(4)	Hangers supporting floors	33
(5)	Crane and hoist support	25
(6)	Crane runway horizontal support	
	- Transverse (trolley and lifted load)	20
	- Longitudinal (maximum wheel load)	10

6. Thermal Loads — 6

A 50°F change in temperature shall be assumed for a steel structure, and a 30°F change for a concrete structure (with insulation) in the conceptual design.

A 120°F change in temperature shall be assumed for walls and slabs at the lag storage vaults with 200°F maximum surface temperature. A 40°F change in

Design Loads	Reference Subsection of Section 1.3.2.D

temperature shall be assumed at process cells with 120°F maximum surface temperature.

7. Wind Loads (100-mph wind) — 7

8. Earthquake Load — 8

   (1) Design Basis Earthquake (DBE)
   (2) Operating Basis Earthquake (OBE)

9. Tornado Loads (maximum wind speed = 360 mph) — 9

10. Lateral Earth Pressure — 10

    (1) Static earth pressure:

    - Active earth pressure: 30 pcf
    - At-rest earth pressure: 55 pcf
    - Surcharge: 300 psf or 20,000-lb wheel load

    (2) Dynamic earth pressure:

    - DBE: $P = 10.3\ H^2$ lb/ft
    - OBE: $P = 5.15\ H^2$ lb/ft

11. Air-Pressure Differential (21 psf maximum) — 11

12. Crane and Hoist Loads — 13

    Cask receiving areas: one 150-ton bridge crane each
    Shielded process cells: one 20-ton bridge crane and 1-1/2-ton, wall-mounted crane, each cell
    Shielded canyon cells: two 35-ton bridge cranes, each cell
    Decon cells: one 1-ton bridge crane, each cell
    Remote handling air filtration cell: one 2-ton bridge crane
    High-activity radwaste cell: one 7-1/2-ton bridge crane
    Maintenance cell: one 15-ton bridge crane and one 1/2-ton bridge crane
    Radwaste maintenance room: one 5-ton jib crane

2.3.2.C. Load Combinations

Load combinations are derived from DOE 6430.1, NRC SRP 3.8.4, ACI 349, and ACI 318. The most stringent cases are listed below:

1. Category I Structures

(1) Concrete Structures:

$$U = 1.4\ (D + F) + 1.7\ (L + H) + 1.9\ Eo$$
$$U = 1.4\ (D + F) + 1.7\ (L + H) + 1.7\ W$$
$$U = 0.9\ D + 1.4\ F + 1.7\ H + 1.9\ Eo$$
$$U = 0.9\ D + 1.4\ F + 1.7\ H + 1.7\ W$$
$$U = 0.75\ [1.4\ (D + F) + 1.7\ (L + H + To) + 1.9\ Eo]$$
$$U = 0.75\ [1.4\ (D + F) + 1.7\ (L + H + To + W)]$$
$$U = 1.1\ (D + L + F + H + To) + Ed$$
$$U = 1.1\ (D + L + F + H + To) + Wt$$
$$U = 0.9\ D + F + H + To + Ed$$
$$U = 0.9\ D + F + H + To + Wt$$

(2) Steel Structures:

$$S = D + L + F + H + Eo$$
$$S = D + L + F + H + W$$
$$1.3\ S = D + L + F + H + Eo + To$$
$$1.3\ S = D + L + F + H + W + To$$
$$1.5\ S = D + L + F + H + To + Ed$$
$$1.5\ S = D + L + F + H + To + Wt$$

2. Non-Category I Structures

(1) Concrete Structures:

$$U = 1.4\ (D + F) + 1.7\ (L + H)$$
$$U = 0.9\ D + 1.4\ F + 1.7\ H$$
$$U = 0.75\ [1.4\ (D + F + To) + 1.7\ (L + H + W)]$$
$$U = 0.75\ [1.4\ (D + F + To) + 1.7\ (L + H) + 1.87\ E]$$
$$U = 0.9\ D + 0.75\ [1.4\ F + 1.7\ (H + W)]$$
$$U = 0.9\ D + 0.75\ (1.4\ F + 1.7\ H + 1.87\ E)$$

(2) Steel Structures:

$$S = D + L + F + H + To$$
$$1.33\ S = D + L + F + H + To + W$$
$$1.33\ S = D + L + F + H + To + E$$

2.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design[a]	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Dynamic analysis Equivalent static load analysis	4
Tornado	Energy balance method NDRC formula	5
Foundation design	Spread footings Wall footings Mat foundations	6
Sliding and overturning	FS = 1.5 FS = 1.1 (tornado and DBE)	7

2.3.2.E. Structural Materials

(1) Concrete: fc' = 5,000 psi for Category I structure and fc' = 3,000 psi for Non-Category I structure

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)
Wire mesh: ASTM A185

(3) Masonry reinforcing steel: ASTM A615, Grade 40

(4) Structural steel: ASTM A36
Bolts: ASTM A325F

(5) Stainless steel plate: ASTM A167, Type 304L
shapes: ASTM A276, Type 304

(6) Masonry: ASTM C90, Grade N, fm' = 1,350 psi

2.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

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[a]Concrete strength shall be reduced by 20% for design of walls and slabs at the lag storage areas (in-process and canistered fuel storage vault) because of the thermal effects on concrete.

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock

1/3 increase for wind, seismic, and OBE
1/2 increase for tornado and DBE

(2) Active soil pressure: See Section 1.3.2.D.10

(3) Passive soil pressure: 400 pcf

(4) Modulus of subgrade reaction: 400 k/ft^3

(5) Friction coefficient: 0.5

(6) Frost line: 2 ft below grade

2.4 ARCHITECTURAL

2.4.1 DESIGN CRITERIA

The R&H Building is the primary operating building of the MRS Facility. For additional general description, see Section 2.1. A detailed description of the facility follows, in this section and other sections as referenced herein.

2.4.1.A. Spent Fuel, HLW and RHTRU Receiving and Processing

1. Shipping Casks. Shipping casks (and transportable metal storage casks when/where appropriate) containing spent fuel, HLW, and RHTRU shall be received by rail or truck in the R&H Building at the incoming air-control vestibule (ACV) and where the vehicles shall be washed down, if necessary. They shall then be moved into the cask handling and preparation area, where:

(1) Impact limiters and protective covers are removed from the cask and temporarily stored.

(2) The cask exterior is checked for contamination and, if necessary, decontaminated.

(3) Interior gases are sampled.

The cask is then moved into the cask unloading room, where it is sealed to a shielded hot-cell entry port for unloading.

2. Cask Unloading. The shielding covers of the hot-cell entry port and the cask are then removed remotely and the cask is unloaded into the shielded hot cell. The empty cask is then checked for interior radiation level and cleaned as necessary for shipment offsite. Then the inner and outer lids are replaced, the exterior decontaminated, if necessary, and the cask is released from the building.

3. Canister Handling. Each intact or previously canistered spent fuel assembly, HLW, or RHTRU canister removed from the cask is then identified for inventory or accountability, and either processing is initiated or the fuel assembly or waste package is placed in the in-process lag storage area. Fuel assemblies may be either canistered or moved to a consolidation station, where the fuel is disassembled and the fuel rods consolidated into canisters. The fuel assembly hardware is densified and placed in drums or canisters. The canisters of consolidated fuel are then moved to a welding station, where the air is removed and replaced with an inert atmosphere, and the covers are welded onto the canisters. Next, the welds are inspected and tested for integrity.

4. Canister Loadout. The canisters are then checked for contamination and cleaned if appropriate; and the surface temperatures and radiation levels are recorded. The canisters are then: (1) moved to the lag storage vault and placed in short-term storage, (2) moved to shipping discharge port and loaded into a shipping cask for shipment offsite, or (3) moved to a loadout port and loaded into a sealed storage cask or a shielded transporter for movement to the storage facility.

5. HLW/RHTRU Canister Monitoring. After removal from the shipping cask, HLW and RHTRU canisters are identified, checked for contamination, decontaminated if required, and/or overpacked if necessary, checked for temperature and radiation level, and transferred to a shipping cask for transport to a repository, a sealed storage cask, or a shielded transporter for movement to the storage facility.

2.4.1.B. Support Functions

The supporting functions that must be provided for in the R&H Building are as follows:

- treatment and handling of radioactive wastes generated by operations performed at the MRS Facility
- aqueous makeup and chemical storage of cleaning and decontamination chemicals
- process control
- analytical laboratory
- mechanical and electrical equipment
- heating, ventilating and air conditioning systems including high-efficiency particulate air (HEPA) filtered exhaust system
- radioactive and nonradioactive maintenance
- room and duct air sampling
- radiation protection

- personnel decontamination
- effluent monitoring and sampling
- protective apparel laundry
- change rooms and protective apparel storage
- process and building systems monitoring and control
- fire protection systems
- building alarm systems (including explosion detectors)
- communications systems
- inventory control system
- security surveillance systems
- materials receiving and storage
- facility security
- offices and lunchroom facilities for operating staff
- restrooms, changerooms, and other related support facilities
- utility systems

2.4.1.C. Architectural

The R&H Building shall be designed to conform to all the design requirements described in Section 1. The various parts of the building shall be designated Category I and Non-Category I and shall be designed accordingly. The Category I elements shall be constructed of reinforced concrete 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 R&H Building shall consist of receiving and inspection facilities, remote handling areas, facilities for processing site-generated radioactive waste, and supporting areas.

1. Receiving and Inspection Facilities. The receiving and inspection facilities shall consist of three subareas: incoming air-control vestibule(s), cask handling and preparation, and outgoing air-control vestibule(s). To accommodate the required throughput and to increase reliability and flexibility, two or more avenues of access and egress shall be provided. The incoming air-control vestibule(s) shall be equipped to clean the cask and transport vehicles of road grime as necessary. Each air-control vestibule shall be designed as a confinement area. The exterior door to the vestibule shall be weatherproof and shall normally be closed before

moving the cask and vehicle into the cask handling and preparation area. The cask handling and preparation area shall be separated from the vestibule by a wall with vehicle and personnel access doors.

In the cask handling and preparation area, all operations shall be performed to prepare the cask for mating to the hot cell in the cask unloading room. The area shall be equipped with a bridge crane with a minimum capacity of 150 tons. The crane shall be capable of lifting and transferring loaded shipping casks and the transportable metal (dual-purpose) cask from one vehicle to another. The crane shall have an easily accessible platform for maintenance and inspections. Other operations include removal of impact limiters and protective covers, checking casks and vehicles for contamination and decontamination, if necessary, and sampling the cask interior gases.

The outgoing air-control vestibule shall be separated from the cask handling and preparation area by a wall with vehicle and personnel access doors. Other functions of this area shall be similar to those performed at the incoming vestibule, except no cleaning capabilities are necessary.

2. Remote Handling Area. The remote handling areas consist of the following subareas: cask unloading rooms, shielded processing cells, lag storage vaults, related crane maintenance, service and operating galleries, and a transfer/discharge area.

(1) Cask Unloading Rooms. The cask unloading rooms (two required for each cell) shall be separated from the cask handling and preparation area by doors. Access routes shall be designed to preclude blocking of vehicle and/or cask movements between the cask handling area and the cask unloading rooms.

Access ports shall provide access to the shielded processing cells (hot cells) from the cask unloading room. Each hot cell shall be provided with two independent cask unloading rooms. Port and cask covers may be removed by the hot-cell crane(s).

(2) Shielded Processing Cells. The shielded processing cells shall be designed and constructed to reduce radiation dose rates to 10 CFR 20 or DOE Order 5480.1A levels or less, in conformance with ALARA principles. To the extent practicable, the dirtier activities (disassembly and consolidation) shall be isolated from the cleaner activities (welding, testing, decontamination, and short-term lag storage of canistered fuel). The shielded process cells shall be lined inside with stainless steel. The shielded process cells shall include central handling areas for handling bare or canistered intact-fuel assemblies and consolidation areas. The design of these areas shall permit routine consolidation or handling of intact fuel (these operations need not be concurrent within a single cell). The central handling areas shall include facilities for cleaning and drying as required, inspecting, identifying, and canistering intact fuel assemblies ready for transfer to storage facilities. The con-

solidation station shall include facilities for disassembly of intact fuel assemblies (including canistered fuel), consolidation and canistering the fuel rods, densifying and packaging the fuel assembly hardware, and inspecting, testing, and labeling of packaged wastes ready for transfer to storage. Facilities shall be provided for processing of canisters containing HLW, RHTRU, consolidated fuel rods, and canisters or drums of densified fuel assembly hardware. Lag storage shall be provided between process steps as necessary to facilitate ease of movement in each process step. The MRS Facility shall be capable of maintaining spent fuel cladding surface temperatures in storage below 375°C in an inert gas environment.

The shielded process cells shall be capable of routinely processing 3,600 MTU/yr of spent fuel (60% PWR/40% BWR by weight), HLW, and RHTRU. Adequate redundancy and surge capacity shall be provided to assure this capability.

(3) In-Building Lag Storage Vault(s). An in-building lag storage vault(s) shall be provided for short-term storage of 1,000 MTU of canistered spent fuel. Accessible surfaces of this vault area need only be protected with special coatings.

The MRS Facility shall be capable of maintaining spent fuel cladding surface temperatures in storage below 375°C in an inert gas environment.

(4) Shielded Process Cell Adjuncts. Crane maintenance, service, and operating galleries shall be provided adjacent to the shielded process cells. The maintenance galleries shall be designed to permit maintenance, dismantling, removal, decontamination, and transfer of in-cell equipment to the service gallery or contact maintenance areas for maintenance and/or further disposition.

Viewing windows and closed-circuit TV (CCTV) equipment shall be provided to permit visual control of process and maintenance activities. Shielded service penetrations shall also be included to provide safe entry and exit of process and maintenance services.

(5) Transfer/Discharge Area. The transfer/discharge area connects the shielded process cells with the building exterior. The cells shall be equipped with two or more shipping discharge ports for loading shipping casks destined for offsite, and at least two loadout ports for loading waste packages into sealed storage casks (or shielded transporters for drywell concept) for delivery to onsite storage facilities.

Confinement doors shall be provided between the discharge area and the outdoors to maintain proper air balance when moving large vehicles into or out of the building. Doors between the discharge areas and the building exterior shall be weatherproof.

Design of the R&H Building shall permit unloading, examination, and reloading of the transportable metal storage (dual-purpose) cask.

(6) Radwaste Facilities. Facilities for treating site-generated liquid and solid radioactive waste shall be provided within the R&H Building. The equipment used for the treatment shall be shielding as required to limit the personnel radiation exposure to the intent of the ALARA principle.

(7) Support Areas. Supporting areas shall be provided as required for a large spent fuel handling building.

3. Control Room. The control room of the R&H Building shall be one of the supporting areas that shall receive the readout from the process, monitoring, utility, and HVAC control systems. Other control areas may be established at operating stations and mechanical rooms for equipment surveillance and control.

4. FF&E. All building furniture, fixtures, and equipment shall be included.

2.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 2.4.1, the following criteria shall be used.

The R&H Building configuration, with some exceptions, shall be designed as back-to-back, dual-process and -storage systems, providing duplicate functional requirements for receiving, handling, storing, and shipping to an offsite geologic repository. The building design arrangement shall accommodate the required throughput quantities of SF, HLW, and HAW/RHTRU as required by Section 1 - General Requirements (Section 1.1.1, Design Criteria), as well as providing increased reliability and flexibility for production.

2.4.2.A. General Requirements

In general, the R&H Building shall be designed as follows:

1. Design Approach. The main part of the building, which includes spaces subject to high-activity radioactive materials, shall be a multilevel, Category I, reinforced concrete structure with Non-Category I areas as described below.

The R&H Building shall be designed to incorporate an administration area (including health physics facilities); receiving, handling, and shipping areas; remote handling areas; transfer/discharge areas; radwaste areas; analytical laboratories; control room; and areas for other building support and service functions, as required.

Air-control vestibules (ACVs) shall be provided as required throughout the R&H Building. The ACVs function to provide an environmental separation

between the exterior and other interior spaces. This separation (vestibule) shall assist the HVAC system in controlling the flow volume and space pressure differential. In general, ACVs are used between Confinment Zones 2 and 3, Zones 3 and 4, and Zone 3 and the exterior.

2. Exterior Walls and Roofs. All exterior walls and roofs, except Non-Category I parts of the building, shall be of reinforced concrete, as required for structural and/or shielding requirements.

3. Other Interior Walls and Floors. All other interior walls and floors shall be of reinforced concrete of various thicknesses as required for structural and/or shielding requirements.

4. Non-Category I Parts of Building. The Non-Category I parts of the building shall be the incoming ACVs, the receiving, inspection and shipping areas, the outgoing ACVs, the administration area, the low-level liquid radwaste, the low-level solid radwaste, and the nonstandby/UPS/battery/electrical equipment rooms.

5. Fixtures, Furnishings, and Equipment. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

6. Administration Area. The administration area shall be designed to house offices for facility operations, maintenance, and management functions. The health physics facilities, changerooms, and lunchroom shall also be located within the administration area.

(1) Office area - The office area shall be designed to accommodate the following personnel:

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

(2) Conference room - A conference room shall be provided to accommodate up to 32 persons.

(3) Clothing issue room - Protective clothing, boots, and air-breathing devices, etc., required for personnel safety and protection shall be stored in the clothing issue room.

(4) Changerooms - Toilets, shower stalls, and janitor closets (for both male and female personnel) shall accommodate 80 men and 30 women per shift and lockers shall be provided for 320 men and 120 women.

(5) Lunchroom - A lunchroom sized for 110 occupants, equipped with vending machines, microwave oven, and a unit kitchen shall be provided.

(6) Health Physics Facility - A health physics (HP) facility shall be located near the personnel exit from the Category I portion of the R&H Building. All personnel shall be monitored and, if necessary, shall receive decontamination treatment in the health physics facility. Space shall be provided for HP technicians, a supervisor's office, decontamination facilities, and storage. This facility shall be designed to accommodate the following personnel:

Assignment	Number of Personnel by Shift				
	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 facility shall be controlled by a magnetic card-key access system. Emergency exit doors shall be alarmed. Doors used for process operations shall not be alarmed.

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

The receiving, inspection, and shipping area shall also be used for recording, handling, and staging of outgoing casks that shall be shipped by rail to an offsite respository.

Weatherproof doors shall be provided at each rail/truck lane entrance to and exit from the receiving, inspection, and shipping areas. The doors shall be 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 shall be 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) shall be designed to withstand tornado-generated missiles and pressures, and shall satisfy design basis earthquake or operating basis earthquake requirements.

The assignments and number of personnel are as follows:

Assignment	Number of Personnel by Shift				
	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

8. Remote Handling Area. The remote handling area shall be designed for remote unloading of casks into the shielded process cells. Other related functions such as equipment maintenance, crane maintenance, and decontamination shall also be provided. For personnel access to the shielded process cells and canyon cells, air locks and changerooms shall be provided. The operating galleries around the shielded process cells and shielded canyon cells shall 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) Shielded Process Cells and Shielded Canyon Cells

Four shielded process cells, eight cask unloading rooms, and two shielded canyon cells with reinforced concrete floors and walls lined with welded, leak-tight stainless steel shall be provided as follows:

Eight cask unloading rooms, two per shielded process cell, are located beneath one end of the shielded process cells for the final positioning of the incoming cask before the unloading operation. Four shielded process cells shall be provided for receipt and processing (disassembly and consolidation) of spent fuel; two shielded canyon cells shall be 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. Shielded canyon cells shall also be provided with loadout ports. Each shielded process and canyon cell shall be served by independent access ports from the cask unloading rooms and loadout rooms below. In-process lag storage shall be provided as needed in each process cell and canyon cell area.

(a) Shielded Process Cells - The spent-fuel cells shall include a primary process area for bare or canistered intact-fuel or consolidated fuel assemblies. The central handling area shall include facilities for the fuel and canister transferring

system, inspecting, identifying, and consolidating fuel assemblies. The consolidation station shall include facilities for disassembly of intact fuel assemblies (including canistered fuel), consolidation and encapsulation of fuel rods, and compaction and encapsulation of fuel assembly hardware. When desired, the consolidation step may be bypassed. Refer to Section 2.5, Material Handling, Maintenance, and Remote Systems.

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

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

(c) Welding Station Areas - The welding equipment shall be located in a shielded alcove adjacent to each process cell for ease of contact maintenance of the welding equipment.

The process crew in the operating galleries shall consist of the following:

	Number of Personnel by Shift				
Assignment	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

(2) Crane Maintenance

A shielded crane maintenance and decontamination room shall be provided for each shielded process cell, shielded canyon cell, remote handling air filtration cell, and remote handled equipment maintenance room.

(3) Equipment Maintenance Rooms

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

Maintenance personnel shall include the following:

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

9. Transfer/Discharge Area. The transfer/discharge area shall be designed to accommodate the discharge of consolidated spent fuel, HLW, and HAW/RHTRU canisters and drums into either a Primary Storage Concept - Sealed Storage Casks, which are mounted on a crawler-type transporter, or a self-contained shielded transporter for the Alternate Storage Concept - Field Drywells for delivery to the storage site.

Personnel requirements for the Primary Storage Concept shall be as follows:

Assignment	Day	Number of Personnel by Shift 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 shall be:

Assignment	Day	Number of Personnel by Shift 2nd	3rd	4th	Total
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:					
Foreman	1	1	1	1	4
Technicians	2	2	2	2	8
Inspector	1	1	1	1	4
Total	12	11	11	11	45

10. Radwaste Areas. There shall be two separate radwaste areas: the high-activity radwaste (HAW/RHTRU) area for processing high-activity wastes from the shielded cells and low-level radwaste area, including both a low-level liquid radwaste area and a low-level solid radwaste area. The radwaste areas shall prepare site-generated radioactive waste for storage or disposal. The facility shall ensure that disposal criteria (such as physical and chemical quality) are in accordance with environmental standards. For economic reasons, some waste shall require volume reduction before disposal. The end product of proper waste treatment shall be radioactive materials, including discarded contaminated parts, and tools, encapsulated with matrix material inside sealed containers, which shall hence be stored in proper storage facilities. Materials shall be reduced in volume by shredding and/or compaction before encapsulation.

For further definition of the process, see Section 2.6.2. The treatment or process required shall be applied to the following functions with a process crew of:

		Number of Personnel by Shift			
Assignment	Day	2nd	3rd	4th	Total
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

11. Analytical Laboratory. An analytical laboratory facility shall contain apparatus and chemicals required for the counting and analysis or sampling of contaminated solids, liquids, and gases. The laboratory shall accommodate the following personnel:

		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

12. Control Room. Different aspects of the operations, including maintenance activities within the facility, shall be observed and controlled in the control room. Data acquisition equipment shall handle the monitoring of personnel, inventory control, records, and procedures for the control of contaminated materials and facility process activities. Operations in cask unloading rooms, process cells, and loadout rooms shall be observed by closed-circuit television (CCTV), and a system of communication shall be

available for efficient operation of the facility. The control room shall accommodate the following personnel:

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

13. Other Building Functions. Space shall 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
- Steam Generator Building
- 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

The number of personnel is as follows:

Assignment	Number of Personnel by Shift				
	Day	2nd	3rd	4th	Total
Laundry room	2	-	-	-	2
Materials receiving and storage technicians	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

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

2.4.2.B Specific Requirements

(1) UBC Occupancy Class:

Administration area	B-2
Receiving, handling, and shipping areas	B-2
Remote handling area	H-1
Transfer/discharge area	B-2
Radwaste areas	H-1
Analytical laboratories	B-2
Control room	B-2
Other building facilities	B-2

(2) Ceiling heights (suspended ceiling):

Vestibule, offices, conference room, lunchroom, control room, corridors, and health physics facility	9'-4"
Changerooms, toilets, shower stalls, and janitor closet	8'-0"

(3) Kind of traffic:

Foot traffic
Forklift
Railcar transporters
Tractor/trailer transporters
Sealed storage cask transporter or drywell canister transporter

(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
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, and lunchroom equipment.

(b) Changerooms, Toilets and Shower Stalls, Janitor Closets: Lockers, metal toilet partitions, toilet, shower and janitor accessories, mirrors.

(c) Vertical Transportation: Freight elevator, passenger elevator, and vertical lifts.

2.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

2.5.1 DESIGN CRITERIA

This section provides the design criteria for the receiving, facility, processing, equipment, and natural phenomena requirements in the R&H Building.

2.5.1.A. Codes, Standards and Regulations

No additional codes, standards and regulations beyond those listed in Section 1.5.1 shall be used.

2.5.1.B. Receiving Requirements

The receiving requirements and throughput rates for the MRS Facility are defined in Section 1.5.1.B.

2.5.1.C. Facility Requirements

1. Functional Areas.

(1) The R&H Building shall consist of receiving and inspection facilities, remote handling areas, facilities for processing site-generated radioactive waste, and supporting areas.

(2) The receiving and inspection facilities shall consist of three subareas: incoming air-control vestibule(s), cask handling and preparation, and outgoing air-control vestibule(s).

(3) The remote handling areas shall consist of the following subareas: cask unloading rooms, shielded process cells, lag storage vaults, related crane maintenance, service and operating galleries, and a transfer/discharge area.

(4) An in-building lag storage vault shall be provided for short-term storage of 1,000 MTU of canisterized spent fuel.

The MRS Facility shall be capable of maintaining spent fuel cladding surface temperatures in storage below 375°C in an inert gas environment.

(5) Crane maintenance, service and operating galleries shall be provided adjacent to the shielded process cells. The maintenance galleries shall be designed to permit maintenance, dismantling, removal, decontamination and transfer of in-cell equipment to the service gallery or to contact maintenance areas for maintenance and/or further disposition.

(6) Facilities and equipment shall be provided for treatment of onsite-generated liquid and solid radioactive wastes, such as filtration, compaction, shredding, evaporation and concreting wastes. This area shall be equipped with a bridge crane and remote handling equipment where appropriate.

2. Configuration Requirements.

(1) The R&H Building shall be designed to physically contain and control all radioactive or toxic materials being handled or generated by process operations.

(2) To accommodate the required throughput and to increase reliability and flexibility, two or more avenues of access and egress shall be provided.

(3) Each air-control vestibule shall be designed as a confinement area. The exterior door to the vestibule shall be weatherproof and shall normally be closed before moving the cask and vehicle into the cask handling and preparation area.

(4) The cask handling and preparation area shall be separated from the vestibule by a wall with vehicle and personnel access doors.

(5) In the cask handling and preparation area, operations shall be performed to prepare the cask for mating to the hot cell in the cask unloading room.

(6) The outgoing air-control vestibule shall be separated from the cask handling and preparation area by a wall with vehicle and personnel access doors. Other functions of this area shall be similar to those performed at the incoming vestibule, except no cleaning capabilities are necessary.

(7) The cask unloading rooms (two required for each cell) shall be separated from the cask handling and preparation area by doors.

(8) Access routes shall be designed to preclude blocking of vehicle and/or cask movements between the cask handling area and the cask unloading rooms.

(9) Access ports shall provide access to the shielded process cells (hot cells) from the cask unloading room. Port and cask covers may be removed by the hot cell crane(s).

(10) The shielded process cells shall be lined inside with stainless steel.

(11) The shielded process cells shall include central handling areas for handling bare or canistered intact fuel assemblies and consolidation areas.

(12) The design of the shielded process cell central handling areas shall permit routine consolidation or handling of intact fuel (these operations need not be concurrent within a single cell).

(13) Lag storage shall be provided between process steps as necessary to facilitate ease of movement in each process step.

The MRS Facility shall be capable of maintaining spent fuel cladding surface temperatures in storage below 375°C in an inert gas environment.

(14) The shielded process cells shall be capable of routinely processing spent fuel, HLW and RHTRU at the throughput rates defined in Section 1.5.1.B.3. Adequate redundancy and surge capacity shall be provided to assure this capability.

(15) Accessible surfaces of the in-building lag storage vault area need only be protected with special coatings.

(16) The transfer/discharge area connects the shielded canyon cells with the building exterior.

(17) The shielded canyon cells shall be equipped with two or more shipping discharge ports for loading shipping casks destined for offsite, and at least two loadout ports for loading waste packages into sealed storage casks (or shielded transporters for the drywell concept) for delivery to onsite storage facilities.

(18) Confinement doors shall be provided between the discharge area and the outdoors to maintain proper air balance when moving large vehicles into or out of the building.

(19) Doors between the discharge areas and the building exterior shall be weatherproof.

(20) Dirty hot cell operations (such as disassembly and consolidation, cutting, and similar operations) shall be isolated from the cleaner operations (such as welding, testing, decontamination, and loadout) by a contamination barrier.

(21) Hot cell space shall be included to accommodate overpack equipment capable of sealing consolidated fuel canisters in a respository-type overpack. The equipment for overpacking is not included in the design scope at this time.

(22) The R&H Building equipment needed to receive and handle shipping casks, including transportable metal storage casks, shall be located in the cask handling and preparation area.

3. Design Life. The design life of the R&H Building shall be 50 years, maintainable or replaceable to extend life to at least 100 years, irrespective of licensing intervals.

2.5.1.D. Processing Requirements

1. Shipping Container.

(1) Shipping casks (and transportable metal storage casks when/where appropriate) containing spent fuel, HLW and RHTRU shall be received by rail or truck in the R&H Building at the incoming air-control vestibule, and where the vehicle will be washed down, if necessary.

(2) Casks shall then be moved into an enclosed receiving and inspection area where:

(a) Impact limiters and protective covers are removed from the cask and temporily stored

(b) The cask exterior is checked for contamination and, if necessary, decontaminated

(c) Interior gases are sampled

(3) The facility shall be capable of unloading the cask from the shipping vehicle.

(4) The cask is then moved into the cask unloading room, where it is sealed to a shielded hot cell entry port for unloading.

(5) The shielding covers of the hot cell entry port and the cask are then removed remotely and the cask is unloaded into the shielded hot cell.

(6) The empty cask is then checked for interior radiation level for shipment offsite.

(7) The cask inner and outer lids are replaced, the exterior decontaminated if necessary and the cask is released from the building.

(8) The above operations are predicated on spent fuel, HLW, and RHTRU arriving in a dry, gaseous environment and shipping casks being unloaded in air.

(9) The R&H Building shall be designed to permit external cleaning, decontamination, and inspection of the transportable metal (dual-purpose) cask.

(10) The facility shall be capable of unloading this cask from the shipping vehicle and delivering the cask to the storage facility.

(11) Design of the R&H Building shall permit unloading, examination, and reloading the transportable metal storage (dual-purpose) cask.

(12) Nonstandard or off-normal cask shipments shall be routed to a special lag storage area to await special disposition of the shipment. After the appropriate procedure is in place, a nonstandard or off-normal shipment shall be routed through the MRS Facility in conformance with the requirements of the procedure.

2. Fuel and Waste Packages and Containers.

(1) Each intact or previously canistered spent fuel assembly, HLW, or RHTRU canister removed from the cask is then identified for inventory or accountability and either processing is initiated or the fuel assembly or waste package is placed in the in-process lag storage.

(2) Intact fuel assemblies may be either canisterized or moved to a consolidation station, where the fuel is disassembled and the fuel rods consolidated into canisters.

(3) The fuel assembly hardware is densified and placed in drums or canisters.

(4) The canisters of consolidated fuel are then moved to a welding station, where the air is removed and replaced with an inert atmosphere and the covers welded onto the canister.

The MRS Facility shall be capable of maintaining spent fuel cladding surface temperatures in storage below 375°C in an inert gas environment.

(5) Next, the welds are inspected and tested for integrity.

(6) The canisters are then checked for contamination and cleaned, if appropriate, and the surface temperatures and radiation levels are recorded.

(7) The canisters are then moved to the lag storage vault and placed in short-term storage, moved to shipping discharge port and loaded into a shipping cask for shipment offsite, or moved to a loadout port and loaded into a sealed storage cask or a shielded transporter (alternate concept) for movement to the storage facility.

(8) After removal from the shipping cask, HLW and RHTRU canisters are identified, checked for contamination, decontaminated if required, and/or overpacked if necessary, checked for temperature and radiation level, and transferred to a shipping cask for transport to a repository or to a sealed storage cask or shielded transporter for movement to the storage facility.

(9) In-process fuel lag storage vaults (bare fuel) shall be designed to maintain fuel cladding temperatures below 220°C during normal operations.

(10) The in-building lag storage vaults for fuel canistered in an inert environment shall be designed to maintain fuel cladding temperatures below 375°C.

(11) All fuel rods from a fuel assembly shall be consolidated in the same canister.

(12) Broken rods, jammed rods, and others that cannot be readily consolidated with their original assembly may be collected in a separate canister. This canister may contain rods from several assemblies, and shall be identified as such in the accountability system.

2.5.1.E. Equipment Requirements

1. Shipping Cask Related Equipment.

(1) The incoming air-control vestibules shall be equipped to clean the cask and transport vehicles of road grime as necessary.

(2) The cask handling and preparation area shall be equipped with an overhead bridge crane with a 150-ton minimum rated capacity to lift casks and other equipment. This crane must be capable of lifting and transferring loaded shipping casks and the transportable metal (dual-purpose) casks from one vehicle to another. The crane shall have an easily accessible platform for maintenance and inspections.

(3) Capability shall be provided to move casks between the cask handling and preparation area and the cell access ports in the cask unloading rooms.

(4) Equipment for positioning casks shall be provided for precise positioning and sealing of casks to hot cell access ports. This equipment shall have a load capacity of 150 tons minimum and shall be designed to prevent the cask from tipping when exposed to jarring or impact. Supporting equipment and crane accessories shall be included.

2. Fuel and Waste Package Handling and Storage Container Equipment.

(1) Handling Equipment

(a) Handling equipment shall be provided in each of the shielded cells for reliably performing all prescribed operations, including in-cell equipment maintenance, decontamination, and removal. The equipment should include:

- master/slave manipulators equipped for attachment of handling tools.

- viewing windows and closed-circuit TV (CCTV) equipment to permit visual control of process and maintenance activities.

- hot cell remotely operated cranes with a remote readout load cell and with vertical, lateral and rotational motions plus longitudinal travel through the cell. The cranes shall be designed for performing all hot-cell handling operations. Various tools shall be hung from the crane and remotely operated to provide the capability for unlatching and removing cask covers and for grappling and removing fuel assemblies, waste canisters and covers.

(b) Shielded service penetrations shall also be included to provide safe entry and exit of process and maintenance services.

(c) Special canister handling equipment shall be included for transporting empty canisters and lids into the consolidation stations in the shielded cells for loading with spent fuel or waste.

(d) Equipment shall be provided to handle intact or previously canisterized spent fuel assemblies; canisters of HLW, canisters of compacted, nonfuel-bearing components from fuel assemblies; canisters and drums of remotely handled transuranic waste (RHTRU), and encapsulated and/or overpacked spent fuel, HLW and RHTRU.

(2) Consolidation Equipment

The consolidation station shall include facilities for disassembly of intact fuel assemblies (including canistered fuel), consolidation and canistering of fuel rods, and densifying and packaging of the fuel assembly hardware.

(3) Encapsulation Equipment

(a) Equipment shall be provided to encapsulate intact spent fuel assemblies and consolidated fuel rods.

(b) Equipment shall be provided to overpack defective canisters received from offsite.

(c) Hot cell process equipment shall be designed for evacuating air from canisters, backfilling canisters with inert gas, welding of canister and overpack lids, and inspecting and testing canister lid welds using ultrasonic and helium detection equipment.

(4) Other

(a) The R&H Building systems, equipment and operations shall be designed to minimize the quantity of radioactive waste generated during operations.

(b) The control room of the R&H Building shall receive the readout from the process, monitoring systems, utility and HVAC control. Other control areas may be established at operating stations and mechanical rooms for equipment surveillance and control.

(c) Requirements for cranes and hoists shall conform to applicable sections of "DOE Hoisting and Rigging Manual," ANSI Standards Series B30; and the Crane Manufacturers Association of America (CMAA) Specification No. 70. Consideration shall be given to the provisions of RDT Standard F8-6T, "Hoisting and Rigging of Critical Components and Related Equipment." Cranes also shall be accessible for maintenance and inspection.

(d) Hot cell process equipment must be designed to perform all of the required fuel element handling, inspecting and identifying, and the inspecting, testing, and labeling of waste packages ready for transfer to storage facilities.

(e) Facilities shall be provided for processing of canisters containing HLW, RHTRU, consolidated fuel rods, and canisters or drums of densified fuel assembly hardware.

2.5.1.F. Natural Phenomena Related Requirements

1. Material Handling. R&H Building material handling and remote equipment and systems shall be categorized as Category I or Non-Category I based on the criteria defined in Section 1.1.4.

2. Earthquake Loadings. R&H Building equipment and systems shall be designed to withstand the earthquake loadings as defined in Section 1.3.2.D.

2.5.2 BASIS FOR DESIGN

Refer to Drawing No. H-3-56703 for material flow diagrams.

2.5.2.A. Codes, Standards, and Regulations

1. Codes. In addition to the codes listed in Section 1.5.1, the following shall be used:

(1) American Society of Mechanical Engineers (ASME) - Boiler and Pressure Vessel Code

- Section II, Material Specifications
- Section V, Nondestructive Examination
- Section IX, Welding and Brazing Qualifications

(2) American Welding Society (AWS) - Structural Welding Code, AWS D1.1-1983

2. Standards. In addition to the standards listed in Section 1.5.1, the following shall be used:

(1) American Society for Testing and Materials (ASTM)

Material specifications and standards shall be used for materials used for fabrication of equipment and components (as applicable).

(2) American National Standards Institute (ANSI)

ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities

3. DOE Orders. In addition to the orders listed in Sections 1.5.1 and 1.5.2, the following shall be used:

DOE 5820.2, Radioactive Waste Management

4. Nuclear Regulatory Commission (NRC) Regulatory Guides:

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

2.5.2.B. Receiving Requirements

1. Shipping Container Types.

(1) The reference shipping casks and containers are defined in Tables 1.5-1 and 1.5-2. Characteristics of all light water reactor spent fuel shipping casks now available are provided in Table 2.5-1. Additional information on the reference truck and rail casks is as follows:

(a) NLI-1/2 has two closure lids. The outer lid is 28 in. dia. The inner lid is 18 in. dia.

Table 2.5-1 - Characteristics of LWR Spent Fuel Casks

Cask	Number of Assemblies PWR	Number of Assemblies BWR	Approximate Weight (tons)	Transportation Mode	Cavity Coolant	Overall Dimensions (in.) Diameter		Overall Dimensions (in.) Length
NFS-4 or NAC-1	1	2	25	Truck	Water or air	50	x	214
NLI-1/2	1	2	24	Truck	Helium or air	48	x	196
TN-8	3	-	40	Truck/rail	Air	68	x	220
TN-9	-	7	40	Truck/rail	Air	68	x	230
IF-300	7	18	70	Rail	Water or air	64	x	208
NLI-10/24	10	24	97	Rail	Helium	103.5	x	224
TN-12	12	32	117	Rail	Air	98	x	213

(b) TN-12 has two closure lids. The outer cover is 98 in. dia and weighs approximately 8,000 lb. The inner lid is approximately 64 in. dia and weighs approximately 9,000 lb.

(2) The reference transportable metal (dual-purpose) cask is assumed to be the REA 2023 cask. The following characteristics for the REA 2023 cask shall be used in the R&H Building design:

(a) Spent fuel capacity: 24 PWRs or 52 BWRs (or 48 consolidated PWRs or 104 consolidated BWRs)

(b) Overall size: PWR cask: 94 in. dia by 186 in. long
BWR cask: 92.6 in. dia by 195 in. long

(c) Overall weight: Cask empty: 176,000 lb
Cask w/24 PWRs: 212,000 lb
Cask w/48 PWRs (consolidated): 248,000 lb

(d) Covers and lids:

Outer cover: 81.5 in. dia and weighs 3,000 lb
Inner lid: 77.5 in. dia and weighs 8,000 lb

(3) PNL has identified a truck cask that shall be capable of transporting two PWR assemblies or five BWR assemblies. External dimensions of this truck cask are assumed to be similar to those of the NLI truck cask described above.

2. Fuel and Waste Package Types.

(1) The basic size, weight, radiation intensity, and heat-generation information for the reference spent fuel and waste package types presented in Tables 1.5-2 and 1.5-3 will be used.

(2) Additional detailed information on the existing or planned PWR and BWR spent fuel assemblies, which may have to be handled at the R&H Building, is provided below.

(a) A total of 25 different fuel assembly designs by five designers and six vendors has been produced. The characteristics of these fuel assemblies are presented in Table 2.5-2.

(b) Of these 25 designs, several are assumed not to need initial consideration in the MRS design for the following reasons:

- BW 14 x 14 (PWR) - All of these assemblies have been reprocessed. Their residue is in the form of commercial high-level waste, which is currently awaiting vitrification at West Valley.

Table 2.5-2 - LWR Fuel Assembly Data[a]

Assembly Manufacturer[b] and Array	Number of Rods Per Assembly	Fuel Rod Information Dimensions (in.) Diameter	Rod Length	Fuel Length	Fuel Assembly Information Dimensions (in.) Square Envelope	Length	Average Weight (lb)
AC 10 x 10[c]	100	0.400	91.5	83.0	5.61	103.0	-
BW 14 x 14[c]	-	-	-	-	-	-	-
15 x 15	208	0.430	153.125	144	8.536	165.6	1,516
17 x 17	264	0.397	-	143	8.536	165.7	1,502
CE 14 x 14	160-176	0.440	136.7-147.17	126-130	8.25	146.3-182.5	1,280
15 x 15	208-216	0.4135	142	132	8.336	149.1	1,350
16 x 16	224-236	0.382	161.64	150	8.25	178.3	1,450
Exxon/CE 14 x 14	176	0.440	146.5	136.7	8.11	156.7	1,276
15 x 15	216	0.415	139.5	131.8	8.25	148.9	1,350
GE 7 x 7	48	0.570	158.4	144.0	5.25	171.2	605
8 x 8	60	0.501	158.2	144.0	5.25	171.2	616
8 x 8	63	0.484	158.2-165.0	144-150	5.25	171.2-178.5	638
WE 15 x 15	204	0.424	152.0	144.0	8.42	161.3	1,417
17 x 17	264	0.360	152.0	144.0	8.42	161.3	1,364
GE 6 x 6 (1955)[c]	36	0.563	118.6	108	-	-	-
7 x 7 (1966)	49	0.563	158.12	144-146	5.438	171.1	600
7 x 7 (1968)	49	0.570	162.87	144	5.438	175.9	600
7 x 7R (1972)	49	0.563	-	144	5.438	175.9	600
8 x 8 (1973)	63	0.493	-	144-148	5.518	175.9	600
8 x 8R (1977)	62	0.483	-	144-150	5.518	175.9	600
9 x 9 (1960)[c]	81	0.563	80.5	70			
WE 14 x 14	179	0.422	126.7-152.06	120-144	7.763	137.1-162.3	1,260
15 x 15	204	0.422	126.7-152.35	122-144	8.426	137.1-160.1	1,450
17 x 17	264	0.360	151.63	144	8.426	159.8	1,465
17 x 17 XLR[c]	264	0.360	171	168	8.426	185.5	-

[a]Dimensions noted are for unirradiated materials at room temperature.
[b]AC: Allis-Chalmers
BW: Babcock and Wilcox
CE: Combustion Engineering
GE: General Electric
WE: Westinghouse Electric
[c]Not expected to be received by MRS Facility

- BW 17 x 17 (PWR) - Only three plants are currently known to plan the use of this fuel design, Bellefonte-1 and -2 (TVA) and North Anna-3 (VEPCO); with startup dates in 1986, 1987, and 1989, respectively. These reactor plants are not expected to have fuel storage problems early in the MRS lifetime.

- AC 10 x 10 (BWR) - One plant, La Crosse, uses this fuel. It has a pool capacity of 440 assemblies, with a projected discharge of 429 assemblies by the 1990 shutdown date.

- GE 6 x 6 (BWR) - One plant, Dresden 1, uses this fuel. It is now on extended shutdown. There are 683 assemblies in the 720 assembly-capacity pool.

- GE 9 x 9 (BWR) - One plant, Big Rock Point, uses this fuel. It is now projected to have sufficient storage capacity until 1999, 1 year before projected plant shutdown in 2000. A total of 11 assemblies beyond pool capacity is projected. This small number of assemblies should not impact the MRS design because they can be handled on an "off-normal" basis, if necessary.

- WE 17 x 17 XLR (PWR) - Only two plants, South Texas Plants 1 and 2, use this fuel. Since its overall length of 15 ft-5.5 in. is greater than the maximum length defined in the design criteria, it shall not be considered in the initial design.

(c) The fuel designs assumed to be handled, disassembled, consolidated, and encapsulated at the R&H Building are noted in Table 2.5-3. Other types of fuel assemblies shall be handled on a case-by-case basis.

(3) Encapsulated fuel received at the R&H Building is assumed to be in canisters with envelopes not larger than 9 in. (square) or 12 in. (round). Additionally, a small quantity (less than 300 canisters) of HLW and possibly RHTRU canisters and drums is expected.

(4) The salt repository overpack is the assumed overpack for the MRS Facility. The assumed characteristics of this overpack are as follows:

Overall size:	41 to 47 in. OD by 18 ft-6 in. long
Overall weight:	29,000 to 56,000 lb (empty)
Cavity size:	36 in. ID by 16 ft-2 in. deep
Cover size:	39 in. OD, 5 to 9 in. thick, 10-in.-high pintle

Table 2.5-3 - Assumed Fuel Designs for
R&H Building Routine Processing

PWR		BWR
BW	15 x 15	GE 7 x 7[a] (three designs)
CE	14 x 14[a]	GE 8 x 8[a] (two designs)
	15 x 15[a]	
	16 x 16	
WE	14 x 14	
	15 x 15[a]	
	17 x 17[a]	

[a]Also includes Exxon reloads.

3. Throughput Rates. In addition to the design criteria in Sections 1.5.1 and 2.5.1, the following shall be used as the basis for design.

(1) The annual receiving and processing rates for the separate spent-fuel types are:

	3,600 MTU/yr
PWR assemblies	4,676
BWR assemblies	7,740
Total	12,416

(2) The annual shipping rate of consolidated spent-fuel canisters is assumed to be (based on 3,600 MTU/yr):

PWR	1,559
BWR	1,106
Total	2,665

(3) The annual rate of handling and sealing repository overpacks is assumed to be 667 per year, based on an overpack holding four MRS canisters.

(4) The concurrent receiving and shipping rates of waste packages shall not exceed 3,600 MTU/yr.

2.5.2.C. Facility Requirements

1. Functional Areas. The design criteria in Section 2.5.1.C have been interpreted to require the facility areas with the functions described below:

(1) Incoming Air-Control Vestibules (ACVs) - The R&H Building shall be designed to receive shipping casks and transportable metal storage casks containing spent fuel, HLW, and RHTRU by rail or truck in the incoming ACVs, which shall be provided with manually operated washdown equipment for washing the vehicle to remove road grime, if necessary. The washdown equipment shall be designed to permit washing of vehicles having maximum dimensions of 86 ft in length, 12 ft in width, and 15 ft-1 in. in height. Each of the incoming ACVs shall be provided with two parallel rail/truck aisleways to accommodate the required throughput of the facility. The washdown equipment shall be designed to wash one vehicle at a time in each incoming ACV.

(2) Receiving, Inspection, and Shipping Areas - Functions to be performed include cask inspection, cask removal, and replacement of cask on the shipping vehicle.

(3) Cask Handling, Prep and Decon Rooms Area - Functions to be performed include cask survey and decon, outer lid removal and replacement, inner lid preparation for removal, and inner gas sampling.

(4) Cask Unloading Rooms - Functions to be performed include remote inner lid removal, fuel or waste canister removal, cask loading, and inner lid replacement. Radiation level and decontamination shall also be checked as necessary.

(5) Shielded Process Cells and Shielded Canyon Cells - Functions to be performed include remote fuel handling, identification, disassembly, consolidation, and encapsulation; HLW and RHTRU canister or HAW/RHTRU drum handling, inspection, decontamination, and overpacking; spent-fuel hardware packaging and handling; sealed canister or overpack handling, inspection, survey, and decontamination; lag storage; and repository overpack handling, loading, and sealing.

(6) Shielded Canyon Cells In-Building Lag Storage Vaults - Functions to be performed include short-term storage of canistered spent fuel.

(7) Transfer/Discharge Corridors - Functions to be performed include canister loading into storage cask and removal, replacement of storage cask lid or canister loading into the drywell transfer shield, outer lid removal, replacement, and sealing, and cask preparation for transfer to the storage area. Facilities for performing decontamination shall be provided.

(8) Maintenance Areas:

(a) Crane Maintenance Areas - Functions to be performed include crane decontamination, maintenance, repair, and/or replacement.

(b) Processing Equipment Maintenance Cell - Functions to be performed include remote equipment movement into and out of the process cell and the dismantling, decontamination, and transfer of equipment out of the cell for further disposition.

(9) Operating Galleries - Functions to be performed include all in-cell equipment operations, viewing of operations, and process monitoring.

(10) Drum/Canister Transfer Rooms - Functions to be performed include empty drum and canister transfer to the process cell.

2. Additional Functional Requirements. In addition to the functional areas described above, the following facility areas, with functions described below, shall be included in the R&H Building:

Intercell Transfer Corridor - Functions to be performed include canister transfer between shielded canyon cells.

3. Configuration Requirements. The design criteria in Section 2.5.1, in conjunction with the design basis functional areas defined above, have been interpreted to allow the following design basis configurations.

(1) Incoming Air-Control Vestibules (ACV): The incoming ACVs shall be:

(a) Separated from the receiving, inspection, and shipping areas by a wall with vehicle and personnel access doors.

(b) Equipped with portable washing equipment to manually clean the incoming cask and transport vehicles.

(2) Receiving, Inspection, and Shipping Area:

(a) Multiple parallel rail/truck access aisleways.

(b) Access to this area through weatherproof doors from washdown.

(c) Separation from cask handling and preparation area by a wall with movable doors.

(3) Cask Handling, Prep and Decon Rooms:

(a) Separated from receiving, inspection, and shipping area and cask unloading room.

(b) One cask handling, prep and decon room provided for each shielded process cell.

(c) Access from main access aisles by rail tracks.

(4) Cask Unloading Room:

(a) Separated from cask handling, prep and decon room by shielded movable door.

(b) Shielded cell door or auxiliary shielding beneath access port.

(c) Two cask unloading rooms under each shielded process cell.

(d) Independent access ports from each cask unloading room into the shielded process cell, sized for shipping and transportable metal (dual-purpose) casks. Access routes shall be designed to preclude blocking of vehicle and/or cask movements between receiving and preparation area and the cask unloading rooms.

(5) Shielded Process Cell:

(a) Four separate shielded process cells to meet facility throughput requirements of a total of 3,600 MTU per year and provide surge capacity.

(b) Separate compartments to minimize the spread of contamination from the bare fuel handling and consolidation operations to the canister operations.

(c) Shielded in-process lag storage areas for incoming spent-fuel assemblies.

(d) Access hatches/ports to cask unloading rooms, secondary waste transfer corridor, maintenance cells, and shielded canyon cells.

(e) Shielding windows to provide direct observation of process and maintenance activities.

(f) Shielded service penetrations for safe entry and exit of process and maintenance services.

(g) Master/slave manipulators for attachment of handling tools.

(6) Shielded Canyon Cell:

(a) Two separate shielded canyon cells.

(b) Multiple in-building lag storage vaults.

(c) Access to shielded process cells and between shielded canyon cells.

(d) Space for welding stations, inspection, and survey equipment.

(e) Space for repository-type overpack cover and for cover handling and sealing equipment.

(f) Shielding windows to provide direct observation of process and maintenance activities.

(g) Shielded service penetrations for safe entry and exit of process and maintenance services.

(h) Master/slave manipulators for attachment of handling tools.

(7) Transfer/Discharge Corridor:

(a) Two or more shipping discharge ports sized for shipping casks destined for offsite.

(b) A shielded cell with movable shield door or auxiliary shielding beneath each discharge port.

(c) Two or more loadout ports, sized for storage casks, transporter, and transfer shield.

(d) Weatherproof/confinement doors to the transporter entry/exit room; another weatherproof/confinement door to outdoors from transporter entry/exit room.

(8) Maintenance Areas:

(a) A crane maintenance room shall be provided in each shielded process cell and each shielded canyon cell for the maintenance of overhead traveling cranes with bridge-mounted electromechanical manipulators. Each shielded process cell and shielded canyon cell shall be provided with access hatches for equipment maintenance and/or removal. Each crane maintenance room shall be equipped with a remotely operated shielding door.

(b) In addition to the crane maintenance areas for each compartment of shielded process cells, master/slave manipulator maintenance rooms shall be provided for the maintenance of all of the master/slave manipulators in the R&H Building. The failed master/slave manipulators can be removed from the shielded process cells and transported to the maintenance rooms.

(c) A single maintenance cell shall be provided beneath the shielded process cells and shielded cells.

4. Design Life. No additional criteria shall be used.

2.5.2.D. Processing Requirements

The design criteria given in Section 2.5.1.D have been used to define the material handling and flow steps shown on Drawing H-3-56703. This drawing shall be used as the design basis for the R&H Building processing. In addition to the design criteria given in Section 2.5.1.D, the following interpretations and assumptions are included in the processing basis for design.

1. Shipping Container.

(1) Shipping casks are assumed to arrive fully loaded with a dry gaseous internal environment.

(2) Cask sealing to the process cell access port shall be provided to minimize contamination spread to the cask unloading room and to prevent fuel assemblies or waste packages from accidentally dropping into the unloading room. Shielding shall be provided by the unloading room walls and a movable shield door, and by the local shielding located at the access port.

(3) The transportable metal (dual-purpose) cask shall be handled in the cask receiving and inspection area; if needed, it shall be decontaminated and/or unloaded through one of the cask handling and preparation areas and cask unloading rooms.

(4) The shipping cask interior shall be surveyed to ensure that all spent fuel, HLW, or RHTRU has been removed before the cask lid is replaced. Debris in shipping casks shall not be removed before return, and water in casks shall also remain unless casks are provided with drains, as decided during the on-board review meeting (MM-052) with DOE-RL and PNL representatives on August 22 through 24, 1984.

2. Fuel, Waste Packages, and Containers.

(1) Shielded process cells and shielded canyon cells shall be set up to process either PWR or BWR fuel assemblies, depending on need. All cells shall have the capability to disassemble or consolidate either type of fuel.

(2) Previously canisterized spent fuel, HLW canisters, and RHTRU canisters and drums shall be handled through only one shielded canyon cell.

(3) In-process lag storage capability in each shielded process cell and canyon cell shall be based on the following:

(a) Sufficient storage for bare fuel from the reference transportable metal (dual-purpose) cask.

(b) Sufficient storage for bare fuel or high-level waste canisters from the reference rail shipping cask.

(4) Nonfuel-bearing components of spent fuel assemblies shall be volume-reduced to fit into 55-gal drums in the shielded process cells.

(5) Canister drying is not needed because consolidation is a dry process.

(6) Storage canister/drum components shall be labeled by physical marking applied before canister/drum and closure lid transfer into the shielded process cells.

(7) Canister closure welds shall be leak-tested for integrity. Weld integrity shall be verified by visual examination of the completed weld, by process control of welding parameters established by a weld process qualification program, and by ultrasonic inspection of the completed weld.

(8) Capability shall be provided to replace canister closures if the integrity of the weld is suspect.

(9) Capability shall be provided for handling the repository overpack, handling the overpack cover, loading the overpack with consolidated spent-fuel canisters, and sealing the overpack and cover.

3. Onsite-Generated Low-Level Radwaste Treatment Area.

(1) Combustible Solid Radwaste - Facilities and equipment shall be provided for treatment of onsite-generated radioactive waste, such as filtration, evaporation, and concreting wastes. Remotely operated equipment shall be provided to:

(a) Receive, sort, package, and immobilize with mortar the combustible waste in plastic-bag-lined, 55-gal, stainless steel drums (DOT-17H) for storage.

(b) Receive, separate, mix with mortar, and place the evaporator bottoms and spent resins in plastic-bag-lined, 55-gal, stainless steel drums (DOT-17H) for storage.

(c) Inspect the cured 55-gal drums.

(2) Noncombustible Solid Radwaste - Failed and/or contaminated items (such as hand tools, power tools, failed equipment and components that are made of noncombustible materials) shall be placed in 55-gal, stainless steel drums (DOT-17H) for storage. Items made of materials degradable because of radiation are precluded from this category.

(3) HEPA Filters - A compactor shall be provided to reduce the volume of the spent HEPA filters. The system shall reduce four spent HEPA filters to a bale size of 12-1/2 by 14 by 25 in. A plastic-bag-lined, 55-gal, stainless steel drum (DOT-17H) shall be used to store each bale of compacted spent HEPA filters.

(4) Spent Cartridges - The spent cartridges from the cartridge filters from the Freon drycleaning unit shall be removed and placed in 55-gal, stainless steel drums (DOT 17-H), together with LLW/CHTRU noncombustibles for storage.

(5) Transfer Equipment - Low-level solid radwaste shall be transferred by use of sealed and/or shielded containers from the point of generation to the solid radwaste treatment area. Handling equipment (such as motorized hand trucks, industrial trucks, overhead lifting equipment, and conveyors) shall be provided to handle onsite-generated radwaste. All radwaste-handling equipment shall be designed to satisfy ALARA principles.

(6) Low-Level Evaporator Bottoms Slurry - The slurry shall be mixed with cement to produce mortar to immobilize the combustible solid radwaste in 55-gal, stainless steel drums (DOT 17-H) for storage.

4. Onsite-Generated High-Activity Radwaste (HAW/RHTRU)

(1) HEPA Filters - A remote HEPA filter media removal and compaction system shall be provided to reduce the volume of the spent HEPA filters from the hot cells and remote handling air filtration cell. The system shall be capable of removing the filter medium from its frame and compacting the medium into a cylindrical mass of approximately 21 in. dia. The compacted filter media shall be loaded into plastic drums that shall be placed in 55-gal, stainless steel drums (DOT 17-H) for storage. A mechanically operated shear machine shall be provided to shear the filter frames. The cut frames shall be loaded into 55-gal, stainless steel drums (DOT 17-H) for storage.

(2) High-Activity Waste (HAW/RHTRU) Evaporator Bottoms and Spent Resin Slurry - A remotely operated cementing station shall be provided to mix and solidify high-activity waste evaporator bottoms and spent resin slurry with cement in 55-gal, carbon-steel drums (DOT 17-H) with a 4-in.-dia screwed cap. A cement filling station shall be provided to manually fill the drums with cement in an operating gallery before the remote cementing operation.

2.5.2.E. Equipment Requirements

1. Shipping Cask Handling Equipment. In addition to the design criteria given in Section 2.5.1.E, the following interpretations and assumptions are included:

(1) Cask-lifting fixtures shall provide positive engagement during the lift, and shall be designed for fail-safe operation in case of a loss of power.

(2) Crane main hook and cask transfer cart equipment load capacity shall be based on the maximum weight of the casks to be handled.

2. Fuel and Waste Package Handling and Storage Container Equipment.

(1) Handling Equipment

In addition to the design criteria given in Section 2.5.1.E, the following shall also be used:

(a) Fuel-handling grapples shall be designed to provide positive engagement with fuel assemblies and canisters containing fuel, the capability to determine that engagement has been achieved, and a method of ensuring that engagement is maintained.

(b) The lifting fixtures and handling equipment installed in hot cells shall be capable of remote operation in a high-radiation environment.

(c) All lifting components shall be designed for fail-safe operation in case of a loss of power. Means of remote manipulator actuation shall be provided.

(2) Consolidation Equipment

The design criteria given in Section 2.5.1.E shall be used, along with the following interpretations and additions, as the basis for design.

(a) The consolidation equipment shall be able to disassemble and consolidate fuel rods from all fuel assembly types noted in Table 2.5-3.

(b) The equipment shall perform the following operations:

- End fitting removal
- Fuel rod removal from the assembly
- Fuel rod rearrangement into a close-packed array
- Fuel rod installation into a canister
- Secondary waste handling and disposal by volume reduction of nonfuel-bearing components

(c) The equipment shall allow fuel assembly loading in the vertical mode, and shall translate the fuel to horizontal for fuel rod removal.

(d) The equipment shall be capable of processing multiple fuel assemblies at one time. The number of assemblies shall be based on canister size and shape.

(e) The equipment shall perform all operations in a dry, air environment.

(f) Disassembly operations shall be designed to minimize fines and chips produced by cutting, machining, etc., and shall avoid the potential problem of pyrophoric zircaloy fines.

(g) Consolidation operations (fuel rod removal, rearrangement in a close-packed array, and installation in a storage canister) shall be designed so that fuel clad integrity shall not be compromised.

(h) The equipment shall be designed to minimize the spread of loose contamination resulting from fuel handling and consolidation. Directed air flow into a collection/filtration system shall be used for local contamination control.

(i) The equipment shall be designed for remote component removal and replacement and for remote decon before removal.

(j) The components required to consolidate various fuel assembly types shall be designed as remotely replaceable modules, with disconnects for power/control lines.

(k) Except for broken rods, fuel rods from whole numbers of fuel assemblies (either PWR or BWR) shall be loaded into the same canister.

(l) The consolidation equipment shall include equipment for reducing the volume of the nonfuel-bearing components of the fuel assemblies as much as practicable, and for packaging these components in drums. The drums shall be stored onsite pending final disposition.

(3) Encapsulation Equipment

The design criteria given in Section 2.5.1.E shall be used, along with the following interpretations and additions. Specific equipment design bases have been separated for the canister/overpack; welding station and equipment; evacuation, backfill, and inspection equipment; survey and decontamination equipment; and lag storage areas.

(a) Canister/Overpack

- The canister shall be designed to provide a containment for spent-fuel assemblies and fission products during handling and storage.

- The canister shall be cylindrical, and shall be capable of containing intact fuel assemblies or all consolidated fuel rods from an integral number of fuel assemblies. The design basis canister shall hold one intact PWR, two intact BWRs, three consolidated PWRs, or seven consolidated BWRs of the designs described in Tables 2.5-2 and 2.5-3.

- The canister shall be capable of maintaining its integrity for up to 100 years and under design basis seismic and drop loadings.

- The canister shall be evacuated and backfilled with an inert gas (refer to Section 2.7.2.D) before the closure lid is welded on.

- The canister design shall accommodate closure lid attachment to the canister body by remote welding. The weld must be structurally adequate to support the weight of the canister and the contained spent fuel. The weld must also provide a

barrier against gaseous leakage from the interior of the canister. The closure shall be designed to accommodate ultrasonic examination of the weld.

- The canister shall incorporate features necessary for onsite handling. The handling feature should be compatible with repository or other nuclear fuel cycle facilities, if possible.

- The canisters and closure lids shall be physically marked before transfer into the shielded process cell.

- The canister should be capable of offsite shipping in licensed spent-fuel shipping casks.

- Cylindrical overpacks shall be designed for the spent-fuel canister and for canisters of HLW. The overpacks shall meet the same criteria and bases as the canisters.

(b) Welding Station and Equipment

- The welding station(s) shall allow for welding of both canisters and overpacks.

- Welding station features shall be provided to facilitate visual inspection of the completed closure weld around its entire perimeter.

- The welding station shall be located to allow visual and manipulator access to the canister weld area.

- The welding station shall be modular to facilitate installation, maintenance, repair, and removal of the welding equipment.

- The welding equipment shall be capable of providing automatic, repeatable, high-quality welds, with a high degree of reliability, in a remote, high-radiation, inert-atmosphere environment.

- The welding equipment shall be capable of monitoring and recording essential parameters for each weld made.

(c) Evacuation, Backfill, and Inspection Equipment

- The evacuation and backfill equipment shall be designed to remove air from the canister and closure lid, and replace it with an inert gas. Helium shall be introduced as a trace gas to allow leak inspection after canister sealing.

- The leak-inspection equipment shall have the capability of detecting a helium leak at a rate of 10^{-5} atm-cc/sec.

- The leak-inspection equipment shall contain provisions for calibrating the leak detector by use of a helium leak standard.

- This equipment shall be capable of remote operation in a high-radiation environment.

- Equipment shall be provided to facilitate ultrasonic inspection of the completed closure welds.

(d) Survey and Decontamination Equipment

- The survey and decontamination equipment shall be capable of remotely checking and cleaning the canister exterior.

- The survey and decontamination processes shall not leave any corrosive materials on the canister that could jeopardize the 100-year life. The evaluation and selection of cleaning materials shall also consider and incorporate the need to minimize produced quantities of potentially contaminated material requiring disposal.

- A survey swipe transfer system shall be included to provide clean swipes for surveying and to return swipes for counting.

(e) In-Process Lag Storage and In-Building Lag Storage Vaults

- Lag storage areas shall be designed to protect fuel during the maximum postulated seismic event.

- Lag storage shall be designed to maintain simplicity of the loading and unloading processes.

- Lag storage shall maintain maximum fuel clad temperatures below 220°C by the use of passive or forced air cooling (based on 10 yr fuel).

- Lag storage shall be capable of being decontaminated.

- Lag storage shall include removable covers to reduce radiation in canyon cells only to levels permissible for manned access.

- Lag storage shall be designed to maintain the stored fuel in a subcritical configuration during normal operations and during the occurrence of any design basis natural phenomena.

- Lag storage shall be designed to restrict liquids from flowing into the storage areas.

(4) Viewing Windows

The shielded viewing windows shall be sized to permit maximum visual control of process and maintenance operations in the hot cells. The viewing windows shall be removable from the operating gallery sides of the hot cells for ease of maintenance. Each viewing window shall have an alpha sealing glass door assembly on the hot side to facilitate removal of window housing without breaching the containment zone. The alpha sealing glass door shall be remotely removable from the hot side for maintenance and replacement. The viewing window housings shall have seals to facilitate changing of the alpha sealing door assemblies without any leaks of contamination from the hot cells to the operating galleries. Special equipment to support and service the viewing windows during maintenance operations shall be provided.

(5) Other

The design criteria given in Section 2.5.1.E shall be used with the following interpretations and additions:

(a) Equipment shall be designed to facilitate maintenance.

(b) Remotely operated equipment shall be detachable from its mounting unit and remotely replaceable by use of manipulator-operated latches or automatic-release mechanisms.

(c) All service lines for remotely operated equipment shall have manipulator-actuated disconnects located in the hot cell.

3. High-Activity Radwaste (HAW/RHTRU) Area Equipment.

(1) A remote operated overhead bridge crane with a bridge-mounted electromechanical manipulator shall be provided for remote operation and maintenance of the equipment located in the high-activity radwaste (HAW/RHTRU) area.

(2) The HAW/RHTRU area shall be provided with means of remote decontamination of failed equipment to facilitate contact maintenance.

(3) A maintenance gallery shall be provided adjacent to the HAW area for the maintenance, repair, and decontamination of the crane and bridge-mounted manipulator to reduce the radiation dose rates to ALARA levels.

4. Remote Handling Air Filtration Room Equipment

(1) A remotely operated overhead bridge crane, with a bridge-mounted electromechanical manipulator, shall be provided for remote

changeout of HEPA filters and remote operation and maintenance of the equipment located in the remote handling air filtration (RHAF) room.

(2) The RHAF room shall be provided with means of remote decontamination of failed equipment to facilitate contact maintenance.

(3) A maintenance gallery shall be provided adjacent to the RHAF room for the maintenance, repair, and decontamination of the crane and bridge-mounted manipulator to limit the radiation dose rates to ALARA levels.

2.5.2.F. Natural Phenomena-Related Requirements

The R&H Building material handling and remote equipment and systems are categorized below.

1. Category I Components, Systems, and Structures

(1) Lag storage racks
(2) Port plugs and jacking mechanisms
(3) Shielding windows

2. Non-Category I Components, Systems, and Structures

All other equipment and systems are Non-Category I.

2.6 PROCESS (RADWASTE TREATMENT)

2.6.1 DESIGN CRITERIA

Design criteria for the liquid and solid radwaste treatments in the R&H Building are given in this section.

2.6.1.A. Liquid Radwaste Treatment

Facilities and equipment shall be provided for treatment of onsite-generated radioactive wastes such as filtration and evaporation.

All potentially contaminated effluent streams shall be monitored and treated in accordance with applicable environmental standards prior to release.

2.6.1.B. Solid Radwaste Treatment

Facilities and equipment shall be provided for treatment of onsite-generated radioactive wastes, such as filtration, compaction, shredding, and concreting wastes.

Radioactive waste treatment facilities shall be included for treatment, solidification, storage and shipment for disposal of low-level radioactive wastes generated at the MRS Facility. Transuranic wastes and high-activity wastes (HAW)[1] generated onsite shall be treated, packaged, and stored onsite.

The systems, equipment and operations shall be designed to minimize the volume of radioactive waste generated during operations.

2.6.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.6.2, the following criteria shall be used.

2.6.2.A. Liquid Radwaste System

The liquid radwaste system consists of two subsystems: (1) low-level liquid radwaste system and (2) high-activity liquid radwaste system.

1. Low-Level Liquid Radwaste System.

Refer to Drawing No. H-3-56707, Liquid Radwaste System, High-Activity and Low-Level, Flow Diagram, which forms the basis for design.

(1) General

The low-level liquid radwaste system shall be designed to treat low-level liquid radwaste. The low-level liquid radwaste is collected from the low-level radwaste drains, the analytical lab drain, the laundry system, and the washdown collection sumps. The system shall be capable of processing low-level liquid radwastes to produce effluent pure enough for recycle. Effluent shall be stored in a deionized water storage tank. Spent resin shall be removed periodically from the LLW ion exchangers and sent to the high-activity solid radwaste system. The low-level evaporator bottoms product shall be sent to the LLW evaporator bottoms slurry tank in the solid radwaste system. Throughput capacities for the low-level liquid radwaste system shall be based on processing the LLW liquid radwaste intermittently, as required.

The major streams and all liquid effluents shall be continuously monitored for radioactivity and other environmental contamination in compliance with 10 CFR 20 and DOE Order 5480.1A.

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[1]High-activity waste consists of highly radioactive wastes generated during operations at the MRS Facility. These wastes may or may not contain transuranic materials. Because the waste may contain transuranic material and because the radioactive intensity is high, the wastes are treated similar to (and are sometimes called) RHTRU.

(2) Major Equipment.

(a) LLW Liquid Collection Vessels

The storage capacities shall be adequate for handling the liquid radwaste generated during 1 week. The collection vessels shall be equipped with sampling, volume, density, and temperature-measuring devices. Provision shall be made to neutralize the contents of the radwaste collection vessels with nitric acid or caustic soda, as required. Mechanical agitators shall be used to keep solids in suspension and also help the neutralization process. Defoamer shall be added to prevent foaming. Offgas shall be vented to HVAC.

(b) LLW Evaporator Feed Tank

An evaporator feed tank shall be provided for better control of feed to the evaporator. The tank shall be equipped with a mechanical agitator to keep solids in suspension. Defoamer shall be added to prevent foaming. Offgas shall be vented to HVAC.

(c) LLW Liquid Evaporators

The low-level liquid radwaste shall contain approximately 0.4 wt% suspended and dissolved solids. The solids are primarily Turco decon detergents and foam. The solids shall be concentrated by evaporators. Evaporation was selected instead of reverse osmosis because it is able to handle large amounts of dissolved solid more effectively. Thin-film evaporators were selected because of their ability to process hard-to-handle materials, materials that cannot be processed economically or at all in other types of evaporators. Two evaporators were selected instead of one on the basis of increased reliability and onstream factor. Finally, horizontal evaporators were selected instead of vertical evaporators to minimize cost and also for ease of access and maintenance to reduce personnel exposure to radiation (ALARA).

The bottoms products from the evaporator shall be approximately 25 wt% solids. The low-level evaporator bottoms product shall be sent to the evaporator bottoms slurry tank in the low-level solid radwaste system. Saturated steam at 50 psig is used as the evaporative medium. The condensate return shall be monitored for contamination.

(d) LLW Evaporator Overhead Condenser

The overhead vapor from the evaporator shall be cooled in a condenser to produce condensate. The condenser shall be a shell-and-tube type condenser. The overhead vapor shall enter

the tube side and cooling water in the shell side to condense the vapor. The LLW evaporator overhead condensate shall be monitored for contamination. The cooling water return shall also be monitored for contamination.

(e) LLW Evaporator Condensate Hold Tank

The condensate produced in the condenser shall be collected in the hold tank. The hold tank shall be equipped with temperature and liquid level measuring devices. The collected condensate is sent to the LLW ion exchangers for further cleaning and deionization. Vacuum pumps shall be provided to maintain a vacuum. They shall discharge to HVAC.

(f) LLW Ion Exchangers

The condensate from the evaporator shall be further cleaned in a mixed-bed ion exchange column so that the treated water can be recycled within the facility. Spent resin shall not be regenerated because of the minimum consumption of resin. Regeneration would produce liquid radwaste, which would have to be further treated. Duplicate columns shall be provided, with one unit for service and the other for standby. When the combustible resin have become fully spent, they shall be changed and sent to the high-activity solid radwaste system. The cleaned condensate leaving the ion exchanger shall be checked for contamination before recycle.

2. High-Activity Liquid Radwaste System

Refer to Drawing No. H-3-56707, Liquid Radwaste System, High-Activity and Low Level, Flow Diagram, which forms the basis for design.

(1) General

The system shall be designed to treat the high-activity liquid radwaste (HAW/RHTRU). The high-activity liquid radwaste is collected from the high-activity radwaste drains. The system shall be capable of processing HAW/RHTRU liquid radwaste to produce effluent pure enough for recycle. Effluent shall be stored in a deionized water storage tank. Spent resin shall be removed periodically from the HAW/ RHTRU ion exchanger and sent to the high-activity solid radwaste system. The HAW/RHTRU evaporator bottoms product shall be sent to the evaporator bottoms slurry tank in the high-activity solid radwaste system.

Throughput capacities for the HAW/RHTRU liquid radwaste system shall be based on processing the HAW/RHTRU liquid radwaste intermittently, as required.

The major streams and all liquid effluents shall be continuously monitored for radioactivity and other environmental contamination in compliance with 10 CFR 20 and DOE Order 5480.1A.

(2) Major Equipment.

(a) HAW/RHTRU Liquid Collection Vessel

The storage capacity shall be adequate for handling the HAW/RHTRU liquid radwaste generated from decontaminating the largest surface area in a hot cell. For ALARA considerations and to minimize cost, spent decontamination solution from decontaminating a hot cell wall shall be first collected and treated before the other walls are decontaminated. Because of nearly 100% redundancy of the hot cells, this decontamination procedure shall have no impact on the efficiency of the hot cells. For the same reasons, no spares shall be provided for the downstream equipment. The collection vessel shall be equipped with sampling, volume, density, and temperature-measuring devices. Provision shall be made to neutralize the contents of the collection vessel with nitric acid or caustic soda, as required. Mechanical agitators shall be used to keep solids in suspension and also help the neutralization process. Defoamer shall be added to prevent foaming. Offgas shall be vented to HVAC.

(b) HAW/RHTRU Liquid Evaporator

The high-activity liquid radwaste shall contain approximately 0.1 wt% suspended and dissolved solids. The solids are primarily Turco decon detergents, crud, and foam. The solids shall be concentrated by the evaporator. Evaporation was selected instead of reverse osmosis because it is able to handle large amounts of dissolved solids more effectively. A thin-film evaporator was selected because of its ability to process hard-to-handle materials, materials that cannot be processed economically or at all in other types of evaporators. Finally, the horizontal evaporator was selected instead of a vertical evaporator to minimize cost and also for ease of access and maintenance to reduce personnel exposure to radiation (ALARA). The bottoms products from the evaporator shall be approximately 25 wt% solids. The HAW/RHTRU evaporator bottoms product shall be sent to the HAW/RHTRU slurry tank in the high-activity solid radwaste system. Saturated steam at 50 psig is used as the evaporative medium. The condensate return shall be monitored for contamination.

(c) HAW/RHTRU Evaporator Overhead Condenser

The overhead vapor from the evaporator shall be cooled in a condenser to produce condensate. The condenser shall be a

shell-and-tube type condenser. The overhead vapor shall enter the tube side and cooling water in the shell side to condense the vapor. The HAW/RHTRU evaporator overhead condensate shall be monitored for contamination. The cooling water return shall also be monitored for contamination.

(d) HAW/RHTRU Evaporator Condensate Hold Tank

The condensate produced in the condenser shall be collected in the hold tank. The hold tank shall be equipped with temperature and liquid level measuring devices. The collected condensate is sent to the HAW/RHTRU ion exchanger for further cleaning and deionization. Vacuum pumps shall be provided to maintain a vacuum. They shall discharge to HVAC.

(e) HAW/RHTRU Ion Exchanger

The condensate from the evaporator shall be further cleaned in a mixed-bed ion exchange column so that the treated water can be recycled within the facility. Spent resin shall not be regenerated because of the minimum consumption of resin. Regeneration would produce liquid radwaste, which would have to be further treated. When the combustible resin has become fully spent, it shall be sent to the high-activity solid radwaste system. The cleaned condensate leaving the ion exchanger shall be checked for contamination before recycle.

2.6.2.B. Solid Radwaste System

The solid radwaste system shall consist of two subsystems: (1) the LLW/CHTRU solid radwaste system and (2) the high-activity solid radwaste system.

1. LLW/CHTRU Solid Radwaste System

Refer to Drawing H-3-56708, Solid Radwaste System Flow Diagram, which forms the basis for design.

(1) Overall System Selection. The selection of an LLW/CHTRU solid radwaste system is based on the following assumptions:

(a) All waste not proven to be low level is CHTRU.

(b) Less than 25% by volume of combustibles shall be contained in each waste drum.

(c) Noncombustible radwaste shall be decontaminated before packaging if its surface dose rate is too high to be contact-handled and most of the decontaminated waste shall become contact-handled.

(d) LLW evaporator bottoms slurry shall be used in grout mix for solidification.

(e) HEPA filter assembly for hot cells and remote handled equipment maintenance room shall have three groups of filters: 2-stage in-cell filters, first-stage testable filters, and 2-stage Zone 1 and 2 final filters.

The in-cell filters and the first-stage testable filters are considered to be HAW/RHTRU, and the Zone 1 and 2 final filters are CHTRU waste. A set of prefilters and HEPA filters, located at the glove boxes in the radwaste area and in the analytical laboratory, are also considered CHTRU waste. Zone 3 and 4 final filters and all the other contaminated filters are low-level waste (LLW).

(f) Four LLW HEPA filters and/or CHTRU HEPA filters shall be compacted in a filter compactor/packaging unit, baled, and packaged in 55-gal drums.

(g) A drum interrogator shall be used to separate drums with LLW from CHTRU drums by determining the presence of TRU material by gamma pulse-height analysis.

(h) The LLW shall be stored onsite temporarily, and then sent to an offsite disposal site. The CHTRU waste shall be stored in onsite storage facilities.

(2) Feed Rate

(a) Combustibles

The annual generation rate of combustible LLW/CHTRU radwaste has been estimated to be 15,000 lb. The composition of the combustibles is estimated as shown in Table 2.6-1.

Table 2.6-1 - Composition of Combustible LLW/CHTRU Radwaste

Component	Rate (lb/yr)	wt%
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
	15,000	100.0

The assumptions made to estimate the combustibles are as follows:

- Cotton Products
  - An average of 55 operators per day shall be clothed in reusable cotton coveralls, caps, gloves, and boots.
  - Each operator wears two complete outfits per shift.
  - The facility will operate three shifts per day, 365 days per year.
  - Supplies for 1 wk are in stock and the stocked items will be worn out in a year.
  - The total weight of a cotton coverall, a cap, a pair of gloves, and a pair of boots is estimated at 2.7 lb.
- Latex
  - Both reusable rubber shoe covers and dry box gloves are made of latex.
  - 55 operators per day use the reusable shoe covers.
  - Each operator wears two shoe cover sets per shift.
  - The facility operates three shifts per day.
  - Considering that operators will wear shoe covers during the maintenance and decon operations, the operators will wear shoe covers 365 days/yr.
  - One pair of shoe covers weighs 1-1/2 lb.
  - For the estimate of number of dry box gloves disposed, an average of 30 glove boxes are operating every day.
  - The average useful lifetime for the gloves and shoe covers is 3 months.
  - Gloves weigh 2 lb per pair.
- Vinyl
  - Disposable surgical gloves are made of vinyl.
  - An average of 55 operators per day wear the gloves; there are three shifts per day, and 365 days of operation per year.
  - Each operator wears four pairs of gloves per shift.
  - A box of 300 lightweight vinyl gloves (150 pairs) weighs 8 lb.

- Polyvinyl Chloride (PVC)

  - For bagout operation of spent HEPA filters and prefilters, the bags are made of PVC. Polyvinyl chloride materials are avoided whenever possible; however, PVC bags are the only ones available at a reasonable cost for the HEPA filter bagout operations. (See RTC-133 for price comparison.)

  - Bags for HEPA filters and prefilters weigh 4 and 1.75 lb each, respectively.

- Polyethylene

  - Disposable bags to collect combustible radwaste (such as smear papers, disposable surgical gloves, shoe covers, and dry box gloves) are made of polyethylene.

  - A box containing 70 disposable bags weighs 85 lb.

  - Each bag holds the following quantities: 1,000 smear papers and holders, or 100 pairs of surgical gloves, or 20 pairs of shoe covers, 15 pairs of dry box gloves, or 7 pairs of cotton products.

- Paper

  - The contaminated paper products generated are smear papers, their folders, and some swipes.

  - The total number of smears is 12,000 per year. The weight of smears is 1-1/2 lb for a box of 500. The folders weigh the same.

- Miscellaneous

  Miscellaneous combustible radwaste includes items generated on a nonroutine basis, such as torn permeable protective clothing from decontamination operations; this item is estimated to be 1,900 lb/yr and is included as a contingency.

(b) Noncombustibles

Suspected CHTRU noncombustibles are generated from the contaminated areas in the R&H Building, such as the liquid and solid radwaste areas.

The suspected CHTRU noncombustibles generated have been estimated at 5,000 lb/yr. The suspected CHTRU waste consists of 3,500 lb/yr of failed equipment; 1,000 lb/yr of small tools and metal items, such as ruptured drums; and 500 lb/yr of miscellaneous contaminated items.

(c) HEPA Filters and Prefilters

The total number of CHTRU and LLW HEPA filters generated has been estimated as follows:

CHTRU HEPA filters	543/yr
LLW HEPA filters	235/yr
Total	778/yr

Also, 1,079 prefilters are generated annually from the R&H Building. Of these, 618 are considered CHTRU and the rest are low-level waste.

A prefilter and two HEPA filters in the Zone 1 and 2 final filter assembly are CHTRU and changed annually. Filters located at the glove boxes in the Zone 2 area are also changed annually.

Time intervals for filter changes are for volume estimates and sizing. A filter shall be changed on a pressure-drop or radiation- load basis.

The HEPA filters and prefilters collected from the Zone 3 and 4 final filter and all other contaminated filters are considered LLW.

(d) LLW Evaporator Bottoms Slurry

The LLW or suspected CHTRU evaporator bottoms slurry shall contain 25% solids by weight, most of which are dissolved in the slurry. The annual amount of the slurry is 23,004 lb.

(e) Spent Resin

When 108 lb of spent resin is collected from the low-level liquid radwaste system, it shall be slurried with 507 lb of water, and the slurry, with 18% solids by weight, shall be pumped to the spent resin slurry tank in the HAW solid radwaste system. The total annual rate shall be 1,447 lb of the spent resin slurry.

(3) Major Equipment

(a) The LLW/CHTRU evaporator bottoms slurry tank is sized for a 60-day storage capacity. No spare shall be provided because the evaporator bottoms can be recycled should there be any problems with the tank; also, the slurry requirement for grout mixing is intermittent. A mechanical agitator shall be used to keep solids in suspension. Offgas shall vent to HVAC.

(b) The LLW/CHTRU slurry feed pump is sized for 10 gpm so that the pump can be operated for 2.5 minutes for each batch of grout, which is enough to fill one drum. A spare pump is provided to

prevent interruptions to the grout-mixing operation should there be a pump failure. Double-diaphragm, air-operated pumps are selected because no rotating parts are involved. Also, no mechanical seal is required, and the pumps can run dry without any damage to the pumps.

2. HAW/RHTRU Solid Radwaste System

Refer to Drawing H-3-56708, Solid Radwaste System Flow Diagram, which forms the basis for design.

(1) Overall System Selection. The selection of the HAW/RHTRU solid radwaste system is based on the following assumptions:

(a) HAW/RHTRU evaporator bottoms slurry shall be used in grout mix for solidification.

(b) The in-cell filters and the first-stage testable filters are considered to be HAW/RHTRU.

(c) HAW/RHTRU HEPA filters shall be processed through a HEPA filter cutter/compactor to cut out HEPA media from frames. The frames shall be removed from the cutter/compactor, and sent to the shear machine, where they are sheared. The cutout HEPA media shall be compacted in the cutter/compactor unit, and stored in 55-gal drums. Each drum shall contain six compacted HEPA media or six sheared frames.

(d) Highly contaminated noncombustibles, such as failed pumps, tools, etc., shall be decontaminated before being placed in a drum. Most of the decontaminated noncombustibles shall become contact-handled waste.

(e) High-activity solid radwaste shall be stored onsite at the storage facility.

(2) Feed Rate

(a) Noncombustibles

The HAW/RHTRU noncombustible radwaste is generated from hot cells and the remote handled equipment maintenance room.

The total HAW/RHTRU noncombustibles generated have been estimated to be nil. The majority of HAW/RHTRU noncombustibles are considered to be failed equipment and tools.

(b) HAW/RHTRU HEPA Filters and Prefilters

The total number of HAW/RHTRU HEPA filters generated has been estimated to be 4,000 per year.

The HAW/RHTRU HEPA filters are collected remotely from hot cells and from the equipment maintenance room. They are changed biweekly or monthly.

The first-stage testable HEPA filters are also considered HAW. They are changed quarterly or semiannually.

Time intervals for filter changes are for volume estimates and sizing. A filter shall be changed on a pressure-drop or radiation-load basis.

(c) HAW/RHTRU Evaporator Bottoms Slurry

The HAW/RHTRU evaporator bottoms slurry shall be collected in the HAW/RHTRU slurry tank.

The HAW/RHTRU slurry shall be received intermittently. The HAW/RHTRU slurry contains 25 wt% solids. The annual production of the slurry is 7,400 lb.

(d) HAW/RHTRU Spent Resin

When spent resin is generated from the HAW/RHTRU liquid radwaste system, it shall be slurried with water, and the slurry, with 20% solids by weight, shall be pumped to the spent resin slurry tank in the HAW/RHTRU solid radwaste system. The total annual rate shall be 1,499 lb of the spent resin slurry.

(3) Major Equipment

(a) The HAW/RHTRU slurry tank shall be sized for 60-day storage capacity. No spare shall be provided because the slurry in the tank can be recycled or the evaporator operation can be stopped should there be any problems with the slurry tank. Offgas shall vent to HVAC.

(b) The HAW/RHTRU drumming station package shall include a HAW/RHTRU evaporator bottoms slurry metering pump, a spent resin slurry metering pump, and equipment for uncapping the 55-gal drum, filling the drum with the slurry, recapping, clamping, tumbling, and unclamping. Approximate process time per drum is 20 minutes.

(c) The HAW/RHTRU HEPA filter cutter/compactor shall be designed to handle 24- x 24- x 11-in. HEPA filters. The cutter/compactor shall be able to cut HEPA filter media cleanly from the filter frame and compact the media.

(d) The shear machine shall shear the metal HEPA filter frames.

(e) The spent resin slurry tank shall be sized for 6-month HAW/RHTRU spent resin slurry storage capacity. No spare shall be provided because the spent resin transfer is intermittent. Offgas shall vent to HVAC.

2.7 MECHANICAL PROCESS

2.7.1 DESIGN CRITERIA

The MRS Facility must satisfy the following requirements:

(1) It must be capable of decontaminating shipping cask exteriors, shipping containers, and vehicles; and treating washwater and other wastes for disposal.

(2) It must be capable of safely storing for offsite disposal all low-level radioactive wastes resulting from operations at the facility while handling spent fuel, HLW, and TRU.

(3) It must place intact or consolidated fuel assemblies in canisters, backfill with inert gas, seal-weld, leak test, ultrasonic test weld, decontaminate, and label canisters.

(4) The R&H Building shall be designed to permit external cleaning, decontamination, and inspection of the transportable metal (dual-purpose) cask.

2.7.1.A. Support Functions

The supporting functions that shall be provided for in the R&H Building are as follows:

(1) Treatment and handling of radioactive wastes generated by operations performed at the MRS Facility

(2) Aqueous makeup and chemical storage of cleaning and decontamination chemicals

(3) Materials receiving and storage

(4) Personnel decontamination

(5) Effluent monitoring and sampling

(6) Fire protection systems

(7) Utilities systems

(8) Protective apparel laundry

(9) Analytical laboratory

(10) Process control

2.7.1.B. Service and Process Areas

The service and process areas of the R&H Building shall be furnished with the following services as applicable:

- Safety showers and eyewash stations on sanitary water
- Sanitary (potable) water - hot and cold
- Process water - hot and cold
- Deionized water
- Vacuum (HEPA filtered)
- Compressed air
- Breathing air
- Instrument air
- Inert gas
- Other gas systems as required
- Vacuum air sampling
- Steam
- Process sewer
- Process vent
- Radioactive waste system
- Decontamination solutions

The building shall be designed with sufficient space to accommodate additional piping and services at some future time. The office and other portions of the building shall be provided with sanitary water, which shall be obtained from the central water treatment plant, and shall have appropriate drains. A separate water system, isolated from the sanitary system by backflow preventer, shall provide water for process or service areas. Sanitary water shall be routed to safety showers and eyewash stations via a separate line fed from the main sanitary water source. Breathing air should be provided by oil-free compressors in the facility; however, alternative methods of providing breathing air may be substituted. Instrument and process compressed air is required. Vacuum systems serving contaminated zones shall be HEPA filtered before discharge. The filter(s) shall be upstream of the vacuum pump and monitored with automatic shutdown of the pump for a plugged filter.

Process vacuum and radiation monitoring vacuum air sampling systems for Zones 1 and 2 shall discharge into the building HEPA-filtered exhaust system upstream of the last two banks of filters. For Zones 3 and 4, the vacuum and sampling systems may discharge upstream of the last bank of filters.

Drains from restrooms, lunchrooms, and other similar areas in ventilation Zone 4 shall be routed to the sanitary sewer. Floor drains and service drains from areas in ventilation Zones 2 and 3 shall be connected to the process sewer. Process sewer effluents shall be collected and monitored prior to release to disposal facilities. If concentrations of radioisotopes

exceed 10 CFR 20 or DOE Order 5480.1A limits, the effluent shall be diverted to the radioactive waste system. Drains from the shielded process cells and other radioactive waste streams shall be routed to the radwaste facilities for processing and disposition. Personnel decontamination sinks and showers and other similar streams shall also be connected to the radwaste system.

Process support gas systems shall be provided from an external gas cylinder manifold and storage area.

2.7.1.C. Utility Systems

1. Vehicle Washdown System. The incoming air-control vestibule(s) shall be equipped to manually clean the cask and transport vehicles of road grime as necessary.

2. Steam System. Consideration shall be given to a central powerhouse equipped with steam boilers to provide steam for heating and for process uses. Steam from the powerhouse shall be distributed via insulated underground lines to the R&H Building and others as appropriate. DOE regulations must be considered when selecting the type of fuel to be used. Condensate return should also be evaluated. Provisions should be included for delivery and stockpiling of fuel.

2.7.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.7.2, the following criteria shall be used.

2.7.2.A. Decontamination Systems

Refer to Drawing H-3-56709, Decon Solution Makeup System Flow Diagrams, which forms the basis for design.

1. Decontamination. The primary function of the decon solution makeup and distribution system shall be to provide a centralized area for preparation and supply, on a daily basis or as required, of decon solution, nitric acid, and caustic soda solutions needed by the various users in the R&H Building. This system shall be located in the aqueous makeup area, segregated from the contaminated, radioactive processes.

Turco 4324 NP concentrate (or equivalent) shall be used for preparing at least one decon solution in a concentration that shall be needed for normal decontamination operation. Turco 4512A concentrate (or equivalent) shall be used for preparing decon solution that shall be used for foam decon applications. Deionized water from the deionizer system shall be used for solution preparation and for high-pressure water rinses. Nitric acid and caustic solutions shall be used selectively for decontamination work on heavily crudded or contaminated equipment, decommissioning, and neutralization of radwaste solutions. Steam shall be made available at the decon stations for cleaning.

Four makeup tanks of 250-gal capacity each shall be installed in the aqueous makeup room for solution preparation; two tanks shall be dedicated for decon solutions. The other two tanks shall be used for preparing nitric acid and caustic soda solutions, respectively, or they may also be used for decon solution interchangeably.

Steam coils for solution heating shall be furnished to heat the decon solution temperature to about 160°F, which may be required for effective decontamination. Each tank shall have a pump and a common spare that shall deliver the solution to the users. Agitators shall be furnished with the tanks for solution mixing.

2. Decontamination of Remote Hot Cells. Hot cells shall be fully decontaminated only as necessary to permit essential manned entry. A procedure for frequent remote vacuuming shall be followed to prevent the accumulation of large quantities of contaminants. Full decontamination shall involve:

(1) Remote removal of highly contaminated equipment, as well as removal of equipment that, because of its size or location, interferes with the efficiency of subsequent decon operations.

(2) Remote vacuuming of loose contamination, using a HEPA filter portable vacuum cleaner.

(3) Remote application of foamed decon agent (Turco 4512A) produced by a portable compressed air foamer, using plant air and pumped decon agent to educt and mix foaming agent (Turco 5865) for discharge from a hose nozzle.

(4) Remote wet vacuuming of foam drainage.

(5) Remote high-pressure water rinse.

Following these operations, a remote radiation survey shall be taken to determine whether the cell is safe for personnel entry to perform detailed surveys and final contact decontamination of hot spots, or whether additional remote decontamination operations are necessary. Table 2.7-1 summarizes the decontamination techniques and frequencies recommended for remote areas and equipment.

3. Decontamination of Contact Maintenance Rooms. Limits shall be established for the allowable average contamination level of contact maintenance rooms. Upon reaching this level, the room shall be fully decontaminated down to a predetermined "clean" level. In addition, "hot spots" shall be decontaminated as they are discovered, and regularly scheduled vacuuming and floor mopping shall be performed. Table 2.7-2 summarizes the decontamination techniques and frequencies recommended for low-level radiation areas and equipment.

2.7.2.B. Vehicle Washdown System

Refer to Drawing H-3-56710, Water Treatment System Flow Diagram, which forms the basis for design.

Table 2.7-1 - Decontamination of High-Activity Radiation Areas and Equipment

Area	Frequency[a]	Technique	Liquid Application Rate
Process cells	All surfaces: 5 years	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft
Maintenance cell	All surfaces: 5 years	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft
High-activity radwaste cell	All surfaces: 5 years	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft
Remote equipment decon room	All surfaces: semiannually	Remote: high-pressure rinse. Contact: as required.	1.0 gal/sq ft
Remote handling air filtration cell	All surfaces: 5 years	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse. Contact: as required.	1.08 gal/sq ft
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
Crane maintenance rooms	All surfaces: annually	Contact: dry vacuum, foam, wet vacuum, high-pressure rinse.	0.5 gal/sq ft
Process cell ventilation ducts between nontestable and testable HEPA filters	Internal surfaces: 5 years	Remote: self-propelled spray hose.	1.0 gal/sq ft

[a]Actual decontamination shall be on an "as-required" basis. Frequencies given are for calculation purposes only.

Table 2.7-1 (Contd)

Area	Frequency	Technique	Liquid Application Rate
Drum decon cells	All surfaces: 5 years	Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft
Canyon cells	All surfaces: 5 years	1. Floor near canister upender equipment: Remote: dry vacuum, foam, wet vacuum, high-pressure rinse.	1.08 gal/sq ft
		2. Other surfaces: Contact: vacuum, mop, and rinse.	1.0 gal/100 sq ft
Equipment			
Cranes	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. Freon spray or electropolisher as required.	1 gal/sq ft
Sealed storage canisters	3,253 canisters/yr	Remote: Freon.	-
In-cell equipment components	Every 2 weeks	Remote: high-pressure rinse, electropolisher or Freon spray as required.	1 gal/sq ft
Secondary waste drums	1,582 drums/yr	Remote: Freon	-
Solid radwaste drums (assume 50% contaminated)	17 drums/yr	Remote: high-pressure rinse.	20 gal/drum
HAW filter drums	676 drums/yr	Remote: Freon	-

Table 2.7-1 (Contd)

Area	Frequency	Technique	Liquid Application Rate
Manipulators (70, once every 2 weeks)	1,820 decons/yr	Remote: Freon.	-
Tool decon	As needed	Remote: Freon or electropolisher as required.	-

Table 2.7-2 - Decontamination of Low-Level Radiation Areas and Equipment

Area	Frequency	Technique	Liquid Application Rate
Cask handling and decon	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Loadout and decon rooms	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Contact repair room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Weld, test, and decon equipment room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Low-level radwaste (solid and liquid)	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Decon rooms (contact handled)	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Laundry room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Analyzer room	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
Analytical laboratory	Floor: weekly All surfaces: biannually	Vacuum, mop, and rinse	1 gal/100 sq ft
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

Incoming vehicles and shipping containers shall be washed, as required, to remove road grime and mud before the vehicles are admitted to the R&H Building for unloading of the containers.

Process water and steam shall be provided for this service. It is assumed that only 1% of the incoming vehicles may require washing.

A combination of process water and steam shall be used for the vehicle wash during cold days. The washdown water shall be collected in the area sumps and monitored for contamination before discharge to the process sewer. If contaminated, this water shall be diverted to the low-level liquid radwaste system.

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

2.7.2.C. Welding Station Cleaning and Testing System

Refer to Drawing H-3-56712, Air, Gas, and Solvent Systems Flow Diagram, which forms the basis for design.

A total of 3,253 canisters, processed in the hot cells, shall be welded per year (365 days). During a 24-hr period, a total of nine canisters may be welded, cleaned, and tested for leaks. The welding stations shall contain a volume of 69.2 cu ft (empty). Argon shall be supplied to the plant as a liquid, which shall be vaporized as needed, and helium shall be supplied from cylinders. They shall be mixed in the lines to the vacuum chambers. The flow controllers for the gases shall be by ratio control.

The volume of argon-helium required shall be based on the following:

Empty Chamber Volume (scf)	Cycles/ Day	Gas Rate (scf/day)
69.2	9	622.8

For 30 days, 18,684 scf of argon-helium shall be required. The mixture shall be 90% argon and 10% helium by volume.

The solvent used for cleaning and displacing the argon-helium from the annular space in the vacuum chamber shall be trichlorotrifluoroethane ($C_2Cl_3F_3$), also known as Refrigerant-113 (R-113). This compound has a boiling point of 117.5°F at atmospheric pressure, and thermal decomposition of the solvent is initiated at 500°F in the presence of carbon or stainless steel.

The solvent shall be recycled in the process. It shall be used to clean the outside of canisters. Then the solvent removed from the vacuum chamber by gravity shall go to a surge tank, from which it shall be filtered and pumped to the evaporator. Solvent vapor shall be condensed and returned to the feed tank. It is assumed that 0.5% of the solvent shall be lost in the process.

The volume of liquid solvent required shall be 623 cu ft per day. At a 0.5% loss, 3.11 cu ft of liquid solvent shall be required for makeup per day, or 93.3 cu ft per month. The basis for solvent storage capacity is 60 days' storage. In addition, sufficient solvent shall be provided to fill the feed and surge drums. Each drum shall have adequate capacity for the solvent circulation needed for 1 day. The feed and surge drums shall be 7 ft-6 in. dia and 17 ft-0 in. high.

The 0.5% solvent vapors estimated to be lost shall be recovered by the solvent recovery system. The vapors shall be absorbed on a carbon bed in the solvent absorbers. When saturated, the absorber is steam-regenerated. The steam passes through the bed, stripping the concentrated solvent from the carbon. The resulting steam-solvent vapor mixture is condensed, and the condensate flows to a decanting tank, where the solvent is decanted from the water and recycled to the solvent feed drums. It is estimated that 95% of the vapors shall be recovered.

The process vacuum system shall consist of a diffusion pump connected in series with a two-stage mechanical booster pump, which are connected to the welding process chamber. The pumps, running simultaneously, shall create a vacuum up to 1×10^{-4} torr. HEPA filters shall remove all contaminated particles from the line during the evacuation process. The exhaust gases shall be sent to the solvent recovery system, and then to the HVAC system.

Also, there shall be another welding station, which shall be used for lid welding of the overpacked HLW canisters (estimated at three HLW canisters per year).

2.7.2.D. Steam and Condensate Systems

Refer to Drawing H-3-56711, Steam and Condensate System Flow Diagram, which forms the basis for design.

(1) Steam

A central steam plant was considered initially for the entire MRS Facility. However, results of an evaluation indicated that this would be uneconomical and operationally more complicated, making independent heating systems for the support buildings and a dedicated steam plant for the R&H Building the more economical and efficient alternate. (Refer to P-PNL-095, August 2, 1984, MRS Facility Central Plant Evaluation.)

Steam shall be used for all process, utility, and building heating requirements in the R&H Building. The steam shall be supplied by three 50-psig, packaged-type, fire tube steam boilers capable of firing either fuel oil or gas and with a 4:1 turndown. Depending upon the load, two boilers shall normally be operating and one spare. The boilers shall be constructed in accordance with the latest edition of the ASME Boiler and Pressure Vessel Code.

Boiler feedwater shall be softened or DI water, and shall be deaerated before feeding to the boilers. The boiler feedwater shall be chemically treated to control corrosion and scaling.

Steam shall be provided to the following:

LLW liquid evaporators
HAW/RHTRU liquid evaporator
Deaerator
Decontamination stations
Vehicle washdown
Utility stations
HVAC heating (building)
Ejectors
Vessels and tanks with steam-heating coils
Hot water heater

(2) Condensate

A condensate collection system shall be provided to recover steam condensate from all of the steam-heated equipment, steam traps, and drainers throughout the R&H Building. The condensate shall then be returned to the deaerator, as boiler feedwater, in the Steam Generator Building.

2.7.2.E. Low-Level Radwaste Drain System

Refer to Drawing H-3-56713, Sewer and Drain Systems Flow Diagram, which forms the basis for design.

The low-level radwaste drain system shall consist of sumps that collect contaminated waste and deliver it via pumps or steam-driven ejectors to the low-level liquid radwaste system for processing. Low-level radwaste is collected from three categories of drainage: (1) decontamination of exposed surfaces of selected contact handled rooms, (2) decontamination of selected equipment, and (3) liquid drainage from selected processes. For items 1 and 2, Table 2.7-2 delineates specific areas, frequencies, techniques, and application rates of decontamination fluids. The drainage rate is assumed equal to the application rate. Liquid drainage from processes (item 3 above) is assumed to consist of the following: 1.5 gpd from low-level liquid radwaste, 100 gal/week from the health physics area (including showers and eyewashes), and 90 gpd of drainage from the analytical laboratory.

2.7.2.F. High-Activity Radwaste Drain System

Refer to Drawing H-3-56713, Sewer and Drain Systems Flow Diagram, which forms the basis for design.

The high-activity radwaste drain system shall consist of sumps that collect contaminated waste and deliver it via steam-driven ejectors to the HAW/RHTRU liquid radwaste system for processing. High-activity radwaste is collected from three categories of drainage: (1) decontamination of exposed surfaces of selected remote cells and rooms, (2) decontamination of selected equipment, and (3) liquid drainage from selected processes. For items 1 and 2, Table 2.7-1 delineates specific areas, frequencies, techniques, and application rates of decontamination fluids. The drainage rate is assumed equal to the application rate. Liquid drainage from processes (item 3 above) is assumed to consist of the following:

Source	Frequency	Drainage
Cask offgas condensate	2,266 casks/yr	10 gal/cask
High-activity liquid radwaste drains	Daily	1 gal/day

2.7.2.G. Contaminated Laundry System

The contaminated laundry system shall be divided into water washing and Freon drycleaning. Contaminated rubber clothing and respirators shall be water washed only. Contaminated clothing may be either water washed or drycleaned. To minimize the liquid radwaste generated, contaminated clothing shall be mainly Freon drycleaned. However, it may be necessary for the Freon-cleaned clothing to be water washed periodically to remove body odor and to reduce the buildup of water-soluble contaminants. The laundry water shall be filtered, collected in a tank, monitored for radioactive contaminants, and then discharged to the process sewer. If the concentration of the radioactive contaminants exceeds the limits set in 10 CFR 20, Appendix B, the contaminated water shall be diverted to the low-level liquid radwaste system.

2.7.2.H. Deionizer System

Deionized water for decontamination solution preparation, decontamination rinse, final HEPA filter spray, and laundry system operation shall be supplied.

2.7.2.I. Water Softener System

Softened water shall be provided for boiler feedwater makeup. A normal throughput of 48 gpm shall be supplied.

2.7.2.J. Air Systems

Refer to Drawing H-3-56712, Air, Gas, and Solvent Systems Flow Diagram, which forms the basis for design.

Plant, instrument, and breathing air shall be provided.

Breathing air shall be provided to all areas where life-support equipment shall be required. The air supply shall meet Grade E quality requirements in accordance with the Compressed Gas Association (CGA) Bulletin G7.1, Commodity Specification for Air. It shall be capable of being monitored for purity during its operation. Hose couplings and manifolds shall be designed to preclude connection of respiratory protective equipment to any system other than the breathing air system. Delivery pressure at hose couplings shall be 70 psig. Respiratory protective equipment shall have emergency egress, self-contained air supplies. The air intake point shall be located away from any combustion or ventilation exhausts to ensure that high-quality air is used for breathing purposes.

A high-pressure bottle-filling system shall be provided to recharge portable, 4,500-psig SCBA air-pack cylinders. This shall be a complete, self-contained vendor package consisting of a compressor, aftercooler, purification filters, air quality monitor, controls, and water bath bottle-filling station.

2.7.2.K. Potable and Process Water System

Refer to Drawing H-3-56710, Water Treatment System Flow Diagram, which forms the basis for design.

Potable water shall be provided for fire suppression, drinking, restrooms, eyewash stations, safety showers, and the process water system (through a backflow preventer). Process water shall supply boiler makeup water, process hot and cold functions, and utility stations.

2.7.2.L. Process Sewer System

Refer to Drawing H-3-56713, Sewer and Drain Systems Flow Diagram, which forms the basis for design.

A process sewer shall be provided for boiler blowdown and drainage, cooling tower blowdown, nonoily floor and equipment drains from the cooling tower, chiller equipment room, noncontaminated spent washwater from vehicle washdown and laundry areas, etc.

2.7.2.M. Cooling Tower System

A closed-loop, evaporative-type, water-cooling tower system shall provide cooling water for all process and utility cooling requirements in the R&H Building. The cooling tower shall supply cooling water to the HAW/RHTRU and LLW radwaste condensers, the cask offgas condenser, the HVAC refrigerant

condensers, solvent system condensers, and the plant air compressor aftercooler. The cooling loop pressure shall be maintained higher than the process system pressure to minimize radioactive contamination caused by leaks. As a safety precaution, monitoring equipment shall be installed on the water outlet of each equipment item in radioactive service in the loop to detect any radioactive contamination in the system.

Potable water shall be used for makeup to the cooling tower. The cooling tower design is based on the HVAC refrigerant condenser use of 3 gpm/ton. A water-treatment program shall be implemented to maintain water quality and minimize corrosion and scaling in the equipment.

2.7.2.N. Air Sampling System

Refer to Section 2.8.2.H.

2.8 INSTRUMENTATION AND CONTROL

2.8.1 DESIGN CRITERIA

The R&H Building shall include equipment for remote receiving, monitoring, identifying, disassembling, consolidating, and packaging spent fuel; and densifying, packaging, and handling spent fuel hardware and site-generated wastes. Spaces and equipment shall also be designed to receive and handle canisters of HLW and RHTRU, and to ship these materials offsite and/or load them out for onsite storage.

Radioactive waste treatment facilities shall also be included. All potentially contaminated effluent streams shall be monitored and treated in accordance with environmental standards listed in Section 1.8.1.A before release.

The facility design shall limit direct radiation exposure of onsite and offsite personnel within the limits established in 10 CFR 72, DOE Order 5480.1A, and other applicable regulations. DOE Order 5480.1A requires as a design objective that operating personnel exposure levels shall be less than one-fifth of the permissible dose equivalent limits promulgated by the order.

2.8.1.A. Cask Monitoring

Shipping casks (and transportable metal storage casks when/where appropriate) containing spent fuel, HLW, and RHTRU shall be received by rail or truck in the R&H Building at the incoming air-control vestibule and where the vehicles will be washed down, if necessary. They shall then be moved into the cask handling and preparation area, where:

(1) Impact limiters and protective covers are removed from the cask and temporarily stored.

(2) The cask exterior is checked for contamination and, if necessary, decontaminated.

(3) Interior gases are sampled

2.8.1.B. Canister Monitoring

Each intact or previously canistered spent fuel assembly, HLW, or RHTRU canister removed from the cask is then identified for inventory or accountability, and either processing is initiated or the fuel assembly or waste package is placed in the in-process lag storage. The fuel assembly hardware is densified and placed in drums or canisters. The canisters of consolidated fuel are then moved to a welding station, where the air is removed and replaced with an inert atmosphere, and the covers are welded onto the canisters. Next, the welds are inspected and tested for integrity.

The canisters are then checked for contamination and cleaned, if appropriate; the surface temperatures and radiation levels are recorded.

After removal from the shipping cask, HLW and RHTRU canisters are identified, checked for contamination, decontaminated if required and/or overpacked if necessary, checked for temperature and radiation levels, and transferred to a shipping cask for transport to a repository, a sealed storage cask, or a shielded transporter for movement to the storage facility.

2.8.1.C. Support Functions

The supporting functions that must be provided for in the R&H Building are as follows:

(1) Aqueous makeup and chemical storage of cleaning and decontamination chemicals

(2) Effluent monitoring and sampling

(3) Process and building systems monitoring and control

(4) Building alarm systems (including explosion detectors)

(5) Inventory control systems

(6) Security surveillance systems

(7) Facility security

(8) Utility systems

(9) Treatment and handling of radioactive wastes generated by operations performed at the MRS Facility

(10) Analytical laboratory

(11) Radiation protection

(12) Process control

(13) Room and duct air sampling

Viewing windows and closed-circuit TV (CCTV) equipment shall be provided to monitor process and maintenance activities.

2.8.1.D. Control Room

The control room of the R&H Building shall be one of the supporting areas that receive the readout from the process, monitoring, utility, and HVAC control systems. Other control areas may be established at operating stations and mechanical rooms for equipment surveillance and control.

2.8.1.E. Equipment

Handling equipment shall be provided in each of the shielded cells for reliably performing all prescribed operations, including in-cell equipment maintenance, decontamination, and removal. The equipment should include:

(1) CCTV equipment

(2) Hot-cell remotely operated cranes with a remote readout load cell

(3) Hot-cell process equipment must be designed for evacuating air from canisters and equipped for backfilling with inert gas, welding of canister and overpack lids, and inspecting and testing lid welds using ultrasonic and helium detection equipment.

2.8.1.F. Exhaust System

The exhaust system shall have test ports for sampling the exhaust air particulate distribution in size and content before and after the prefilter and for each stage of HEPA filters. Air sampling capability shall be provided to enable sampling or measurement of airborne radioactivity in each leg of the exhaust systems.

The first stage of testable HEPA filters serving the shielded process cells shall be equipped with radiation monitors.

All filtered exhaust air streams shall be discharged through a common exhaust stack. The exhaust stack effluent shall be sampled and monitored in accordance with the requirements of ANSI N13.10, and airflows shall be measured.

2.8.1.G. Service and Process Areas

The service and process areas of the R&H Building shall be furnished with the following services as applicable:

- Safety showers and eyewash stations on sanitary water
- Sanitary (potable) water - hot and cold
- Process water - hot and cold
- Deionized water
- Decontamination solutions
- Vacuum (HEPA filtered)
- Compressed air
- Breathing air
- Instrument air
- Inert gas
- Other gas systems as required
- Vacuum air sampling
- Steam
- Process sewer
- Process vent
- Sanitary sewer
- Radioactive waste system

Process sewer effluents shall be collected and monitored before release to disposal facilities.

Process support gas systems shall be provided from an external gas cylinder manifold and storage area. Explosion-detection devices shall be provided where appropriate.

Process vacuum and radiation monitoring vacuum air sampling systems for Zones 1 and 2 shall discharge into the building HEPA filtered exhaust system upstream of the last two banks of filters. For Zones 3 and 4, the vacuum and sampling systems may discharge upstream of the last bank of filters. The motors for these systems shall be connected to the standby power system.

2.8.1.H. Radiation Alarms

A neutron-sensitive criticality alarm system shall be included. Area radiation monitors shall be provided in service areas where the radiation dose rate may exceed 50 mrem/hr. These monitors shall be equipped to audibly and visually alarm if the unit fails. They shall activate both audible and visual alarms with a tone different from the failure tone when the radiation intensity exceeds a preset limit.

Areas occupied by personnel where the airborne radionuclide concentration might exceed maximum permissible concentrations listed in 10 CFR 20 Appendix B or DOE Order 5480.1, Change 2, Attachment XI-1 shall be provided with continuous monitoring devices that provide an audible and visual alarm when the concentration exceeds 30 MPC-hr. These monitors shall be equipped to visually and audibly alarm if the unit fails. Fixed air-monitoring and -sampling systems shall be provided to collect, monitor, and/or sample the air of areas occupied by personnel to determine the radioactive airborne particulate concentrations. Counting and analysis of samples shall also be performed.

2.8.1.I. Vacuum System

The vacuum system for the monitoring and sampling systems shall be centralized. Particulate collection filter assemblies shall be located as near the point of measurement as practicable. Sample heads shall be located to facilitate filter collection and changing. They shall be located to provide near-representative samples of airborne concentrations in a worker's breathing zone. All sample heads shall be detachable and shall have flow metering and regulating devices. The central system shall have full redundancy of air pumps with motors on standby power. Pump capacity shall be sufficient to provide a minimum pressure drop of at least 20 in. of water across each sample head when all sample heads are operating simultaneously, plus a 15% reserve capacity. Air collected through air monitors and samplers shall be discharged into the building filtered exhaust system upstream of the last bank of HEPA filters.

2.8.1.J. Evacuation Alarms

Audible building evacuation alarms shall be provided and shall be connected to an MRS Facility site evacuation alarm system. Evacuation alarms must conform to ANSI N2.3.

2.8.1.K. CCTV

A closed-circuit television system shall be provided for viewing of process cell operations from the control room and operating and service galleries.

2.8.1.L. Explosion Detection

Explosion-detection and alarm systems shall be provided where appropriate.

2.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 2.8.1, the following criteria shall be used.

2.8.2.A. Instrumentation and Controls

The instrumentation and controls provided for the R&H Building shall:

(1) Allow for safe and efficient operation of handling and processing equipment.

(2) Provide for safe shutdown integrity.

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

(4) Have the capability of being operated or shut down, when required, from remote locations.

(5) Have the capability of transmitting information to remote locations.

Monitoring, alarming, and surveying instrumentation shall be designed and used so that occupationally related radiation exposures in controlled work areas shall be limited 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 shall be designed so that exposures to offsite personnel in uncontrolled areas shall be 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 N8.3, N2.3, N13.10, N42.18, N13.4, and N323.

Controls for mechanized and automated remote-handling and processing equipment shall permit operation from remote locations, where required.

2.8.2.B. Radiation Monitoring and Alarms

The centralized radiation monitoring system shall operate continuously. It shall include detectors, transmitters, visual and audible alarms, and centralized and remote instrumentation for alarm status indication, logging, printout, and retransmission of alarm status information to remote locations.

The system shall be capable of providing both audible and visible, local and remote alarms if any radiation detector indicates a trend, alert, or high alarm (corresponding to high rate of approach to alarm, alert alarm, and high alarm conditions, respectively). The system shall also display the current status of any selected channel by front panel light indications of normal, maintenance, and failed conditions. Self-diagnostic means shall be used to detect internal component failures.

If any detector fails, a unique audible and visible alarm shall be generated.

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

2.8.2.C. Process CCTV

The process closed-circuit television (CCTV) system shall permit the monochrome viewing of handling and processing operations in the shielded cells and cask and shipping cask loading and unloading, HEPA filter changeout, and remote equipment maintenance operations in other areas of the R&H Building.

The pan, tilt, and zoom television cameras shall be located in high-radiation areas, and will be designed to be radiation-tolerant and to have remote-control capability. They shall also be designed to permit their removal for maintenance or replacement by remote-handling equipment.

The control room and local control areas shall have process TV monitors to provide operators with the capability to remotely observe the handling and processing operations of the R&H Building.

2.8.2.D. Distributed Control System

The Distributed Control System (DCS) and operator consoles shall be located in the R&H Building control room. It shall be interfaced with hot-cell local control panels, and shall 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 shall be remotely monitored and capable of being controlled by the DCS.

The operator consoles shall permit displays of current process status, process alarms, and radiation monitoring and alarms, and shall include the capability for control room operators to modify selected process operating parameters. The process cell supervisor shall be 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 shall be initiated by such occurrences as criticalities, process upsets, and administrative decisions.

An identical, redundant system, consisting of all of the same control room peripheral equipment, shall be located in the Site Services Building control room. The redundant DCS shall assume control when initiated by a self-diagnostic command or manually upon failure of the primary DCS.

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

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 shall be kept in the DCS central memory.

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

2.8.2.E. General-Purpose Computer Terminal

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

2.8.2.F. CHTRU/LLW Interrogation Assay System

The CHTRU/LLW interrogation assay system shall operate on demand. It shall be designed to provide remotely located operating personnel with characteristic emission rates for the purpose of discriminating between CHTRU and low-level, process-generated radwaste (LLW).

2.8.2.G. Criticality Alarm System

The neutron-sensitive criticality alarm system shall operate continuously. It shall include detectors, transmitters, visual and audible alarms, and centralized and remote instrumentation for alarm-status indication, logging, printout, and retransmission of alarm-status information to remote locations. System equipment shall conform to the requirements of NRC Regulatory Guides 3.41, 3.43, and ANSI Code N8.3.

The criticality alarm system shall 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 shall interface 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 fail 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 shall be generated.

2.8.2.H. Air Sampling System

The radioactive airborne particulate sampling system shall operate automatically and continously and shall conform to the following codes, regulations, and standards: ANSI N13.1, N13.10, 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 shall include 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 shall be designed to have full redundancy of air pumps with motors on standby power. Pumps shall be selected to provide a minimum 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 shall consist of two or more central vacuum stations drawing air through small-pore filters so that airborne particles shall be deposited on the filter surfaces. The filters shall be changed periodically, and the amount and type of radioactivity deposited during the sampling period shall be determined. The resulting concentrations determined by this procedure shall be 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.

2.8.2.I. Laboratory Analyzers

The laboratory analyzers - consisting of a multichannel analyzer (MCA), with alpha, beta, and gamma analysis capability; gas chromatograph; mass spectrometer; and infrared analyzer - shall be located in the analyzer room adjacent to the analytical laboratory. They shall be used for all routine and nonroutine analyses of process and environmental gas and liquid samples. Analyzers shall also be 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 shall be used for data interchange with the DCS.

2.8.2.J. Shipping Cask Monitoring Systems

After removal from the shipping cask, the HLW and RHTRU canisters shall be identified and checked for exterior surface contamination, temperature, and gross radiation levels. The shipping cask monitoring system shall monitor the offgases from shipping casks upon their arrival and interconnection with the R&H Building sample system. Although this shall be a dry gas monitoring system, a possibility exists that some entrained water may be transferred into the shipping cask during the loading operation. The vapor treatment

system in the R&H Building shall be designed to condense out up to 10 gal of high-temperature water vapor, which shall be transmitted to the LLW radwaste drain system. Any residual water shall remain in the cask during the return shipment of the cask. The gases shall then be monitored on an as-needed basis for beta and gamma emissions before releasing the gases to the offgas system. This fixed system shall monitor, indicate, and alarm as readout on the DCS.

2.8.2.K. Canister Monitoring System

After processing and inspection, the canisters containing consolidated fuel shall be tested for leaks, and checked for exterior surface contamination, temperature, and gross radiation level. This information shall be recorded.

2.8.2.L. HVAC Intake and Exhaust Monitoring and Control System

The HVAC system within the R&H Building shall be controlled and monitored by the DCS from the central control room or, alternatively, from the Site Services Building control room. Instrumentation shall be 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 shall be provided in each leg of the exhaust systems by means of test ports. The exhaust air particulate distribution shall be determined in this manner by laboratory analyses of these samples. Test ports shall be 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 shall be equipped with radiation area monitors. Locally indicating differential pressure gauges shall be provided across each testable filter stage.

All filtered exhaust air streams shall be discharged to the common exhaust stack. The stack shall be sampled and monitored for particulate radioiodine and fission product noble gases, primarily ^{85}Kr, and the flow rate shall be measured by the stack gas monitoring system.

2.8.2.M. Utility Offgas Monitoring System

The steam boiler offgas stack shall be sampled and monitored at the required location 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.

2.8.2.N. Evacuation Alarms

Separate and distinct audible and visible alarms shall be provided for process, security, criticality, radiation, fire, and building evacuation. They shall be initiated automatically or manually from the control room as required by the alarm scenario.

2.8.2.O. 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, shall be accomplished by the continuous radiation monitoring system. All potentially contaminated effluent streams shall be monitored before release. The data shall be transmitted to, and stored in, the DCS memory.

A sample connection shall be provided on all collection tanks, vessels, and sumps for sampling the liquid contents. All samples shall be analyzed by the R&H Building analytical laboratory. In high-radiation zones, these "grab samples" shall be taken remotely, and transported to the laboratory in shielded containers or by means of a pneumatic transport ("rabbit") system from within the process cells.

2.8.2.P Explosion Detection

If required, an explosion detection and alarm system shall be provided. The system shall include detectors, transmitters, audible alarms, and the capability for transmission to remote locations.

2.9 PIPING

2.9.1 DESIGN CRITERIA

Refer to Section 1.9.1 for general design criteria and the following specific design criteria for the R&H Building.

(1) The various parts of the building shall be designated Category I and Non-Category I and shall be designed accordingly.

(2) The incoming air control vestibule(s) shall be equipped to clean the cask and transport vehicles of road grime as necessary.

(3) In the cask handling and preparation areas, other operations include checking casks and vehicles for contamination and decontamination, if necessary, and sampling the cask interior gases.

2.9.1.A. Support Functions

The supporting functions that shall be provided for in the R&H Building are listed below:

(1) Personnel decontamination
(2) Utilities systems
(3) Protective apparel laundry
(4) Analytical laboratory
(5) Aqueous makeup and chemical storage of cleaning and decontamination chemicals

2.9.1.B. Other Building Services

(1) The service and process areas of the R&H Building shall be furnished with the following services as applicable:

- safety showers and eyewash stations on sanitary water
- sanitary (potable) water - hot and cold
- process water - hot and cold
- deionized water
- decontamination solutions
- vacuum (HEPA filtered)
- compressed air
- breathing air
- instrument air
- inert gas
- other gas systems as required
- steam
- process sewer
- process vent
- sanitary sewer
- radioactive waste

(2) The building shall be designed with sufficient space to accommodate additional piping and services at some future time. The office and other portions of the building shall be provided with sanitary water, which shall be obtained from the central water treatment plant, and shall have appropriate drains. A separate water system isolated from the sanitary system by backflow preventer shall provide water for process or service areas. Sanitary water shall be routed to safety showers and eyewash stations, via a separate line fed from the main sanitary water source.

(3) Breathing air should be provided by oil-free compressors in the facility; however, alternative methods of providing breathing air may be substituted. Instrument and process compressed air is required.

(4) Drains from restrooms, lunchrooms and other similar areas in ventilation Zone 4 shall be routed to the sanitary sewer. Floor drains and service drains from areas in ventilation Zones 2 and 3 shall be connected to the process sewer. Process sewer effluents shall be collected and monitored prior to release to disposal facilities. If concentrations of radioisotopes exceed 10 CFR 20 or DOE Order 5480.1A limits, the effluent shall be diverted to the radioactive waste system. Drains from the shielded process cells and other radioactive waste streams, where not exposed, shall be routed through doubly encased lines (original line inside a secondary encasing line) to the radwaste facilities for processing and disposition. Personnel decontamination sinks and showers and other similar streams shall also be connected to the radwaste system.

(5) Process support gas systems shall be provided from an external gas cylinder storage area. Explosion-detection devices shall be provided where appropriate.

(6) The building areas shall be divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. The zones are depicted in Table 2.11-1.

2.9.2 BASIS FOR DESIGN

2.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

1. Plumbing Systems for Category I and Non-Category I Structures.

(1) Various parts of the building shall be designated Category I and Non-Category I.

(2) The plumbing systems in the Category I structure shall be designed to withstand the design basis earthquake (DBE) and operating basis earthquake (OBE) described in Section 1.3.2, Structural Basis for Design.

(3) The plumbing systems in the Non-Category I structure shall be designed to meet UBC seismic requirements for Zone 2 or less and an importance factor of 1.5.

2. Design Life. The design life of the plumbing systems shall be 50 years, maintainable or replaceable to extend life to at least 100 years, irrespective of licensing intervals.

3. Sanitary Water. Sanitary water shall be interpreted as potable water.

4. Design for Expansion. The building service corridors, utility chases, and piping shall be designed with sufficient space to accommodate additional piping and services in the future.

5. Ventilation-Control Zones. The building areas shall be divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. The zones are depicted in Table 2.11-2 and are referred to in the design requirements for drains, piping and valve locations, etc.

6. Piping Runs. Piping runs shall be concealed in ceilings, walls, and furred spaces in the administration area of the building.

7. Potable Water.

(1) Hot potable water shall be supplied by a steam water heater.

(2) An electric (drinking) water cooler shall be provided.

8. Drains. Drains from restrooms, lunchrooms, and other, similar areas in Ventilation Zone 4 shall be routed to the sanitary sewer.

9. Personnel Decontamination Station. A personnel decontamination station shall be provided at the exit from the process operating areas, and shall be supplied with hot and cold potable water.

10. Safety Shower and Eyewash Stations. Safety shower and eyewash stations shall be provided near the equipment decontamination areas, aqueous makeup area, battery rooms, steam generators, and cooling tower chemical handling areas, and shall be supplied from the cold potable water system.

2.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used:

1. Piping Systems for Category I and Non-Category I Structures.

(1) Various parts of the building shall be designated Category I and Non-Category I.

(2) The piping systems in the Category I structure shall be designed to withstand the DBE and OBE described in Section 1.3.2, Structural Basis for Design.

(3) The piping systems in the Non-Category I structure shall be designed to meet UBC seismic requirements for Zone 2 or less and an importance factor of 1.5.

2. Design Life. The design life of the piping systems shall be 50 years, maintainable or replaceable to extend life to at least 100 years, irrespective of licensing intervals.

3. Design for Expansion. The building service corridors, utility chases, and piping shall be designed with sufficient space to accommodate additional piping and services in the future.

4. Ventilation-Control Zones.

(1) The building areas shall be divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides.

(2) The zones are depicted in Table 2.11-2, and are referred to in the design requirements for drains, piping and valve locations, etc.

5. Drain Design in Ventilation Zones.

(1) Drains from Ventilation Zone 1 areas shall be connected to the high-activity waste (HAW) system. The drain piping shall be double-contained to detect and contain leaks in areas where visual inspection is not possible.

(2) Drains from Ventilation Zone 2 areas (except crane maintenance room drains, remote-handled HEPA filter room drains, and the HAW drum decon room drain) shall be connected to the low-level liquid radwaste drain system. The other Zone 2 area drains shall be connected to the HAW collection system.

(3) Drains from Ventilation Zone 3 areas (except canistered fuel lag storage vault drains) shall be connected to the low-level liquid radwaste drain system. The other Zone 3 area drains shall be connected to the HAW collection system.

(4) Drains from Ventilation Zone 4 areas shall be connected to the process sewer (except sanitary drains). The incoming air-control vestibule (receipt and washdown area) drains shall be monitored before release to the process sewer and, if contaminated, shall be diverted to the low-level liquid radwaste drain system.

6. Other Drain Designs.

(1) Equipment drains and funnel drains shall be provided in the Steam Generator Building, and shall be connected to the oily sewer.

(2) Boiler-blowdown drains shall be provided in the Steam Generator Building, and shall be connected to the process sewer.

(3) Floor drains and funnel drains shall be provided in the mechanical equipment room, and shall be connected to the process sewer.

(4) Floor drains shall require special precautions for handling contaminated water runoff (from sprinklers) and avoiding potential water-induced criticality.

(5) Laundry drains shall be connected to the low-level liquid radwaste system.

(6) Analytical laboratory sink drains shall be connected to the low-level liquid radwaste system.

7. Personnel Decontamination Lavatory and Shower. The personnel decontamination lavatory and shower shall be connected to the low-level liquid radwaste system.

8. Utility Service Piping. Utility service piping shall be kept to a minimum in the operating areas, and shall be arranged to facilitate decontamination.

9. Piping System Design Requirements.

(1) Piping systems shall be designed to take advantage of gravity flow or the use of jets to reduce potential contamination problems and reduce the maintenance requirements associated with pumping.

(2) Piping shall be arranged in arrays to comply with criticality design requirements, if necessary.

(3) Piping located on or near floors, including the pipe supports, must be configured so as not to impede rapid cleaning of floors; e.g., removing deposits of solids and flushing or otherwise moving slurries toward floor drains.

10. Piping Systems Subject to Contamination.

(1) All piping systems that contain contaminated gases or liquids shall be 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.

(2) The contaminated piping systems shall be constructed of corrosion-resistant materials, and shall be located for easy accessibility. The contaminated piping systems shall be designed to allow collection of effluents from leaks in the system without releasing the effluents into personnel access areas or the environment.

(3) In general, contaminated piping shall not be located underground. If underground piping is required, it shall be double-contained. Sample drains shall be installed in the secondary encasing pipe to detect leaks in the original pipe.

(4) Notches, cracks, crevices, and/or rough surfaces that might retain radioactive materials shall be avoided in the design of radioactive process piping systems.

11. Breathing Air. Breathing air shall be supplied to the low-level liquid and solid radwaste areas; weld/test and decon equipment room; loadout and decon rooms; service gallery and equipment decon room; remote handled equipment maintenance and decon rooms; cask handling, prep, and decon rooms; HAW/RHTRU area; manipulator maintenance and decon rooms; exhaust filter rooms; remote air-handling filtration cell; shielded process cells; crane maintenance rooms; high-activity radwaste area; in-cell lag storage vaults; and shredded material drum transfer and decon area.

Hose couplings and manifolds shall be designed to preclude connection of respiratory protective equipment to any system other than the breathing air system.

12. Separation. Sufficient separation shall be provided in equipment and piping layouts to facilitate removal, maintenance, and criticality requirements when applicable.

13. Welded Construction. Piping systems used for handling radioactive and corrosive materials shall be of welded construction whenever practicable. Connections suitable for remote handling shall be used when required in areas of high-level contamination.

14. Welding. All welding shall be in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code, as modified by ANSI B31.1.

15. Pipe Plugging. Prevention of pipe plugging and clearing of plugs shall be considered during the design of process piping systems. Maintenance shall be a primary consideration in the design of process piping systems. Systems shall be designed to minimize exposure of maintenance personnel to radiation.

16. Elimination of Pockets or Traps. Process piping systems shall be designed to eliminate, wherever possible, pockets or traps so that piping can be flushed and drained except when loop seals are required. Floor drains shall have loop seals.

17. Vessel Vent Piping. Vessel vent lines shall be designed so that inadvertent transfer of solutions or slurries into ventilation systems is prevented.

18. Fittings. Changes in direction of process piping shall be made with long-radius elbows or bends. Bends shall be preferred, where practicable, except for solids transport lines, for which blinded tees or laterals have proved to prevent erosion. Reduction of line size in process piping shall be made with eccentric reducers installed with the flat side down to avoid the formation of traps.

19. Flanges. Care shall be taken in locating flanges to minimize the consequences of contamination from leaks.

20. Gaskets. Grafoil by Union Carbide, or equivalent, shall be the preferred material for gaskets. Teflon shall not be used for gasket material in process piping systems or as a component part of any valve or other piece of equipment subject to radiation.

21. Bolting. Use of galling-resistant bolting materials, such as Nitronic 60, shall be considered for stainless steel piping systems.

22. Unions. Unions shall be installed in out-of-cell piping systems to allow the maintenance or replacement of equipment, unless otherwise required by the project design criteria.

23. Pipe Penetrations. Pipe sleeves shall generally be provided when piping passes through masonry, concrete walls (except shielding walls), floors, and roofs. Sleeves shall be of galvanized pipe and of sufficient length to pass entirely through walls, partitions, or slabs. Sleeves shall be sloped to drain toward process areas. Pipe penetrations through firewalls require fire stops. The space between the pipe and the sleeve shall be packed and sealed with suitable caulking compound.

24. Shielding Wall Penetrations. Piping passing through concrete shielding walls shall be embedded in the concrete without sleeves. Pipe shall be protected against electrolytic action and shall not be in contact with rebar or other embedments. In addition, the pipe shall be fabricated with necessary offsets to prevent the streaming of radiation through the penetration. All embedded pipe and penetrations shall be shown on structural drawings. Pipes shall be sloped toward process areas.

Stainless steel lines embedded directly in concrete shall be protected against chloride contamination.

25. In-Cell Piping.

(1) All in-cell piping shall be of stainless steel to facilitate decontamination. In-cell piping normally shall not be insulated. Where insulation is required, it shall be jacketed with stainless steel.

(2) All piping that must be located within enclosure systems shall be designed to allow for in-place maintenance and/or replacement.

26. Valve Installation.

(1) Valves shall be installed in the stem-up orientation. Valves shall be so installed that removal or maintenance of the valve without dismantling the associated piping shall be allowed whenever practicable.

(2) Care shall be taken in locating valves to permit ease of access for maintenance and to minimize the consequences of contamination from leaks.

27. In-Cell Valves. In-cell process valves shall be selected for leakproof construction, optimum corrosion resistance, flow characteristics, fail-safe characteristics, and ease of maintenance and decontamination. Consideration shall be given to process and decontamination solution resistance and the ability of the component parts of the valve to withstand radiation.

In-cell valves shall be of the welded, all-metal, packless type, and shall employ a metal bellows seal. The design shall provide for the installation of air-operated valves that shall allow free drainage of the valve body.

In-cell valves shall be installed in "jumpers" that are fabricated with special piping connectors to permit replacement by using remote handling equipment.

28. Quick Disconnects. Quick disconnects shall be provided in the process cells and remote handled equipment maintenance room for utility connections. These shall be designed to be used by remote handling equipment.

29. Out-of-Cell Valves.

(1) Out-of-cell process valves shall be selected on the basis of corrosion resistance and flow characteristics.

(2) Every pipe entering or exiting a process cell shall be equipped with a suitable block valve.

(3) Piping that conveys process solutions shall be equipped with a packless (bellows seal) block valve immediately outside the cell wall.

(4) Piping that conveys process solutions in a normally pressurized system may require a check valve in addition to the packless block valve.

(5) Piping that does not convey process solutions in normal operation may be equipped with a ball valve.

(6) Piping that shall not convey process solutions except by failure of pressure boundary component may be equipped with a gate valve.

(7) In every case, the primary block valve and/or check valve shall be of corrosion-resistant material equivalent to the associated in-cell piping.

(8) All valves not functionally required to operate directly on nuclear material shall be located outside the cell.

(9) Such utilities as steam, air, and water shall not be valved in-cell.

2.10 ELECTRICAL

2.10.1 DESIGN CRITERIA

This section states the design criteria for electrical power, lighting, and communications in the R&H Building.

2.10.1.A. Power

Normal electrical power for the R&H Building shall be provided by a building substation located at the building. The substation shall be supplied from

2.10.1.C. Communications

A fire alarm system shall be provided throughout the building. In areas where water may cause additional operating problems, different types of detectors may be used to determine the type of fire. The detectors shall activate a delay sequence to allow the building operators time to evaluate the consequences of the fire versus the consequences of the water. The fire alarm system shall include manual pull stations at all exits, audible evacuation alarms, sprinkler and box zone annunciation, and modular control panel with supply valve supervisory circuits. The alarm system shall be connected to the central alarm center at the MRS Facility Fire Station and at the Security Building. It shall be powered from the R&H Building.

The R&H Building shall be enclosed within a protected area perimeter. Physical protection features shall comply with 10 CFR 73.50.

Explosion-detection and alarm systems shall be provided where appropriate.

All security alarms, fire alarms, evacuation alarms, or any other alarm that would require a security force response, shall annunciate at the Protected Area Gatehouse as the primary location, and at the Security Building as the backup or redundant location. These alarm stations shall be hardened (per criteria in UL 752), controlled access buildings with capabilities to communicate to all security personnel and offsite law enforcement agencies.

Audible building evacuation alarms shall be provided and shall be connected to an MRS Facility site evacuation alarm system. Evacuation alarms must conform to ANSI N2.3.

A telephone system shall be provided and connected to the MRS Facility central telephone system located in the Site Services Building.

A building intercom system shall be provided, activated at the control room area and audible in all parts of the facility, except for the hot cells and in-building lag storage vaults.

2.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 2.10.1, the following criteria shall be used.

2.10.2.A. Power Service

1. R&H Building.

(1) Building power shall be 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, shall feed all 5-kV motor loads. Five double-ended, dry-type, indoor load center unit substations, with three tie

the MRS Facility main substation and from an alternate source in a separate substation. Both systems shall be capable of supplying total capacity for the R&H Building loads. The MRS Facility main substation shall be the preferred source, with automatic transfer to the alternate source. The building voltage shall be 480Y/277 volts, 3 phase, for power and lighting systems in the building. Standby power shall be provided by standby generators to provide continuous power to systems important to safety, such as filtered exhaust fans, hot-cell systems, controls, monitors, and alarms. Automatic start and transfer from normal power sources to the standby power source shall take place if both normal sources fail. The 1,000-MTU in-building lag storage exhaust fan motors shall be automatically switched to a dedicated generator system, installed exclusively for these fans, if all normal and facility standby generator sources fail.

Process, service, and support areas in the building shall be provided with 480Y/277 volts, 3 phase, and 208Y/120 volts, 3 phase. Water-resistant enclosures shall be provided where subject to moisture.

An uninterruptible power supply (UPS) shall be provided for the following systems:

- Radio communications
- Security intrusion detection and surveillance
- Radionuclide monitoring and alarms
- Air monitoring and sampling
- Fire alarm and supervision
- Door access control and surveillance
- Distributed control instrumentation
- Process and operations computers

2.10.1.B. Lighting

Lighting for the R&H Building must conform to applicable standards for the type of area serviced and shall include appropriate emergency and exit lighting. Process cell lighting shall be provided by special fixtures which shall be maintained and relamped without exposing operating personnel to excessive radiation fields. In-cell maintained lighting levels at all work stations shall be sufficient to provide clear visibility of in-cell objects when seen through the shielded viewing windows or CCTV. Normal indoor building lighting shall be provided by 277-volt, energy-efficient fixtures. Outside lighting at each building exit shall be photocell-controlled fixtures or as required by safety and security considerations.

feeders to three standby unit substations, shall transform the primary voltage to 480Y/277 volts, 3 phase, for all low-voltage power loads. For each substation, either normal feeder shall be rated to carry 100% of the substation load. If one of the primary feeders fails, power shall switch to the alternate feeder automatically with minimum delay transfer time.

(2) Motors rated 250 hp and above shall be controlled by a 4.16-kV, metal-clad motor control switchgear with fused vacuum contactor-type motor controllers. The motor control switchgear shall include transfer trip control interlock equipment with sequenced load shedding and reacceleration.

(3) In case of simultaneous failure of both normal primary and alternate feeders, power shall be provided by four 4.16-kV primary feeders from the standby generator system. Three single-ended, dry-type, indoor load center unit substations shall transform the primary voltage to 480Y/277 volts for all critical low-voltage power and lighting loads. The standby unit substations shall be located in a room separate from the normal power unit substations. Standby power shall be provided, for safe shutdown and evacuation, to the HVAC filtered exhaust fans, uninterruptible power supply (UPS) battery chargers, selected lighting fixtures, computer room, and similar air-conditioning loads. The standby power system shall be provided to permit safe and orderly shutdown of the facility in case of a total failure of the normal power supply sources, but is not intended to permit continuance of all operational functions.

(4) A UPS system shall be 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, and distributed control systems (DCSs).

(5) A battery charger/inverter unit shall be installed and rated at 100% of the maximum UPS load. The inverter output shall be 480Y/277 volts, 60 Hz, 3 phase, connected to a UPS bus from which all UPS loads shall derive. The battery bank shall be 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 shall be sufficient to sustain the entire UPS load for a period of 10 minutes, with a final volts per cell not below 1.75. Power for air-conditioning units for the computer rooms shall be obtained from the standby power system.

(6) Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels shall be used for receptacle circuits, intermittent lighting circuits, and small single-phase loads.

(7) The entire power distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use.

2. Steam Generator Building and Cooling Tower.

(1) Building power shall be 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, shall transform the primary voltage to 480Y/277 volts, 3 phase, for all power loads. In the substation, either normal feeder shall be rated to carry 100% of the substation load. If one of the primary feeders fails, power shall switch to the alternate feeder automatically with minimum delay transfer time.

(2) Motors rated 200 hp and above shall be controlled by a 480-volt, metal-clad motor control switchgear with fused vacuum contactor-type motor controllers. The motor control switchgear shall include transfer trip control interlock equipment with sequenced load shedding and reacceleration.

(3) In case of simultaneous failure of both normal primary and alternate feeders, power shall be provided by one 4.16-kV primary feeder from the standby generator system. One single-ended, dry-type, indoor load center unit substation shall transform the primary voltage to 480Y/277 volts for all critical power and lighting loads. Both unit substations shall be located inside one prefabricated powerhouse located near the Steam Generator Building and the cooling tower. Standby power shall be provided, for safe shutdown and evacuation, to all critical systems and selected lighting fixtures.

(4) MCCs for the Steam Generator Building shall be located within the building. MCCs for the cooling tower shall be located within the prefabricated powerhouse.

(5) Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels shall be used for receptacle circuits, intermittent lighting circuits, and small single-phase loads.

(6) The entire power distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use.

2.10.2.B. Lighting

(1) In all process areas, lighting shall be 277 volts and the lighting fixtures shall be of the high-intensity discharge (HID) type. In offices and maintenance areas, lighting shall be 277 volts (fluorescent) or 120 volts (incandescent) for small, infrequently used storerooms, with local switching. Outside lighting shall be 277 volts and of the HID type. All fixtures shall employ high-efficiency ballasts of the energy-efficient, high-power-factor type. Outdoor lighting shall be controlled by solar-compensated, time-switch control, with manual and/or photocell override. Hot-cell lighting shall be provided by internally mounted fixtures capable of removal

by remote-controlled manipulator to facilitate relamping or reglazing without exposing personnel to excessive radiation fields.

(2) Battery-type emergency lighting units shall be installed to provide safe and orderly shutdown of operations and safe egress during a total power outage. Emergency power shall be available to these selected lights at stairways, corridors, control rooms, processing and storage areas, and exit lights.

No local switches shall be provided for emergency lighting circuits. All switching shall be 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 shall conform to the applicable requirements of Article 700 of the NEC.

(3) Illuminated exit signs shall be installed in all emergency exits, passageways, and corridors as required by NFPA Life Safety Code No. 101. The exit signs shall be internally illuminated, with translucent globe or letters, as approved by the Underwriters' Laboratories, Inc. for the service.

(4) Illumination levels shall be consistent with the recommendations of the latest edition of the IES Lighting Handbook. Illumination at 30 in. above floor level for the various areas shall be as shown in Table 1 of this handbook. Illumination levels shall be consistent with the energy-conservation regulations issued by state and federal government agencies. Hot-cell illumination level shall be 350 ft-c at 30 in. above floor level.

(5) Lighting fixtures shall be mounted on cranes when required to supplement area lighting.

2.10.2.C. Communications

1. Fire Alarm and Detection System. A fire alarm and detection system shall be installed throughout the R&H Building, the Steam Generator Building, and the cooling tower. The system shall consist of, but not be limited to, audible and visual alarm devices, manual pull stations, water flow switches, post indicator valve switches, and various types of detection devices.

The fire alarm and detection system shall be zoned and supervised (not in the hot cells); it shall be UL listed; it shall be in compliance with NFPA 72A, 72D, and 72E; and it shall be installed in accordance with the NFPA-101 Life Safety Code. The fire alarm and detection system shall be connected to the central alarm center at the MRS Facility Fire Station and at the Security Building. A local fire alarm panel, located in the vestibule area, shall be provided.

2. Public Address System. A public address system shall be furnished and installed in the R&H Building, the Steam Generator Building, and the cooling

tower. The system shall be zoned and centrally controlled. Telephone access capability shall be provided by the telephone system.

Each zone shall have its own amplifier and volume control, and shall be interconnected to the fire alarm and evacuation system.

3. Intercommunication Systems. Hardwired intercommunication systems shall be provided in the R&H Building, the Steam Generator Building, and the cooling tower for communications from the control room area and the hot cells.

4. Telephone System. A telephone system shall be provided within the R&H Building, the Steam Generator Building, and the cooling tower, with the main switchboard located in the Site Services Building.

5. Door Alarm and Access Control System. All exterior doors shall be controlled by a door alarm system. Any unauthorized entry or exit shall be announced and graphically displayed at the alarm monitoring stations.

Access to certain areas shall be controlled by a card-key access control system, supplemented by CCTV.

A central processor shall control, monitor, and report all selected entry points and shall be compatible with the site security systems computer.

6. Building Warning and Evacuation System. A building warning and evacuation system shall be provided by visual and audible warning devices actuated automatically or manually from the control center at the R&H Building.

7. Explosion Detection System. If required, an explosion detection system shall be provided by audible warning devices actuated automatically with a visual warning in the control center.

2.11 HVAC

2.11.1 DESIGN CRITERIA

This section provides the additional design criteria specifically required for the R&H Building in terms of documents and criteria.

2.11.1.A. Federal Regulations and Regulatory Guides

1. Federal Regulations. In addition to the Codes, Standards, Specifications, and Orders listed in Section 1.11.1, the following shall be used:

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

(2) 10 CFR 50, Appendix B (Quality Assurance) and Appendix E (Emergency Planning)

(3) 10 CFR 51, Licensing and Regulatory Policy and Procedures for Environmental Protection

(4) 10 CFR 72, Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation

(5) 10 CFR 73, Physical Protection of Plants and Materials

(6) 29 CFR 1910, Occupational Safety and Health Standards

2. Nuclear Regulatory Commission (NRC) Regulatory Guides

(1) Appendix A, Applicable Regulatory Guides

(2) Appendix B, Potentially Applicable Regulatory Guides

2.11.1.B. Specific Design Requirements

The HVAC design shall conform to all applicable specific design requirements described in Sections 1.3.1.C and 1.3.1.D.1. In addition to the seismic and tornado designs described in these sections, the Category I HVAC system shall 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 in excess of the limits in 10 CFR 20 or DOE Order 5480.1A.

(2) Maintain nuclear criticality safety.

2.11.1.C. Confinement Zones

The building areas shall be divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. The zones are depicted in Table 2.11-1.

Air flows within the building shall be from less hazardous to more hazardous ventilation control zones. Static pressures within the various zones with respect to atmosphere shall nominally be as follows:

Zone 1 -2" to -4" H_2O gauge

Zone 2 -0.75" to -1.5" H_2O gauge

Zone 3 -0.5" to -0.7" H_2O gauge

Zone 4 +0.05" to -0.1" H_2O gauge

To limit contamination spread, air control vestibules, airlocks, back draft dampers and other barriers shall be provided to separate ventilation control zones from each other. HEPA filters shall be provided between zones when air flows cascade from cleaner zones to zones of higher potential for contamination, except that filters are not required between Zones 3 and 4.

Table 2.11-1 - Ventilation Zones

Zone	Definition	Typical Locations
1	Process zone Highly contaminated area, restricted access zones	Shielded hot cells Bare fuel lag storage Glove boxes Remote-handled maintenance areas
2	Restricted access zones Potentially contaminated areas	Hot cell service gallery Radwaste treatment facilities Shipping cask preparation, decontamination, and unloading rooms Cask loadout and decontamination Hot maintenance areas (contact) Spent fuel and HLW transfer corridor(s) HEPA filtered exhaust filter room Crane maintenance areas
3	Operating zones Not normally contaminated	Operating galleries Canistered fuel lag storage vaults Process area corridors Air-control vestibule Changerooms Analytical laboratory and health physics area Filtered exhaust fan room(s) Laundry Personnel decontamination area
4	Unrestricted access zones	Administrative areas Restrooms and lunchrooms Mechanical and electrical equipment rooms Supply air fan room(s) Cask receiving and inspection areas Unregulated support areas

Dirty hot cell operations (such as disassembly and consolidation, cutting, and similar operations) shall be isolated from the cleaner operations (such as welding, testing, decontamination, and loadout) by a contamination barrier. A pressure differential of at least 1 in. WG shall be maintained between these hot cell operations, with the dirtier areas more negative.

The 1,000-MTU, in-building lag storage vault(s) for short-term storage of canistered fuel shall be separated from the clean side of the hot cell operations by a contamination barrier. A pressure differential of at least 1.5 in. WG shall be maintained between the two, with the hot cell more negative.

The ventilation system shall be designed and constructed to confine airborne radioactive materials within the appropriate zones and enclosures of the building. It shall be capable of removing from routinely occupied areas airborne radioactive materials that may appear during abnormal conditions, and shall be designed to adequately clean all normally or accidentally contaminated air effluent streams before release to the environment.

Ducts serving continuously contaminated areas should not connect with ducts serving uncontaminated or infrequently contaminated areas unless HEPA filters and backflow preventers are provided or until the contaminated air stream has gone through all but the final testable stages of HEPA filtration or other cleaning devices. Fire dampers and back-draft dampers should be provided to prevent the escape of radioactive materials from the building during accidents that may temporarily pressurize the building.

Manual controls and automatic controls, capable of being manually bypassed, shall be provided to give operational flexibility. Provisions shall be made for the automatic shutdown of portions of the ventilation system when this could limit major accidents.

All Category I related ventilation system instrumentation shall be designed to fail in a safe mode. Visual and/or audible alarms shall be provided to indicate the failure of a Category I system component or the development of a potentially serious condition such as the loss of pressure differentials, plugging of HEPA filters, or excessive release of radioactive materials.

Failure of any single ventilation system component shall not jeopardize the ability of the system to adequately confine radioactive materials and adequately restrict their release to the environment.

2.11.1.D. Inside Design Conditions

The temperature in service areas shall be maintained between 60°F and 80°F under normal operating conditions. The nominal temperature in the process cells shall not exceed 120°F under normal operating conditions. Head end fuel lag storage vaults (bare fuel) shall be designed to maintain fuel cladding temperatures below 220°C during normal operations. The lag storage vaults for fuel canistered in an inert environment shall be designed to maintain fuel cladding temperature below 375°C.

2.11.1.E. Energy Conservations

Ventilation systems in the R&H Building shall be once-through, with heat recovery features included where appropriate, except that recirculation, with an appropriate amount of makeup air within a zone with the air circulated through HEPA filters and discharged back into the same zone, is permitted. Consideration shall be given to using the exhaust streams to precondition the incoming air.

2.11.1.F. Cooling System

No specific design criteria are cited.

2.11.1.G. Heating System

No specific design criteria are cited.

2.11.1.H. Air Supply System

Ventilation systems in the R&H Building shall be once-through, with heat recovery features included where appropriate, except that recirculation within a zone with the air circulated through HEPA filters and discharged back into the same zone is permitted.

Incoming supply air shall be filtered (85% ASHRAE, filter efficiency) and conditioned to supply the various areas as required. The supply air intake shall be located above ground level and arranged to minimize dust loading on the filters, effects of high winds, wind-blown debris, snow and ice, and intake of exhaust air streams. The air supply to areas having access to the shielded process cells shall be sufficient to maintain a minimum air velocity of 150 +25 ft/min, averaged over the opening area at all penetrations into the cells when penetrations are open. When all cell penetrations are closed, a lower volume of air may be supplied to the service areas. In all cases, the air supply rate to any zone shall be controlled not to exceed the exhaust rate.

Ducts supplying the shielded process cells shall be equipped with anti-backflow dampers and HEPA filters.

2.11.1.I. Exhaust System

The exhaust system shall be designed to collect and adequately remove radioactive materials. Release of contaminants to the environment at the point of release shall be controlled within the constraints of DOE Order 5480.1A, Chapter XI, Chg 6, for environmental standards for exposure to the general public and as required by 10 CFR 20. The exhaust system shall also be designed to prevent the spread of contaminated air into less potentially contaminated areas. Provisions shall be made to isolate the exhaust systems that serve ventilation Zones 1 and 2 from those serving Zones 3 and 4.

The exhaust control systems shall be interlocked with the air supply control systems to maintain proper pressure differentials and air flows.

1. Exhaust Filter System. Exhaust systems shall be designed to maintain contamination control within operating limits during changeout of HEPA filters. Filtered exhaust systems shall be designed with multiple filter banks to allow backup for maintenance and switchover to change filters. The double filtered exhaust system from Zones 1 and 2 shall have 50% redundancy of filters. The single filtered exhaust systems shall have 50% redundancy of filters from Zone 3. Air exhausted from Zone 4 need not be filtered. The 1,000-MTU, in-building lag storage vaults shall be forced air cooled with the exhausting air passing through a single stage of HEPA filters.

The exhaust systems shall have test ports for sampling the exhaust air particulate distribution in size and content before and after the prefilter and for each stage of HEPA filters. Leakproof dampers shall be provided on each bank of HEPA filters such that each bank can be isolated for filter change-out. Differential pressure gauges shall be installed across each stage of filters. The first stage of testable HEPA filters serving the shielded process cells shall be equipped with radiation monitors. The filter systems shall be designed to facilitate manual filter replacement with low personnel radiation exposure. All filter systems (except the in-cell filters described later) shall be designed to facilitate dioctyl phthalate (DOP) or equivalent testing of each filter. Additional nontestable but replaceable HEPA filters shall be located inside the shielded cells to filter exhaust air prior to exiting from the cell. The nontestable HEPA filters shall be equipped with radiation monitors. The capability for installing carbon filters or scrubbers to collect gaseous effluents shall be included in the hot-cell exhaust system. Prior to entering the final two stages of HEPA filters from Zones 1 and 2 and the final stage for Zone 3, air shall flow through a fire/smoke and heat suppression system, including fire-screens, mist eliminators and prefilters. The ventilation system shall meet the requirements outlined in DOE Order 6430.1 and the guidelines of ERDA 76-21 (Nuclear Air Cleaning Handbook). All of the HEPA filter enclosures shall meet the requirements of ANSI N510 and ANSI N509, and shall follow the guidelines of U.S. Nuclear Regulatory Guide 3.12.

2. Exhaust Fan System. The exhaust fans shall be located downstream of final HEPA filter banks. The filtered exhaust system shall be designed with multiple fans to allow backup for maintenance and switchover to change filters. The double filtered exhaust system from Zones 1 and 2 shall have full redundancy of fans. The single filtered exhaust system from Zone 3 shall have 50% redundancy of fans. The 1,000-MTU, in-building lag storage vaults shall be forced air cooled.

Exhaust fans shall be located outside of the zone being exhausted. Fans and fan enclosure interiors shall be provided with corrosion-resistant coatings.

3. Exhaust Stack. All filtered exhaust air streams shall be discharged through a common exhaust stack. The exhaust stream shall be sampled and monitored in accordance with the requirements of ANSI N13.10, and airflows shall be measured.

2.11.1.J. HVAC Ductwork

Exhaust duct materials shall be stainless and/or carbon steel as appropriate for the areas being exhausted and for ease in decontamination. Exhaust ducts serving contaminated areas shall not share common ducts with supply or non-contaminated ducts and their lengths in clean areas shall be minimized or avoided. Air sampling capability shall be provided to enable sampling or measurement of airborne radioactivity in each leg of the exhaust system(s).

2.11.1.K. Standby Power Requirements

Power to exhaust fan motors shall be provided from the standby electrical system, which is automatically switched to facility generator power if both normal power sources fail. The 1,000-MTU, in-building lag storage vault exhaust fan motors shall be connected to standby power; in addition, these fans shall be automatically switched to a dedicated generator system, installed exclusively for these fans, if all other electrical sources fail.

2.11.1.L. Radiological Safety

Radiation protection features shall include the following:

(1) Ventilation zoning to assure flow of air from areas of lower contamination potential to areas of higher potential.

(2) Maintenace of ventilation flow rates into areas of high contamination potential at levels that preclude air escape into lower potential areas through openings.

(3) Filtration of gaseous and airborne particulate effluents from contaminated or potentially contaminated areas before release to the environs to comply with 10 CFR 20 and DOE Order 5480.1A release limits.

(4) Redundancy of HEPA filter banks and exhaust fans to assure protection during maintenance.

(5) Standby power to exhaust fans, radiation protection devices, and other essential systems during loss of normal power.

2.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

2.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) system for the R&H Building shall provide an environment throughout the building necessary for personnel comfort and safety, and to protect personnel and equipment during

normal, abnormal, and accident operating conditions. The HVAC design will include provisions for future decommissioning. The components of the HVAC system that are important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance to safety of the functions to be performed. These components shall also be designed to withstand the effects of such natural phenomena as earthquakes, tornados, lightning, floods, etc., without impairing their capability to perform safety functions.

2.11.2.B. Specific Design Requirements

The HVAC system shall be designed to remain intact during design basis accidents, and shall comply with all design requirements specified in Section 2.11.1.B.

2.11.2.C. Confinement Zones

The HVAC system for the R&H Building shall be designed to provide air movement from areas of lesser contamination potential to areas of greater potential. To ensure air movement in the proper direction, the ventilation control zones and their respective static pressures with respect to atmosphere, described in Section 2.11.1.C and shown in Table 2.11-1, shall be adhered to; however, the typical locations for the four zones shall be slightly different. Table 2.11-2 shows the updated ventilation-control zones that shall be followed.

In addition to the confinement zones listed in Table 2.11-2, other incremental zones shall be provided in order to differentiate between hazards within the same confinement zones. Dirty hot cell operations shall be isolated from the cleaner operations and maintained at a minimum 1 in. WG lower pressure than clean operations. In addition, the clean hot cells shall be maintained at a minimum of 1.5 in. WG lower pressure than the lag storage vaults.

The control room within the R&H Building shall be considered as Zone 4 and shall be maintained at a slightly higher positive pressure than the surrounding Zone 4 areas.

Air locks, air-control vestibules, backdraft dampers, fire dampers, and other barriers shall be provided to confine airborne radioactive materials within the appropriate zones and to prevent the escape of airborne radioactive materials from the building during normal or abnormal conditions. HEPA filters shall be provided between confinement zones in the cascading air stream, except when air is cascaded from Zone 4 to Zone 3 areas. Ducts serving contaminated areas shall not be connected or share a common duct wall with noncontaminated or supply ducts.

Manual and automatic controls, capable of being manually bypassed, shall be provided to give operational flexibility and ease of maintenance, and to provide for automatic shutdown of portions of the ventilation system to limit and/or confine the spread of contamination in case of an accident.

Table 2.11-2 - Ventilation Zones

Zone	Definition	Typical Locations
1	Process zone Highly contaminated area, restricted access zones	Shielded process cells Shielded canyon cells In-process lag storage (uncanistered) Drum transfer corridor Glove boxes (including spent-filter processing enclosures within solid radwaste) Remote-handled maintenance equipment room Remote handling air filtration cell Overpack High-activity waste
2	Restricted access zones Potentially contaminated areas	Hot-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
3	Operating zones Not normally contaminated	Operating galleries In-building lag storage vaults (canistered) Process area corridors Air locks and air-control vestibules Laundry Changerooms Storage rooms Personnel decon rooms Filtered exhaust fan and heat recovery rooms Analytical laboratory and health physics area

Table 2.11-2 (Contd)

Zone	Definition	Typical Locations
		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 Changerooms, toilet rooms, and janitor closets Electrical equipment rooms Supply air fan room(s) UPS/battery room Control room Chiller room Compressor room Receiving, inspection, and shipping areas Incoming ACVs Outgoing ACVs

All Category I related ventilation system instrumentation and controls shall be designed to fail in a safe mode. In addition, audible alarms and/or visual alarm or indication shall be provided to indicate the failure of a Category I system component or the development of a potentially serious condition.

All other control and instrumentation requirements described in Section 2.11.1.C shall be incorporated into the HVAC design.

2.11.2.D. Inside Design Conditions

(1) Inside design temperatures shall be maintained between 60 and 80°F DB for personnel comfort in all normally occupied areas. Humidification shall not be provided for these areas.

(2) For normally unoccupied areas (such as equipment rooms and miscellaneous storage areas), the temperature shall be maintained between 50 and 90°F DB. Humidification shall not be provided for these areas.

(3) Inside the process cells, the temperature shall be maintained between 75 and 120°F DB under normal operating conditions.

(4) The temperature and humidity inside the control room shall be maintained as required for equipment operation.

(5) The canistered in-building lag storage vaults shall be maintained at a maximum temperature of 60°F above outside ambient air temperature when the vaults are fully loaded.

(6) The counting room and reagent room of the analytical laboratory shall be maintained at 70 $\pm$ 1°F.

2.11.2.E. Energy Conservation

The main building ventilation, as well as the lag storage ventilation, shall be a once-through system with recirculation used for selected Zone 4 areas only. In addition, a heat-recovery system shall be provided to capture the heat from the main building exhaust system and use it to preheat the incoming air.

2.11.2.F. Cooling System

Cooling shall be provided by a localized chilled-water system. The chilled-water system shall consist of several chilled-water pumps and chillers located inside the mechanical equipment room and cooling towers located adjacent to the R&H Building.

2.11.2.G. Heating System

Several heating systems shall be used to provide required heating for the R&H Building. Heat recovered from the exhaust system shall be used to

preheat entering outside air. Steam generated by adjacent boilers shall be used to provide additional heating of entering outside air. Hot water generated by a steam-to-hot-water converter shall be used for zone reheat in the main HVAC system, and as the heating medium for several hot water unit heaters in miscellaneous Zone 4 areas.

In addition, heating oil shall be used for several oil-fired door heaters located in the vehicle exit and receipt and washdown areas.

2.11.2.H. Air Supply System

The main air supply system shall be a once-through, 100% outside air, cascading system. Outside air shall pass through 30% ASHRAE efficiency prefilters, 85% ASHRAE efficiency final filters, and a heat-recovery coil before entering the air-handling units containing chilled water, steam coils, and a supply fan.

The supply system for in-building lag storage vaults shall be a once-through, 100% outside air system. Air shall pass through 30% ASHRAE efficiency prefilters and 85% efficiency final filters. No heating or cooling shall be provided.

In addition to the air supply systems described, the following shall be provided: a standby HVAC system to serve the control room, a standby HVAC system to serve the switchgear/UPS and battery rooms, and independent outside air intakes for the electrical and boiler rooms. The standby units for the control room and UPS room shall operate only during loss of normal power or main supply air system malfunction.

Recirculation shall be used in selected Zone 4 areas only.

The air supply system shall be balanced to provide proper distribution of air flow throughout the building during normal operations and maintenance activities. The air supply shall be designed to maintain air flow into the shielded process cell from adjacent areas with all penetrations open; however, a velocity of 150 ±25 ft/min shall be maintained only if the cell opening is into an area of lower zone classification. A fail-safe design philosophy shall be used so that no single component or equipment failure shall affect the continuous confinement of radioactive or other hazardous materials. The air supply system controls shall be interlocked with the exhaust system to ensure required pressure differential between the various ventilation zones. Controls shall be designed to shut off the supply fans and open all automatic control dampers in case of fire. This shall permit concentration of full exhaust fan capacity on smoke removal.

At this time, it would be impracticable to design the supply or exhaust systems to accommodate future expansions. The systems, however, shall be designed to permit future expansions that can be accomplished by adding new equipment rooms with additional equipment. All other requirements described in Section 2.11.1.H shall be incorporated into the HVAC design.

2.11.2.I. Exhaust System

The primary concern in the design of the exhaust system shall be hazard isolation in case of contamination.

The exhaust system shall collect and adequately remove radioactive materials, and shall comply with all of the requirements indicated in Section 2.11.1.I, except that, in the cascading system to be used (Section 2.11.2.H), the exhaust air from lower hazard areas may become the supply for higher hazard areas; therefore, the exhaust serving Zones 3 and 4 may not be isolated if it is used as Zone 2 supply air. Backdraft dampers and HEPA filters shall be used to prevent flow of contaminants into Zones 3 and 4 in case of accidental pressurization of Zone 2 areas.

1. Exhaust Filter System. The Zone 1 and 2 final exhaust filter system shall consist of several two-stage, bag-in/bag-out-type isolatable HEPA filter trains, with in-place aerosol test sections for each HEPA filter. In addition, aerosol testable single-stage HEPA filters shall be provided inside the air stream entering and leaving all dirty cells of Zone 1 and selected Zone 2 areas. In-cell HEPA filters, consisting of two stages of nontestable HEPA filters, shall be provided inside all shielded hot cells.

The final exhaust filter system shall have 50% redundancy and shall comply with all requirements described in Section 2.11.1.I.1. The HEPA filters inside the hot cells, as well as the first filter downstream of the hot cells, shall be designed for remote handling. All others shall be designed to facilitate manual changing.

The Zone 3 final exhaust filter system shall consist of several single-stage, bag-in/bag-out type, isolatable HEPA filter trains with prefilters and in-place aerosol test sections. Zone 3 final exhaust filters shall be separated from Zone 1 and 2 exhaust filters in order to minimize the adverse effect of a possible contamination of the Zone 1 and 2 filters. All HEPA filters shall be provided with aerosol test sections; however, prefilters shall not be testable. The final exhaust filter system shall have 50% redundancy.

Fire/smoke and heat suppression systems, with fire screen and mist eliminators, shall be provided for each bank of Zones 1 and 2 and Zone 3 final exhaust filters. Prefilters shall be provided with each HEPA filter except at the two-stage nontestable filters.

The in-building lag storage vault exhaust filter system shall be identical to the Zone 3 final exhaust filter system described above. They shall be separated from Zone 1 and 2 and Zone 3 final exhaust filters.

Each filter in the exhaust filter system shall be provided with a pressure differential indicator with local readout. Final exhaust filters shall also be provided with remote readout. Zone 4 exhaust air shall not be filtered.

2. Exhaust Fan System. Multiple Zone 1 and 2 exhaust fans shall have 100% redundancy, shall be isolatable to allow in-place maintenance or changeout, shall be located downstream of Zone 1 and 2 final HEPA filter banks, and shall be located in a separate room outside the zones being exhausted.

Multiple Zone 3 exhaust fans shall have 50% redundancy, shall be isolatable to allow in-place maintenance or changeout, shall be located downstream of Zone 3 final HEPA filter banks, and shall be separated from the zones to be exhausted, as well as from Zone 1 and 2 exhaust fans, by being placed in a separate fan room.

Multiple lag storage vault exhaust fans shall have 100% redundancy, shall be isolatable to allow in-place maintenance or changeout, shall be located downstream of HEPA filter banks, and shall be separated from the area to be exhausted, as well as from Zone 1 and 2 and Zone 3 exhaust fans, by being placed in a separate fan room.

3. Exhaust Stack. A single stack shall be provided for exhausting filtered air from the R&H Building. The stack shall disperse all airborne emissions at concentration levels as low as reasonably achievable (ALARA). The stack shall include all appropriate safety appurtenances (e.g., ladders, lightning arrestors, and warning lights). The stack discharge velocity shall be 4,000 fpm minimum. The stack shall be tapered at the top at an angle not greater than 15 deg from the vertical to achieve the required discharge velocity. The stack height shall be determined from a radiological/toxicological-based dispersion analysis, but shall be at least 150 ft above the ground level at the R&H Building. Air from Zone 4 exhaust shall not be discharged through the stack.

Stack sampling and monitoring shall not be required. Instead, continuous radiological sampling and monitoring shall be performed at each main exhaust duct entering the stack (main exhaust ducts from Zone 1 and 2, Zone 3, and in-building lag storage vault exhaust).

2.11.2.J. HVAC Ductwork

Ductwork shall be designed to properly convey air for ventilation and contamination control. Ductwork shall be designed to meet Category I construction requirements at building intake and exhaust openings, and shall be in accordance with ERDA 76-21, ASHRAE Guides, SMACNA, NFPA 90 A and B, and ACGIH. The following ductwork materials shall be used:

(1) Supply air and heat-recovery ductwork shall be of galvanized steel, designed in accordance with SMACNA standards for high-velocity/high-pressure duct construction.

(2) Exhaust ductwork for unrestricted and not-normally-contaminated areas shall be of airtight, continuously welded carbon steel.

(3) Ductwork for highly contaminated and potentially contaminated areas shall be of stainless steel.

(4) Recirculation ductwork (Zone 4 only) shall be the same as that for the exhaust for the area being recirculated.

2.11.2.K. Standby Power Requirements

Power to exhaust fan motors shall be provided from the standby electrical system, which is automatically switched to plant generator power if both normal power sources fail. The 1,000-MTU, in-building lag storage vault exhaust fan motors shall be connected to standby power; in addition, these fans shall be automatically switched to a dedicated generator system, installed exclusively for these fans, if all other electrical sources fail.

2.11.2.L. Radiological Safety

The HVAC system shall comply with all radiological safety and protection features described in the Design Criteria, Section 2.11.1.L.

2.12 FIRE PROTECTION

2.12.1 DESIGN CRITERIA

An automatic fire protection sprinkler system shall be provided throughout the building. It shall be designed in accordance with National Fire Protection Association (NFPA), DOE 6430.1 Chapter X, and U.S. Nuclear Regulatory Guide 3.16. In areas where water is unacceptable, a Halon system, or other acceptable systems, may be substituted where fire suppression capability is required.

2.12.2 BASIS FOR DESIGN

The fire-protection systems shall be designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions. Design features shall include items that would have a significant effect on safety if altered or modified.

The design of the fire-protection systems shall consider criticality of the areas to be protected. The system shall also include provisions for decommissioning.

For fire protection, automatic fire-suppression systems shall be supplied throughout the process and nonprocess areas of the R&H Building. Nonprocess areas shall be protected with a standard, automatic wet-pipe sprinkler system and critical areas, such as the control room and electrical equipment room, shall be provided with a Halon 1301 system.

A fire-suppression system is not required in the shielded hot cells. This is because it is an unoccupied area, with massive cell-wall thickness (fire separation) and proper equipment spacing. Criticality considerations preclude the use of a water-suppression system. Contamination and HVAC requirements make impracticable the application of a total-flooding Halon 1301 system.

2.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be designed as specified. It shall be complete, including piping, valves, fittings, sprinkler heads, 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 nonprocess areas of the facility shall be determined after final design of the fire-protection systems.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions.

Standpipe and hose cabinets shall be provided in accordance with NFPA 14.

Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

2.12.2.B. Halon 1301 System

Areas of high value or of high program importance (computer areas/control room) shall be provided with a total-flooding Halon 1301 system. The system shall consist 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.

2.12.2.C. Dry Chemical System

An automatic dry chemical system shall be used to extinguish fires inside the glove boxes. Additional dry chemical systems shall be used to extinguish flammable-liquid fires in other areas within the R&H Building. Areas protected with a dry chemical system shall be determined after final design of the fire-protection systems.

2.12.2.D. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire-protection system provided for the R&H Building. Portable fire extinguishers shall be sized, located, and installed throughout the building in accordance with NFPA 10.

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SECTION 3

SF, HLW, AND HAW/RHTRU STORAGE FACILITIES

3.1 INTRODUCTION

3.1.1 DESIGN CRITERIA

The Spent Fuel, HLW, and HAW/RHTRU Storage Facilities shall be capable of safely accepting and storing the waste containers. The storage capacity shall be 15,000 MTU of spent fuel and associated wastes, plus a small quantity (less than 300) of HLW canisters. The storage facilities shall be designed to safely receive, emplace and store spent fuel and a small quantity of HLW canisters at the rate of at least 3,600 MTU per year. The MRS Facility shall be designed to permit the placement of canisters of spent fuel in sealed storage casks or field drywells for extended onsite storage. The storage facilities shall be capable of routine retrieval of stored spent fuel and waste packages. The storage facilities shall be capable of storing 15,000 MTU of spent fuel and associated wastes in sealed storage casks or field drywells prior to shipment offsite. The storage facilities shall be capable of discharging spent fuel and waste at the same rates at which they are able to receive them. The storage facilities must also be decommissionable. They shall be designed for safely storing spent fuel and waste canisters for up to 100 years.

The storage facilities shall be capable of receiving and storing canisters of either intact or consolidated spent fuel assemblies or canisters of HLW and HAW/RHTRU. They shall protect spent fuel and waste from natural and man-induced events (except war), controlling damage to acceptable/recoverable levels, and containing and controlling radioactive materials. The walls and end closures of each storage receptacle shall be designed to preclude failure from corrosion for 100 years, and shall contain all fuel and waste form degradation products within acceptable release limits for that length of time. The design shall prevent any criticality incident and shall be designed to withstand external loads imposed upon the storage container. It shall also provide sufficient radiation shielding and isolation to comply with the requirements set forth in 10 CFR 20, DOE Order 5480.1A and the ALARA principle. The storage facilities shall be designed to assure that the fuel cladding surface temperature remains below 375°C in an inert atmosphere. The storage facilities shall be capable of maintaining HLW container surface temperatures below 375°C when stored in air, and borosilicate glass centerline temperatures below 500°C. All heat transfer features shall be passive and dry.

A monitoring system shall be provided to monitor:

- loss of canister integrity
- loss of storage system containment integrity
- assess storage system operating conditions
- degradation of storage system radiation shielding

The storage receptacles shall be equipped with the capability to install temperature sensors to statistically monitor for overheating of fuel or waste.

The transportation equipment shall be that which is appropriate to the storage concept selected. Definition and design of the specific transport equipment are a part of the MRS Facility design.

The capacity and number of transporters shall be capable of loading, transporting and unloading the average daily quantity of spent fuel assemblies (assume 100% PWR or 100% BWR) plus an appropriate surge capacity. The transporters must also be able to accommodate HLW and HAW/RHTRU canisters at the anticipated daily rate plus surge capacity.

Area radiation monitors shall be located appropriately throughout the Storage Facilities to alert operations personnel to unusual radiation levels. An audible and visual alarm shall be activated at the storage site and the R&H Building and Site Services Building control rooms. Air monitors and samplers shall be provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from leaking storage receptacles.

All monitoring systems shall 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.

The Storage Facilities yard shall be designed to withstand credible natural (Category I classification) and man-induced events, excluding acts of war.

All storage facilities shall be located and designed to preclude flooding caused by atmospheric or man-made conditions.

The Storage Facilities, the vehicle lag storage area, and the non-standard or off-normal vehicle storage areas shall be enclosed within the Protected Area perimeter. Physical protection features of the storage areas shall comply with 10 CFR 73.50 and DOE Order 5632.2. Specific requirements are further discussed in Section 1.17, Security and Safeguards. Fence and street lighting shall be included to allow visual and CCTV surveillance. Access to the storage areas shall be by the transporter access road from the R&H Building. A gatehouse at the entrance to the storage facility shall be provided with personnel monitoring equipment to check all personnel for contamination upon leaving the storage facility. A communication link to the R&H Building shall also be provided.

(1) Storage Concept - Sealed Storage Casks

This storage facility concept utilizes an array of sealed storage casks for the storage of spent fuel, HLW, and HAW/RHTRU. The casks are transferred to the R&H Building by a transporter and loaded with waste containers. After loading, the cask is delivered to the Storage Facilities and placed upright on a support pad.

The heat from radioactive decay is conducted through the concrete of the sealed storage cask and removed by atmospheric convection and thermal radiation. The walls of the cask and shielding plug provide the radiation shielding protection. The cask interior shall be lined with metal extending to the top of the cask. A metal outer lid is then welded to the liner forming the final welded containment barrier. The sealed storage cask combined with the canister provides double containment to withstand credible natural and man-induced events, excluding acts of war.

The sealed storage casks may be fabricated in a cask manufacturing plant in an assembly line process at or near the site. The manufacturing plant shall be located to facilitate the cask loading and storage functions. When completed, the casks are placed in a staging area.

The cask transporter receives an empty cask at the staging area and transfers it to the R&H Building for loading. At the R&H Building the shielding plug is removed by the hot-cell crane, the waste is loaded, and the shielding plug replaced. A metal lid is welded over the shielding plug while in the R&H Building to isolate the cask cavity from the environment. The cask is delivered to the Spent Fuel, HLW, and HAW/RHTRU Storage Facilities, where it is placed on the previously constructed concrete support pad for storage.

The hot cell loadout port(s) of the R&H Building shall be designed to accommodate the cask opening and to provide a seal between the hot cell and the cask.

(2) Storage Concept - Field Drywells

This storage facility concept utilizes an array of stationary, in-ground, dry, sealed containers for the storage of spent fuel, HLW, and HAW/RHTRU. The canisters of radioactive material are placed in and, when necessary, retrieved from the drywell for storage by an onsite transporter. The transporter containing a shielding transfer cask receives the canister(s) at the R&H Building, moves the canister(s) to, and inserts each canister and shield plug into the proper drywell.

The field drywell storage concept uses the surrounding soil to attenuate nuclear radiation and to dissipate heat from the waste while it is stored underground. The spent fuel, HLW or HAW/RHTRU canisters are sealed inside the drywell.

The drywell consists of a steel liner installed in a hole in the ground. A shielding plug shall be installed over the canister to reduce the ground surface radiation. A metal cover plate is welded to the liner at ground level to isolate the drywell cavity from the environment.

The spacing of drywells shall be based on the thermal conductivity of the soil at the reference sites. Heat dissipation must maintain the temperature of the cladding/canister below the maximum allowable temperatures.

The transporter vehicle may be a modification of a commercial heavy-weight transporter type vehicle.

(3) Storage in Transportable Metal Storage (Dual Purpose) Cask

Space for the transportable metal storage (dual purpose) cask shall be provided with each of the storage concepts. The unloading facilities in the R&H Building have been described in Section 2.

A transport vehicle shall deliver the cask to the storage facility where it is placed on the previously prepared support structure.

3.1.2 BASIS FOR DESIGN

The Spent Fuel, HLW, and HAW/RHTRU Storage Facilities shall provide for all functions required by Section 3.1.1.

3.2 CIVIL AND SITE DEVELOPMENT

3.2.1 DESIGN CRITERIA

Design criteria for the storage areas are included in Sections 1.2.1 and 3.1.1.

3.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall also be used.

All areas subject to transport vehicle traffic shall be designed as transport vehicle roads.

3.3 STRUCTURAL

3.3.1 DESIGN CRITERIA

3.3.1.A. Codes, Standards, and Regulations

No additional codes, standards, or regulations beyond those listed in Section 1.3.1 shall be used.

3.3.1.B. Requirements

1. General.

   (1) The storage facilities shall protect spent fuel and waste from natural and man-induced events (except war), controlling damage to acceptable/recoverable levels, and containing and controlling radioactive materials.

   (2) The storage receptacle shall be designed to withstand external loads imposed upon the storage container.

   (3) The Storage Facilities shall be designed to withstand credible natural (Category I classification) and man-induced events, excluding acts of war.

2. Natural Phenomena-Related Requirements. Storage facility components, systems, and structures shall be categorized as Category I or Non-Category I based on the criteria defined in Section 1.3.2.D.

3.3.2 BASIS FOR DESIGN

3.3.2.A. Codes, Standards, and Regulations

No additional codes, standards, or regulations shall be used.

3.3.2.B. Structural Design Bases

1. Design Loads, Load Combinations.

   (1) The design loads and load combinations defined in Sections 1.3.2.D and 1.3.2.E shall be applied in the structural evaluation of storage facility components, systems, and structures based on the category in which each falls (Category I or Non-Category I).

   (2) In addition to natural events, credible man-induced events (such as drop accidents and equipment loads) shall be evaluated as applicable.

2. Structural Design Considerations.

(1) Structural design considerations for the storage facility shall include those defined in Sections 1.3.2.F, G, and H.

(2) Storage receptacles shall be designed to maintain structural integrity of their radioactivity containment barrier under all normal and accident conditions.

3. Natural Phenomena-Related Category. The storage facility components, systems, and structures are categorized as Non-Category I.

3.4 ARCHITECTURAL

Not applicable to these facilities.

3.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

3.5.1 DESIGN CRITERIA

3.5.1.A. Codes, Standards, and Regulations

1. Codes. No additional codes beyond those listed in Section 1.5.1 shall be used.

2. Standards. In addition to the standards listed in Section 1.5.1, the following shall be used:

American Concrete Institute (ACI)

- Building Code Requirements for Reinforced Concrete, ACI 318-83
- Code Requirements for Nuclear Safety Related Concrete Structures, ACI 349-80

3. Regulations. In addition to the standards listed in Section 1.5.1, the following shall be used:

40 CFR 191 (latest draft), Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level Waste and Transuranic Waste

3.5.1.B. Storage Requirements

1. Fuel and Waste Packages.

(1) The storage facility shall be designed to store canisters of intact and/or consolidated spent fuel, canisters or drums of densified nonfuel-bearing components from fuel assemblies, canisters of HLW, canisters and drums of HAW/RHTRU, and overpacked canisters of spent

fuel, HLW and HAW/RHTRU. Fuel and waste package characteristics are defined in Tables 1.5-2, 1.5-3 and 2.5-2.

(2) A majority (90%) of the spent fuel and reprocessed waste packages to be stored shall be 10 years out of reactor with a 33,000 MWD/MTU burnup. About 10% of the spent fuel to be stored shall be 5 years out of reactor and/or 10 years out of reactor with burnups as high as 55,000 MWD/MTU.

2. Storage/Retrieval Rates.

(1) Spent fuel, HLW, and HAW/RHTRU canisters shall be received from the Receiving and Handling Building, emplaced and stored at the rate defined in Section 1.5.1.

(2) The storage facilities shall be capable of discharging spent fuel and waste at the same rates at which they are able to receive them.

(3) Surge capacity shall be included in the design of the receiving, handling, and storage systems to obviate the impacts of credible offsite and onsite disruptions of spent fuel, waste and material flows.

(4) Throughput capacities should be based on 3 shifts-per-day, 7 days-per-week, year-round operation.

3. Storage Capacity.

(1) The Spent Fuel, HLW and HAW/RHTRU Storage Facilities shall be capable of safely accepting and storing the waste containers. The storage capacity shall be 15,000 MTU of spent fuel, including the onsite-generated HAW/RHTRU and a small quantity (less than 300 canisters) of HLW.

3.5.1.C. Storage Facility Requirements

1. General.

(1) The storage facility shall protect spent fuel and waste from natural and man-induced events (except war), controlling damage to acceptable/recoverable levels, and containing and controlling radioactive materials.

(2) The storage facility shall be designed and constructed to provide sufficient radiation shielding and isolation to protect operating personnel and the public from the radiation emitted from stored materials in compliance with the requirements set forth in 10 CFR 20, 10 CFR 72, DOE Order 5480.1A, and the ALARA principle.

(3) The storage facility shall be designed to prevent any criticality incidents.

(4) The storage facility shall be designed to withstand external loads imposed upon the storage container.

(5) The storage facility shall be designed to allow spent fuel or waste canister retrieval at any time for inspection, repairs or further processing or disposal.

(6) Fuel and waste storage facilities shall be capable of attenuating the radiation and passively dissipating the heat generated primarily by 33,000 MWD/MTU spent fuel and/or equivalent HLW and HAW/RHTRU out of reactor 10 years. About 10% shall be designed to store fuel 5 years out of reactor and/or 10-year-old spent fuel with burnups as high as 55,000 MDW/MTU.

(7) All heat transfer features shall be passive and dry.

(8) The storage facility shall be designed to assure that the fuel cladding surface temperatures remain below 375°C in an inert atmosphere under normal storage conditions.

(9) The storage facility shall be designed to assure that HLW canister surface temperatures remain below 375°C when stored in air and the borosilicate glass centerline temperature below 500°C under normal storage conditions.

(10) The storage facility shall be capable of confining radioactive material within the storage package during the entire storage period.

(11) The storage facility design must permit continual monitoring, management and maintenance of the spent fuel and wastes for the foreseeable future.

(12) The walls and end closures of each storage receptacle shall be designed to preclude failure from corrosion for 100 years, and shall contain all fuel and waste form degradation products within acceptable release limits for that length of time.

(13) The storage facility shall be designed to withstand credible natural (Category I classification) and man-induced events, excluding acts of war.

(14) All storage facilities shall be located and designed to preclude flooding caused by atmospheric or man-made conditions.

(15) For receipt and inventory verification, provisions shall be included to account for the quantity, type and history of the material stored in the facility.

2. Sealed Storage Casks.

(1) This storage facility concept utilizes an array of sealed storage casks for the storage of spent fuel, HLW, and HAW/RHTRU.

(2) The heat from radioactive decay is conducted through the concrete of the sealed storage cask and removed by atmospheric convection and thermal radiation.

(3) The walls of the cask and shielding plug provide the radiation shielding protection.

(4) The cask interior shall be lined with metal extending to the top of the cask. A metal outer lid is welded to the liner forming the final welded containment barrier.

(5) The sealed storage cask combined with the canister provides double containment to withstand credible natural and man-induced events, excluding acts of war.

(6) The sealed storage casks may be fabricated in a cask manufacturing plant in an assembly line process at or near the site.

(7) The manufacturing plant shall be located to facilitate the cask loading and storage functions.

(8) When completed, the concrete casks are placed in a staging area.

(9) The cask transporter receives an empty cask at the staging area and transfers it to the R&H Building for loading.

(10) At the R&H Building, the shielding plug is removed by the hot cell crane, the waste is loaded, and the shielding plug replaced.

(11) A metal lid is welded over the shielding plug while in the R&H Building to isolate the cask cavity from the environment.

(12) The cask is delivered to the Spent Fuel, HLW, and HAW/RHTRU Storage Facilities, where it is placed on the previously constructed concrete support pad for storage.

3. Field Drywells.

(1) This storage facility concept utilizes an array of stationary, in-ground, dry, sealed containers for the storage of spent fuel, HLW, and HAW/RHTRU.

(2) The drywell consists of a steel liner installed in a hole in the ground.

(3) A shielding plug shall be installed over the canister to reduce the ground surface radiation.

(4) A metal cover plate is welded to the liner at ground level to isolate the drywell cavity from the environment.

(5) The canisters of radioactive material are placed in and, when necessary, retrieved from the drywell for storage by an onsite transporter.

(6) The transporter containing a shielding transfer cask receives the canister(s) at the R&H Building, moves the canister(s) to, and inserts each canister and shield plug into the proper drywell.

(7) The spent fuel, HLW or HAW/RHTRU canisters are sealed inside the drywell.

(8) The field drywell storage concept uses the surrounding soil to attenuate nuclear radiation and to dissipate heat from the waste while it is stored underground.

(9) The spacing of drywells shall be based on the thermal conductivity of the soil at the MRS sites.

(10) Heat dissipation must maintain the temperature of the cladding/canister below the maximum allowable temperatures.

4. Transportable (Dual Purpose) Metal Storage Casks.

(1) Space for the transportable (dual purpose) metal storage cask shall be provided with each of the storage concepts.

(2) A transport vehicle shall deliver the cask to the storage facility, where it is placed on the previously prepared support structure.

5. Design Life.

(1) The design life of the storage facilities shall be 100 years.

(2) Storage receptacles shall be designed for safely storing spent fuel and waste canisters for up to 100 years.

3.5.1.D. Equipment Requirements

1. Transport Equipment (Sealed Storage Cask and Transportable Cask).

(1) The sealed storage casks are transferred to the R&H Building for waste container loading by a transporter.

(2) The cask transporter receives an empty cask at the staging area and transfers it to the R&H Building for loading.

(3) The sealed storage cask is delivered by the transporter to the Spent Fuel, HLW, and HAW/RHTRU Storage Facilities, where it is placed on the previously constructed concrete support pad for storage.

(4) A transport vehicle similar to the one used for transporting the sealed storage cask shall deliver the transportable cask to the storage yard.

(5) The capacity and number of transporters shall be capable of loading, transporting and unloading the average daily quantity of spent fuel assembly canisters (assume 100% PWR or 100% BWR) plus an appropriate surge capacity. The transporters must also be able to accommodate HLW and HAW/RHTRU canisters at the anticipated daily rate plus surge capacity.

2. Transport Equipment (Drywells).

(1) The canisters of radioactive material are placed in and, when necessary, retrieved from the drywell by an onsite transporter.

(2) The transporter containing a shielding transfer cask receives the canister(s) at the R&H Building, moves the canister(s) to, and inserts each canister and shield plug into the proper drywell.

(3) The transporter vehicle may be a modification of a commercial heavyweight transporter type vehicle.

(4) The base case capacity and number of transporters shall conform to the requirements in Section 3.5.1.D.1(5) above.

3. Lifting Equipment. Equipment shall be provided to handle the sealed storage casks and/or transportable metal storage casks at the storage area.

4. Monitoring Equipment.

(1) The storage facilities shall have a monitoring system capable of detecting releases of radioactive material in excess of 1/10 of the quantities listed in 10 CFR 20 Appendix B, Table II.

(2) A monitoring system shall be provided to monitor:

- loss of canister integrity
- loss of storage system containment integrity
- assess storage system operating conditions
- degradation of storage system radiation shielding

(3) The storage receptacles shall be equipped with the capability to install temperature sensors to statistically monitor for overheating of fuel or waste.

(4) All monitoring systems shall 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.

3.5.2 BASIS FOR DESIGN

3.5.2.A. Codes, Standards, and Regulations

1. Codes. In addition to the codes listed in Section 1.5.1, the following shall be used:

(1) American Society of Mechanical Engineers (ASME) - Boiler and Pressure Vessel Code, 1980

- Section II, Material Specification
- Section V, Nondestructive Examination
- Section IX, Welding and Brazing Qualifications

(2) American Welding Society (AWS) - Structural Welding Code, AWS D1.1-1983

2. Standards. In addition to the standards listed in Sections 1.5.1, 1.5.2, and 3.5.1, the following shall be used:

(1) American Society for Testing and Materials (ASTM)

Material specifications and standards shall be used for materials used for fabrication of equipment and components, as applicable.

(2) American National Standards Institute (ANSI)

ANSI/ASME NQA-2, 1983, Quality Assurance Requirements for Nuclear Power Plants

3. Regulations. In addition to the regulations listed in Sections 1.5.1, 1.5.2, and 3.5.1, the following shall be used:

(1) DOE Orders

DOE 5820.2, Radioactive Waste Management

3.5.2.B. Storage Requirements

1. Fuel and Waste Packages.

(1) Heat generation for the 2.5'd x 15'l HLW canister (Reference Table 1.5-3) is as follows:

For the drywell concept, the maximum acceptable heat generation rate is 5,348 watts/canister (k = 1.2 W/m°K). For the storage cask concept, maximum acceptable heat generation rate is 14,325 watts/canister/storage cask.

2. Storage/Retrieval Rates. The design criteria in Section 3.5.1B have been translated into the following design basis:

(1) Fifteen percent of the spent-fuel assemblies shall be stored intact. This includes fuel that is suspect and shall not be consolidated (5%) and the higher-burnup or shorter-life fuel (10%) that cannot be stored in consolidated form.

(2) Intact fuel storage shall be one PWR or two BWRs per canister.

(3) Consolidated fuel storage shall be three PWRs or seven BWRs per canister.

(4) Nonfuel-bearing components from consolidated spent-fuel assemblies shall be stored in 55-gal drums at ten PWRs per drum and six BWRs per drum (assuming that each BWR comes with a fuel channel).

(5) Storage and retrieval rates of spent fuel corresponding to 3,600 MTU per year require that 1,404 canisters of consolidated PWR rods and 996 canisters of consolidated BWR rods, 468 canisters of intact PWR assemblies and 388 canisters of BWR assemblies, and 1,582 drums of nonfuel-bearing components be stored or retrieved each year. The storage and retrieval rates for 3,600 MTU per year of HLW and HAW/RHTRU are defined in Section 2.5.2.

(6) West Valley high-level waste canisters shall be received at a rate of 60 per year.

3. Storage Capacity. In addition to the design criteria in Section 3.5.1B, the following shall be used:

The 15,000-MTU-capacity storage facility shall be designed to include 19,481 PWR fuel assemblies encapsulated into 7,794 canisters; 32,258 BWR fuel assemblies encapsulated into 5,761 canisters; 300 HLW canisters from West Valley; and 6,593 drums of nonfuel-bearing fuel assembly components.

3.5.2.C. Storage Facility Requirements

1. General. In addition to the design criteria in Section 3.5.1.C, the design basis material handling and flow steps are defined on Drawings No. H-3-56704, Concrete Cask Material Flow; and H-3-56705, Drywell Material Flow Diagram.

2. Sealed Storage Casks. In addition to the design criteria in Section 3.5.1.C, the following shall be used:

(1) A welded steel liner and seal-welded steel lid shall be designed to provide a secondary barrier against release of radionuclides.

(2) Concrete for the sealed storage cask shall be designed to provide radiation shielding and to protect the contents from external loads.

(3) The sealed storage cask shall be designed to provide a means for periodic sampling of the cask cavity atmosphere to monitor canister leak integrity.

(4) The sealed storage cask shall be designed to attenuate the design basis radiation level of 1×10^5 R/hr to a surface dose rate of 20 mrem/hr.

(5) Sealed storage cask shall be designed to hold a multiple number of canisters or drums consistent with established fuel, canister/drum, and concrete temperature limits.

3. Field Drywells. In addition to the design criteria in Section 3.5.1.C, the following shall be used:

(1) A welded steel liner and seal-welded steel lid shall be designed to provide a secondary barrier against release of radionuclides.

(2) The drywells shall be designed to contain a single canister of spent fuel, HLW, or HAW/RHTRU, or multiple drums of RHTRU and HAW/RHTRU.

(3) The drywell, shield plug, and cover shall be designed to limit the average surface dose rate to 5 mrem/hr when a canister is in storage and to 200 mrem/hr in accessible areas around the drywell and transfer shield during transfer of a canister from the transfer shield to the drywell.

(4) The drywell shall be designed to provide a means for periodic sampling of the drywell atmosphere to monitor canister leak integrity.

(5) The bottom of open field drywells shall be above the water table.

(6) The installed drywells shall be designed to withstand the direct mechanical loads from earthmoving equipment and the cask transport vehicle.

4. Transportable (Dual-Purpose) Metal Storage Casks. No additional criteria shall be used.

5. Design Life. No additional criteria shall be used.

3.5.2.D. Equipment Requirements

1. Transport Equipment (Sealed Storage Cask and Transportable Cask). No additional criteria shall be used.

2. Transport Equipment (Drywells). In addition to the criteria in Section 3.5.1.D, the following shall be used:

(1) The transporter transfer shield shall be designed for single canister emplacement.

(2) The transfer shield or its support shall have features and adjustments necessary for alignment of the shield with the drywell.

(3) The transfer shield shall include a lifting system that meets the following requirements:

(a) The grapple shall be capable of remotely latching onto and releasing the canister and/or shield plug.

(b) The winch control system shall include interlocks to prevent improper operation that could result in equipment damage or exposure of operating personnel in excess of limits.

(4) The transfer shield shall be designed for a maximum surface dose rate of 50 mrem/hr in the transport configuration.

(5) The transporter, in conjunction with the transfer shield, shall be designed to limit the dose rate to the transporter operator to 2 mrem/hr.

3. Lifting Equipment.

(1) Mobile lifting equipment shall be provided at the storage area to handle sealed storage casks and transportable metal storage casks.

(2) All lifting components shall be designed for fail-safe operation.

3.5.2.E. Natural Phenomena-Related Requirements

The storage facility material handling and remote equipment and systems are categorized as Non-Category I.

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 DESIGN CRITERIA

A monitoring system shall be provided to monitor:

- Loss of canister integrity
- Loss of storage system containment integrity
- Assess storage system operating conditions
- Degradation of storage system radiation shielding

The storage receptacles shall be equipped with the capability to install temperature sensors to statistically monitor for overheating of fuel or waste.

Area radiation monitors shall be located appropriately throughout the storage facilities to alert operations personnel to unusual radiation levels. An audible and visual alarm shall be activated at the storage site and at the R&H Building and Site Services Building control rooms. Air monitors and samplers shall be provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from leaking storage receptacles.

All monitoring systems shall 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.

The storage facilities shall be designed to withstand credible natural (Category I classification) and man-induced events, excluding acts of war.

3.8.2 BASIS FOR DESIGN

3.8.2.A. Instrumentation Requirements

(1) The monitoring instrumentation for the SF, HLW, and HAW/RHTRU Storage Facilities shall:

(a) Emphasize reliability, redundancy, modularization, and standardization, with components and subassemblies capable of being removed for inspection, maintenance, calibration, or replacement.

(b) Be capable of transmitting information to remote locations.

(c) Be designed to withstand credible natural (Category I classification) events.

(2) The monitoring instrumentation shall operate continuously. It shall include local detectors, transmitters, and remote instrumentation for alarm, status indication, logging, and printout.

3.8.2.B. Sealed Storage Cask or Drywell Temperature

The sealed storage casks or drywells in the SF, HLW, and HAW/RHTRU Storage Facilities shall be continuously and remotely monitored for temperature where the data shall be stored for long-term trending. The system shall be capable of setting off an alarm for abnormal temperature variation.

3.8.2.C. Grab Sampling

Gas grab samples shall be obtained routinely and analyzed in the R&H Building analyzer room for helium, krypton 85, and other noble gases. The presence of any of these gases shall be an indication of loss of canister integrity.

3.8.2.D. Radiation Monitoring

A selected number of sealed storage casks or drywells shall be monitored by a group of temporarily installed radiation monitors, centrally located among each group. These monitors shall activate audible and visual alarms in the DCS located in the R&H and Site Services Buildings, as well as locally to alert operations personnel to unusual radiation level. The monitors shall be located as required to protect working personnel during cask emplacement.

3.8.2.E. CCTV

A black-and-white, closed-circuit television (CCTV) system shall be provided to permit surveillance of the storage facility protected area perimeter. The system shall include CCTV cameras and viewing monitors. The CCTV cameras shall be capable of remote operation and control from monitoring stations located in the Protected Area Gatehouse and Security Building.

The CCTV viewing monitors shall be provided with selective switching capabilities to enable them to monitor the area surveyed by any CCTV camera in the storage facilities. The CCTV viewing monitors shall be located in the primary and backup alarm monitoring stations.

3.8.2.F. Seismic Monitoring System

A seismic monitoring system shall be provided to record ground acceleration levels triaxially.

3.8.2.G. Weather Stations

A meteorological instrumentation system shall be provided to meet the requirements of 10 CFR 72.72(b)(3) and shall collect the weather-variable signals from the four stations located at the four corners of the exclusion area, inside the alarm zone. These signals shall be transmitted to a microprocessor-controlled central station and to the DCS in the R&H Building control room.

3.9 PIPING

Not applicable to these facilities.

3.10 ELECTRICAL

3.10.1 DESIGN CRITERIA

No specific design criteria are cited.

3.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following criteria shall be used.

3.10.2.A. Power

Facility power shall be obtained from a double-fed substation located in a prefabricated substation adjacent to the facility gate station. The substation shall transform 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.

Dry-type, 480-208Y/120-volt, 3-phase transformers shall be provided. The transformers shall be located at the low-voltage load centers to minimize secondary voltage drop. The substation shall be designed to operate selectively from both normal power sources and the standby power system. If both normal power feeders fail, the normal power loads shall be disconnected, and only the security fence lighting shall remain connected to the standby power system. The transfer system shall be automatic, and shall restore service to the high-intensity discharge (HID) luminaires of the security fence lighting. Selected fixtures at gates, corners, and at intervals shall be provided with quartz-halogen lamps to provide some illumination until gas-discharge lighting is at full intensity.

All indoor electrical equipment shall conform to NEMA-1 type enclosures and all outdoor electrical equipment shall be of weatherproof construction.

3.10.2.B. Lighting

1. General. All outdoor lighting shall be of the 480- or 277-volt, 1-phase, HID type. Control shall be by means of photocell with manual override. Lamp ballasts shall be of the energy-efficient, high-power-factor type. Design of the security fence lighting shall be based upon maintaining illumination during a power transfer from the normal supply to the standby supply.

Lighting shall be serviced at the panelboard.

2. Illumination Levels. Illumination levels shall be as follows:

- Patrol road: 1 lm/sq ft average
- Fence lighting: 1 lm/sq ft minimum at the outside fence

3.10.2.C. Communications

A telephone shall be located at the area gate station, forming part of the main Electronic Private Automatic Branch Exchange (EPABX) located in the Site Services Building.

3.2.10.D. Grounding

The storage facilities shall be 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 shall be provided for a complete grounding system, in compliance with Article 250 of the National Electrical Code.

3.2.10.E. Instrumentation

An underground, concrete-encased, rigid conduit system shall be provided for instrumentation monitoring. Hand- and manholes shall be used to facilitate instrumentation installation and maintenance requirements. Electric power shall be provided to all multiplexer stations at 120 volts, single phase, 60 Hz.

3.11 HVAC

Not applicable to these facilities.

3.12 FIRE PROTECTION

3.12.1 DESIGN CRITERIA

No specific design criteria are cited.

3.12.2 BASIS FOR DESIGN

Fire suppression is not required in these facilities. It is an unoccupied area, the storage positions are separated by space and noncombustible material, and there is a lack of combustible material in storage.

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SECTION 4

CHTRU FACILITY

4.1 INTRODUCTION

4.1.1 DESIGN CRITERIA

The MRS Facility shall be capable of receiving, storing, and shipping onsite-generated, contact handled transuranic waste (CHTRU).

4.1.2 BASIS FOR DESIGN

The CHTRU Facility shall provide for the requirements of Section 4.1.1.

4.2 CIVIL AND SITE DEVELOPMENT

4.2.1. DESIGN CRITERIA

The base storage capacity for the CHTRU Facility shall accommodate all CHTRU wastes generated onsite while processing the first 15,000 MTU of spent fuel.

The CHTRU Facility shall also be incrementally expendable to permit storing CHTRU wastes generated onsite in subsequent years of operation of the MRS Facility.

4.2.2 BASIS FOR DESIGN

The CHTRU Facility shall be designed in accordance with the criteria stated in Section 1.2.2.

4.3 STRUCTURAL

4.3.1 DESIGN CRITERIA

The CHTRU Facility shall provide for safe storage of metal drums or boxes filled with CHTRU. The facilities shall protect the waste packages from the weather, the design basis tornado, and the operating and design basis earthquakes.

The CHTRU Facility shall be designed to conform to all the specific design requirements described in Section 1.3.1. It shall be designed for containment and for maintaining radiation exposures of operating personnel to ALARA

levels. The storage area of the CHTRU Facility shall be compartmented to the extent practical to minimize the potential of contamination spread and to facilitate loading and unloading operations.

4.3.2 BASIS FOR DESIGN

The CHTRU Facility shall be an underground box structure with concrete block walls and concrete roof, divided into removable segments to cover individual compartments. The roof shall be designed as a tornado barrier.

4.3.2.A. Classification

The entire structure shall be designed as a Category I structure.

4.3.2.B. Design Loads

The design loads shall be in accordance with applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
1. Dead load:	1
2. Live load:	2
(1) Roof: 20 psf or 2,000-lb concentrated load	
(2) Floor: 400 psf or storage weight, whichever is larger	
3. Snow loads: (ground snow = 25 psf)	4
4. Earthquake load:	8
(1) Design Basis Earthquake (DBE) (2) Operating Basis Earthquake (OBE)	
5. Tornado loads: (maximum wind speed = 360 mph)	9
6. Lateral earth pressure:	10
(1) Static earth pressure: - Active earth pressure: 30 pcf - At-rest earth pressure: 55 pcf - Surcharge: 300 psf or 232,000-lb crane load, whichever governs	

Design Loads	Reference Subsection of Section 1.3.2.D

(2) Dynamic earth pressure:

- DBE: $P = 10.3\ H^2$ lb/ft
- OBE: $P = 5.15\ H^2$ lb/ft

4.3.2.C. Load Combinations

1. Concrete:

$U = 1.4\ D + 1.7\ L + 1.9\ Eo$
$U = 0.9\ D + 1.9\ Eo$
$U = 1.1\ (D + L) + Ed$
$U = 1.1\ (D + L) + Wt$
$U = 0.9\ D + Ed$
$U = 0.9\ D + Wt$

2. Masonry:

$D + L + H + Eo$
$D + L + H + Ed$

4.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Masonry	Working stress	3
Seismic	Dynamic analysis Equivalent static analysis	4(2)
Tornado	Energy balance method NDRC formula	5
Foundation design	Wall footings	6

4.3.2.E. Structural Materials

(1) Concrete: 4,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Masonry: ASTM C90, Grade N, f'm = 1,500 psi

4.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for OBE
1/2 increase for DBE

(2) Active soil pressure: As given in Section 1.3.2.D.10

(3) Passive soil pressure: 400 pcf

(4) Modulus of subgrade reaction: 400 k/ft^3

(5) Friction coefficent: 0.5

4.4 ARCHITECTURAL

Not applicable to this facility.

4.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

4.5.1 DESIGN CRITERIA

The MRS Facility shall be capable of receiving, storing, and shipping onsite-generated, contact handled transuranic waste (CHTRU). The vast majority of the CHTRU shall be generated onsite. This CHTRU shall normally be packaged in 55-gal, stainless steel drums. The base storage capacity for the CHTRU Facility shall accommodate all CHTRU wastes generated onsite while processing the first 15,000 MTU of spent fuel.

The CHTRU Facility shall also be incrementally expandable to permit storing CHTRU wastes generated onsite in subsequent years of operation of the MRS Facility.

4.5.2 BASIS FOR DESIGN

The CHTRU Facility shall be equipped to handle and receive all onsite, low-level radwaste, palletized 55-gal drums processed in the R&H Building. Radwaste drums shall be received from the R&H Building packaged four to a pallet. Each pallet shall weigh approximately 4,000 lb.

Pallets shall then be hoisted from the transporter, lowered into CHTRU storage-well concrete cells, and sealed with concrete plugs weighing 30 tons. All selected handling equipment shall be capable of transporting and hoisting gross weights of 2 to 30 tons.

The following shall be provided as minimum required equipment:

(1) One 2-ton flatbed truck
(2) One crawler-mounted, 40-ton crane

4.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

4.7 MECHANICAL PROCESS

4.7.1 DESIGN CRITERIA

Provisions shall be made to collect any water or leakage from the waste containers.

4.7.2 BASIS FOR DESIGN

CHTRU Facility waste treatment shall consist of sumps in the storage cells that collect waste that is "not normally contaminated." The collected waste shall be monitored for contamination and removed by vacuum truck for disposal.

4.8 INSTRUMENTATION AND CONTROL

4.8.1 DESIGN CRITERIA

The CHTRU Facility should be designed for maintaining radiation exposures of operating personnel to ALARA levels. Each compartment shall be individually accessible for adding or removing waste packages. It shall be equipped with provisions for sampling the air and monitoring the interior for temperature and radiation level.

4.8.2 BASIS FOR DESIGN

The temperatures of the waste packages shall be measured manually by means of access ports through the tops of the enclosures. Air samples shall also be taken through these same ports. Portable instruments shall be used to measure temperature and radiation. The discrete air samples shall be analyzed by the R&H Building analytical laboratory.

Each of the two main storage facility sumps shall contain a fixed beta-gamma monitor for monitoring the sump liquid and a level control to maintain the maximum liquid level at a preset value. Liquids removed from the sumps shall be transferred to the liquid radwaste system.

4.9 PIPING

4.9.1 DESIGN CRITERIA

No specific design criteria are cited.

4.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

4.9.2.A. Plumbing

Not applicable to this facility.

4.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

The piping system shall be designed to withstand earthquake loads as described in the Structural Basis for Design, Section 1.3.2.

A drain shall be provided in each compartment of the facility. The drain effluent shall be collected and piped to sumps. The drainage piping shall be double contained (liquid waste line inside a secondary encasing line).

Corrosion-resistant materials shall be used in designing the piping system and the system shall be butt-welded. Flanges shall be provided at equipment only as required for servicing.

All welding shall be in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code, as modified by ANSI B31.1, to comply with the requirements of 10 CFR 72, Subpart G.

4.10 ELECTRICAL

Not applicable to this facility.

4.11 HVAC

Not applicable to this facility.

4.12 FIRE PROTECTION

4.12.1 DESIGN CRITERIA

No specific design criteria are cited.

4.12.2 BASIS FOR DESIGN

Fire suppression is not required in this facility because it is an unoccupied area, compartmentalized by noncombustible construction, and lacks combustible material, except as encapsulated in grout, which is packaged in steel drums in the storage compartments.

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SECTION 5

ADMINISTRATION BUILDING

5.1 INTRODUCTION

5.1.1 DESIGN CRITERIA

Supporting facilities shall be included to provide a complete and operable independent MRS Facility.

The Administration Building shall be designed to provide office space for DOE, NRC, and State personnel assigned to the MRS Facility, and to accommodate such operating contractor functions as accountability, plant management, plant operations, finance and administration, health, safety, quality assurance, and personnel and public relations. Other support facilities (such as lunch, conference, training and copy machine rooms, restrooms, custodial, mail, and storage facilities) shall also be provided.

5.1.2 BASIS FOR DESIGN

The Administration Building shall provide for all functions required by Section 5.1.1. In addition, provisions shall be made for DOE/NRC offices, Contracts, Security Chief, data acquisition, and a kitchen adjacent to the lunchroom.

5.2 CIVIL AND SITE DEVELOPMENT

5.2.1 DESIGN CRITERIA

No specific design criteria are cited.

5.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

5.2.2.A. Parking

Parking for employees working in the Administration Building shall be provided outside the Main Gate/Badgehouse. Parking shall be provided adjacent to the Administration Building for site vehicles serving the building.

5.2.2.B. Landscaping

The area in front of the Administration Building shall be 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

5.3.1 DESIGN CRITERIA

This building shall be constructed of noncombustible materials.

5.3.2 BASIS FOR DESIGN

The Administration Building shall be constructed of reinforced concrete block walls, slab-on-grade floor, steel columns and beams, and a metal deck roof.

5.3.2.A. Classification

The Administration Building shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

5.3.2.B. Design Loads

The design loads shall be in accordance with applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)

5.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ L$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

5.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings	6
Sliding and overturning	FS = 1.5	7

5.3.2.E. Structural Materials

Structural material shall include the following:

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

5.3.2.F. Soil

The soil parameters, for final design, shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
(2) Friction: 0.5
(3) Frost line: 2 ft below grade

5.4 ARCHITECTURAL

5.4.1 DESIGN CRITERIA

The Administration Building shall be designed to provide office space for DOE, NRC, and State personnel assigned to the MRS Facility, and to accommodate such operating contractor functions as accountability, plant management, plant operations, finance and administration, health, safety, quality assurance, and personnel and public relations. Other support facilities (such as lunch, conference, training and copy machine rooms, restrooms, custodial, mail, and storage facilities) shall also be provided. This building shall be constructed of noncombustible materials. All exterior walls and roof shall be insulated to the guidelines in DOE Order 6430.1, General Design Criteria, Chapter XIII. All building fixtures and furniture shall be included.

5.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

5.4.2.A. General Requirements

The building shall be a single-story structure with reinforced masonry exterior bearing wall and steel-framed roof, composed of two main exterior elements:

(1) Split-face concrete block wall and insulated, tinted window elements.

(2) A panelized facia and soffit at the roof structure to provide solar control as climatic conditions require.

All exterior walls, roofs, and roof-ceiling assemblies shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

The Administration Building shall be designed to house offices, computer facilities, a conference room, a lunchroom, multipurpose room, support facilities, and building services.

1. Office Area. The office area shall be designed to house operations management and support personnel. The personnel occupancy for a single day shift shall be broken down by function as follows:

Assignment	Number of Personnel
Finance and Administration	6
Personnel	6
Public Relations	3
Accountability	4
Plant Management	8
Plant Operations	5
Data Acquisition	5
Quality Assurance	6
Reception	1
Health/Safety	4
Contracts	3
Security	1
Subtotal Operational Personnel	52
DOE/NRC/State Representatives (nonoperational personnel)	26
Total	78

(1) Certain separately defined office functions shall have an adequately sized open office area, wherein furniture and furnishings shall be used to define individual work stations for clerical and support personnel.

(2) In addition, at the periphery of the building, each function shall have two or more private (or semiprivate) offices for managers adjacent to their respective open office areas or the corridor.

(3) A convenient conference room, sized for 10 occupants, accessible from the corridor, shall be located within the office area.

(4) Two photocopy machine alcoves adjoining the corridor shall be located at each end of the office area.

2. Computer Facilities. In the computer room, which shall have a dust-sealed access flooring system, a data acquisition system shall be provided; the Computer Supervisor's office is adjacent. Personnel occupancy shall be a total of five persons, all assigned to the day shift.

3. Lunchroom. The lunchroom, with a small kitchen containing food-preparation facilities, shall be designed for a minimum of 20 persons seating capacity. Vending machines and self-service microwave ovens shall be provided. The lunchroom may also serve as an additional conference room.

4. Multipurpose. The multipurpose room shall be used for conferences/training, shall be designed to accommodate 40 occupants, and shall include a counter with a sink and a coat closet. Audio-visual equipment shall be provided along with storage for tables, chairs, and training equipment.

5. Support Functions. The following shall be provided in the service area of the building:

(1) Receiving and Storage - a room with an exterior service entrance shall be provided for receiving and storing goods and supplies necessary for the operations of the office areas, building services, and lunchroom.

(2) Storage - a separate space shall be provided in the office area for office materials and stationery, forms, office machines, and other office needs.

(3) Mail Room - a room shall be provided for the receipt and storage of mail delivered to the Administration Building from the central mail facility.

6. Building Services. Space shall be provided for the following building services, as required for the normal operation of the building:

HVAC equipment (interior and exterior)
Boiler room
Telephone equipment
Plumbing equipment (restrooms, janitor's closet)
Electrical equipment

7. Circulation. Adequate space shall be provided for visitor and personnel circulation throughout the building. All normal entrances and exits shall be provided with vestibules for weather protection. A lobby shall be provided at the main entrance and furnished with a reception desk, waiting area, and a display area. The lobby shall open into a multipurpose room, a personnel office suite, and a main corridor that shall provide access to functions throughout the building as well as to emergency exits. Access to all of these areas shall be controlled by a receptionist, who shall direct visitors to appropriate areas of the building, and shall restrict access as required.

5.4.2.B. Specific Requirements

The following specific requirements shall apply:

(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
(4)	Size of access openings:	6'-0" x 9'-0" personnel 3'-6" x 9'-0" personnel 3'-0" x 7'-0" personnel 8'-0" x 9'-0" service

(5) Special equipment:

Lobby, offices, and conference room:	Fixtures, furnishings, and equipment
Computer room:	Consoles, fixtures, furnishings, and equipment
Toilets:	Metal toilet partitions Toilet accessories Mirrors
Lunchroom:	Vending machines Microwave oven Cooktop and oven Refrigerator/freezers Tables and chairs
Training room:	Audio-visual equipment Training equipment Tables and chairs
Photocopy alcoves:	Photocopy machines Storage and equipment
Receiving and storage:	Storage shelving Desk, table, chairs, etc.

5.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

5.5.1 DESIGN CRITERIA

No specific design criteria are cited.

5.5.2 BASIS FOR DESIGN

Heavy material handling and maintenance equipment shall not be provided in the Administration Building. The normal maintenance and repair of the mechanical and electrical equipment in this building shall be supported by the Site Services Building.

5.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

5.7 MECHANICAL PROCESS

5.7.1 DESIGN CRITERIA

Sanitary plumbing shall be provided for the building occupancy to such areas as the restrooms, lunchroom, janitor sinks, and water coolers. Sanitary water shall be obtained by connecting the building service to the MRS Facility water distribution grid. Sanitary sewer shall be connected to the MRS Facility sanitary sewer system.

Fire protection shall be provided by a wet-pipe sprinkler system fed from the MRS Facility water distribution grid.

5.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Plant air, at 125 psi, for operation of one pneumatic tool at 25 scfm.

(2) Instrument air, at 100 psi, for operation of 10 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and process water for hot water boilers based on a duty of 864 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in. fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, drinking, and restrooms.

5.8 INSTRUMENTATION AND CONTROL

5.8.1 DESIGN CRITERIA

No specific design criteria are cited.

5.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria shall be used.

(1) An area shall be provided for a computer room with 12-in.-deep, entrenched and covered floor for cable routing. A Distributed Control System (DCS) terminal shall be provided for data acquisition of the process and support systems.

(2) The DCS monitoring and data acquisition system shall consist of a color CRT remote terminal, line printer, and a video copier. There shall be no process control from this building.

(3) The DCS monitoring and data acquisition system shall be connected by fault-tolerant data highways, redundant in nature, including diverse routing of paths.

(4) The general-purpose computer system mainframe components, two operator's consoles each with CRT and keyboard, two KSR printers, and one line printer shall be provided for administrative business functions.

(5) A single-point instrument ground system shall be provided that conforms to the requirements of the computer manufacturer.

5.9 PIPING

5.9.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to restrooms, lunchroom, janitor sinks, and water coolers. Sanitary water shall be obtained by connecting the building service to the MRS Facility water distribution grid. Sanitary sewer shall be connected to the MRS Facility sanitary sewer system. Process water shall be provided to the mechanical equipment rooms, and shall be separated from the sanitary system by a backflow preventer. Sanitary sewer shall be provided in the lunchroom, restrooms, janitor sinks, and other sanitary plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the mechanical equipment rooms.

5.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

5.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Sanitary water is interpreted as potable water.

Piping runs shall be concealed in ceilings, walls, and furred spaces in office areas of the building. Piping runs shall be exposed in the mechanical equipment rooms of the building.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

Hot and cold water piping shall be insulated.

Floor drain shall be provided for the recessed floor of the computer room, and connected to the sanitary sewer system.

5.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Fuel oil supply to the heating boiler shall be provided.

Natural gas supply to the heating boiler shall be provided as an alternate fuel, if available.

Meters shall be provided to monitor the fuel usage for the building.

Process water for heating system makeup shall be provided. Process water shall be supplied from the potable water system. The process water shall be separated from the potable water by backflow preventers.

Plant air and instrument air shall be supplied from the Security Building air systems. Plant air utility stations for air tools shall be provided in the boiler room and HVAC equipment room. Instrument air shall also be provided in the boiler room and HVAC equipment room.

Equipment drains and funnel drains shall be provided in the boiler room and connected to the oily sewer.

Boiler blowdown drain shall be provided in the boiler room and connected to the process sewer.

HVAC equipment drains shall be provided in the mechanical equipment room and connected to the process sewer.

The fuel oil supply, natural gas supply, process sewer, oily sewer, and plant air and instrument air shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

Piping runs shall be exposed in the boiler room and HVAC equipment rooms.

5.10 ELECTRICAL

5.10.1 DESIGN CRITERIA

The following electrical design criteria shall apply.

5.10.1.A. Power Service

Electrical power for the building shall be obtained from a transformer fed from the MRS Facility main electrical substation. Building distribution voltages shall be 480Y/277 volts, 3 phase, 4 wire, and 208Y/120 volts, 3 phase, 4 wire. Wall receptacles shall be 120 volts, single phase.

5.10.1.B. Lighting

Interior lighting shall be provided by 277-volt, high-efficiency fluorescent fixtures. Exterior lighting shall be provided by a type of high-intensity discharge (HID) luminaire. Emergency lighting shall be provided for exit lights and corridors.

5.10.1.C. Communications

A central telephone equipment room shall be provided, with telephone raceways provided for each office, conference room, and the lunchroom. In addition, a paging system shall be installed in the corridors with the master station in the building lobby.

A fire alarm system shall be provided throughout the building. It shall include manual pull stations at all exits, audible evacuation alarms, sprinkler and box zone annunciation, and a modular control panel with supply valve supervisory circuits. The alarm system shall connect to an emergency power supply, and to the MRS Facility Fire Station and the Security Building. Battery power supply shall be acceptable.

5.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following design criteria shall be used.

5.10.2.A. Power Service

Building power shall be provided by a double-looped, 4.16-kV primary feeder system. A single, dry-type, outdoor pad-mounted transformer shall transform the primary voltage to 480Y/277 volts for all power and lighting loads. Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels shall be used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installations outdoors shall be of weatherproof construction.

5.10.2.B. Lighting

1. General. In general, 277 volts shall be used for HID and fluorescent lighting. In some cases, the lighting system may be 120 volts when incan-

descent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in areas where continuous work is to be performed, such as offices, control rooms, and corridors. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps. Fluorescent fixtures in mechanical and electrical rooms shall be of the industrial type with rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and of the energy-efficient type.

HID light fixtures shall be used on the exterior of the building. Ballasts with integral fuses shall be used with all HID light fixtures.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be on time-switch control with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are used intermittently, such as janitors' closets.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. This system shall automatically switch to the emergency power upon loss of normal power, and shall consist of individual, battery-operated emergency units, with 120-volt ac output. Emergency power shall be supplied to selected lights at stairways, corridors, computer room, and other specified areas.

The battery shall have capacity for 90 minutes of continuous operation. Emergency lighting circuits shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. General-purpose street and area lighting for ramps, parking areas, and lighting in outdoor and night operational areas shall be of the HID type. Lighting shall be photoelectric, relay-controlled with manual switch override. Outdoor floodlighting shall be provided for ramps and entrance areas.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. The entire exit lighting system shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided for all emergency exits and passageways, as required by NFPA Life Safety Code No. 101.

The electrical power source for the exit lighting system shall be connected to the normal power source. When battery-powered, individual emergency lighting units are used, these shall be considered as separate standby systems, but shall be served from the same normal supply serving the exit lighting in the immediate area of application.

Exit lights and signs shall be combined in an internally illuminated fixture with translucent globe or letters, as approved by the Underwriters' Laboratories, Inc., for this service.

5.10.2.C. Communications

1. Public Address System. A public address system shall be installed in the Administration Building for paging. The system shall be provided with two paging zones and shall operate as follows:

(1) Zone 1: All calls; this zone shall cover all areas of the Administration Building.

(2) Zone 2: This zone shall be initiated from the Site Services Building and shall override Zone 1 for priority calls.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all large paging areas.

The public address system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering. The master station shall be located in the main lobby.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 coded transmitter for transmitting an alarm signal to the MRS Fire Station and Security Building. The interface point with the MRS Fire Station and Security Building shall be determined during design. The annunciator panel shall be located in the lobby area. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL-listed; and shall be installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main Electronic Private Automatic Branch Exchange (EPABX) equipment shall be located in the Site Services Building. Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

5.11 HVAC

5.11.1 DESIGN CRITERIA

Comfort heating and air conditioning shall be provided for normal office-type occupancy.

5.11.1.A. General Requirements

Refer to Section 1.3.1.C, Classifications, and Section 1.3.1.D.2, Design Loads Non-Category I Structures.

5.11.1.B. Specific Design Requirements

1. Inside Design Conditions. No specific design criteria are cited.

2. Energy Conservation. To the degree practical, an economy cycle shall be provided to automatically control the desired air-conditioning effect while conserving energy.

3. Cooling System. No specific design criteria are cited.

4. Heating System. No specific design criteria are cited.

5. Air Supply and Exhaust System. No specific design criteria are cited.

6. Standby Power Requirements. No specific design criteria are cited.

5.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following design criteria shall be used.

5.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) system shall maintain the temperature, humidity, and ventilation requirements for personnel comfort and safety.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2.

5.11.2.B. Specific Requirements

1. Inside Design Conditions.

   (1) Summer. Inside design temperature for personnel comfort shall be 15°F less than the 2-1/2% outside dry bulb (DB) condition as given in the ASHRAE Handbook of Fundamentals, but shall not be less than 76°F DB or more than 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), temperature may be slightly higher, but not more than 90°F DB.

(2) Winter. Inside design temperature for personnel comfort shall be 72°F DB for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), temperature may be slightly lower, but not less than 50°F DB.

Depending on outside design conditions, humidification may be required to raise relative humidity to 20%.

2. Energy Conservation. An energy conservation analysis shall be performed to optimize the HVAC system design and to evaluate the cost effectiveness of an economizer cycle.

Recirculation shall be employed to the maximum extent practicable; therefore, heat recovery shall not be used for the Administration Building.

3. Cooling System. The required cooling shall be provided by a split, direct-expansion cooling system using an air-handling unit and an air-cooled condensing unit.

4. Heating System. Hot water generated by a local hot water boiler shall be used to provide the required heating.

5. Air Supply and Exhaust System. Outside and recirculated air shall be filtered through 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters. A supply fan shall distribute the air through a duct system to the various rooms within the building, including the computer room, which shall have air supplied overhead and below the raised floor. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following minimum air change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour

The air from the toilet areas shall be exhausted to the outside. These areas shall be maintained under negative pressure.

6. Standby Power Requirements. Not required for the HVAC equipment in this building.

5.12 FIRE PROTECTION

5.12.1 DESIGN CRITERIA

Fire protection shall be provided by a wet-pipe sprinkler system fed from the MRS Facility water distribution grid.

5.12.2 BASIS FOR DESIGN

5.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the Administration Building, except in the computer room. The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid as specified.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13 and shall be 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 shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for a secondary water supply to the installed sprinkler systems.

5.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire protection system provided for the Administration Building, and shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

5.12.2.C. Halon 1301 System

The computer room is an area of high value and high program importance, and shall be provided with a total-flooding Halon 1301 system. The system shall consist 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.

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SECTION 6

SECURITY BUILDING

6.1 INTRODUCTION

6.1.1 DESIGN CRITERIA

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas.

6.1.2 BASIS FOR DESIGN

The Security Building shall provide for the requirements of Section 6.1.1. In addition, it shall include offices, a conference room, an exercise room, a multipurpose room, weapons storage, toilets and lockers, and enclosed security vehicle parking.

6.2. CIVIL AND SITE DEVELOPMENT

6.2.1. DESIGN CRITERIA

No specific design criteria are cited.

6.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

6.2.2.A. Parking

Parking for employees working in the Security Building shall be provided outside the Main Gate/Badgehouse. In addition to the parking enclosure directly adjoining the Security Building, parking for security vehicles shall be provided adjacent to the Security Building. This parking lot shall also serve the Fire Station.

6.2.2.B. Landscaping

Landscaping shall be provided around the entrance to the Security Building.

6.3 STRUCTURAL

6.3.1 DESIGN CRITERIA

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas. These alarm monitoring stations shall be hardened (per criteria in UL 752), controlled access buildings.

6.3.2 BASIS FOR DESIGN

The Security Building shall be a concrete block wall building, with a hardened, bullet-resistant area, constructed of reinforced concrete roof and walls. It shall have a metal deck roof, slab-on-grade floor, and continuous wall footings.

In the hardened area, the walls [including windows, ceiling (roof), and floor] shall be constructed of materials capable of a bullet-resistant rating as defined in Standard for Safety UL752 by Underwriters' Laboratories. The power rating for the projectile shall be the "High-Rifle" rating, as shown in Table 3.1 of UL752.

6.3.2.A. Classification

The Security Building shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

6.3.2.B. Design Loads

The design loads shall comply with applicable portions of reference Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Impact load	5
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)
Hoist load	13

6.3.2.C. Load Combinations (Reference Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ (L + H)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

6.3.2.D. Design Methods

The design methods shall be in accordance with portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

6.3.2.E. Structural Materials

1. Concrete: 3,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185
   Masonry reinforcing steel: ASTM A615, Grade 40

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

4. Masonry: ASTM C90, Grade N, f'm = 1,350 psi

6.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

1. Bearing capacity: 4,000 psf for compacted fill or natural soil
   15,000 psf for bedrock or unweathered rock
   1/3 increase for wind and seismic

2. Frost line: 2 ft below grade

3. Friction: 0.5

4. Passive soil pressure: 400 pcf

6.4 ARCHITECTURAL

6.4.1 DESIGN CRITERIA

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas.

6.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

6.4.2.A. General Requirements

1. Security Building. The Security Building shall be located near the Administration Building and shall serve as the security headquarters for the MRS Facility. Security surveillance shall be provided throughout the site, using control alarm and remote surveillance systems also found in the Protected Area Gatehouse. Security clearance and badging operations shall be provided in the Main Gate/Badgehouse as described in Section 7.4.

2. Building Design Description. The building shall be a two-level (ground level and lower level), reinforced masonry and reinforced concrete structure, with structural steel roof framing and metal panel fascias and soffits. The hardened area shall have reinforced concrete walls and roof. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

3. Security Staffing. The Security Building shall normally be occupied by eight security personnel during the day shift and three during the other shifts. Eleven additional Security/Patrol Officers shall serve at various locations throughout the site during the day shift, and nine during the other shifts. These personnel shall report to the Security Building. The

24-hr security force shall be 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				Total
	Day	2nd	3rd	4th	
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 shall occupy permanent stations or offices; the Security/Patrol Officers shall occupy various work stations throughout the site, such as gatehouses, site patrol, and inspections.

4. Personnel Facilities. The Security Building shall have a lobby/waiting area and exercise room for personnel. Adequate restrooms, lockers, and shower facilities shall be provided for both men and women personnel, who shall change into duty uniforms or back into street clothes. A multipurpose room shall be provided for lunches, meetings, briefings, etc.

5. AMS Facility. The AMS guards shall be assigned to a hardened AMS in the basement with uninterruptible power supply (UPS), and HVAC and electrical equipment on the ground level to enable continuous operation during an emergency. A hardened weapons storage vault shall also be provided.

6. AMS Equipment. Equipment within the hardened area shall include the following:

(1) A two-way radio communication system.

(2) A monitoring console for CCTV cameras throughout the facility.

(3) Evacuation and criticality alarms.

(4) A security/safety console with monitoring panels that indicate alarms for fire, intrusion detection, and other designated facility security and safety signals.

(5) Access control system.

(6) Computer.

7. Parking. A security patrol vehicle parking enclosure shall be provided directly adjoining the Security Building.

6.4.2.B. Specific Requirements

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
		9'-4" for lower-level control equipment and computer room and control alarm and remote surveillance room
		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; pallet trucks for lower-level access hatch; 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.	Special equipment:	
	Lobby, offices:	FF&E
	Multipurpose:	Vending machines Kitchen unit Microwave oven Tables and chairs
	Control alarm and remote surveillance:	Monitoring console Security/safety console
	Exercise room:	Exercise equipment

Toilets:	Metal toilet partitions Toilet accessories Mirrors Lockers - double tier Prefabricated metal shower enclosures
Photocopy alcove:	Photocopy machine Clothing storage rack
Weapons storage:	Gun racks Ammunition storage

6.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

6.5.1 DESIGN CRITERIA

No specific design criteria are cited.

6.5.2 BASIS FOR DESIGN

Heavy material-handling and maintenance equipment shall not be required in the Security Building. The normal maintenance and repair of the mechanical and electrical equipment in this building shall be by a crawl-beam-mounted, 3-ton, hand-chain-operated hoist.

6.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

6.7 MECHANICAL PROCESS

6.7.1 DESIGN CRITERIA

No specific design criteria are cited.

6.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Plant air, at 125 psi, for operation of one pneumatic tool at 25 scfm.

(2) Instrument air, at 100 psi, for operation of 10 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and process water for hot water boilers based on a duty of 528 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in. fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, drinking, restrooms, eyewash, and safety showers.

6.8 INSTRUMENTATION AND CONTROL

6.8.1 DESIGN CRITERIA

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas.

All security alarms, fire alarms, evacuation alarms, or any other alarm that would require a security force response shall annunciate at the Protected Area Gatehouse as the primary location and at the Security Building as the backup or redundant location. These alarm stations shall be hardened controlled access buildings with capabilities to communicate to all security personnel and offsite law enforcement agencies.

6.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria shall be used.

6.8.2.A. Alarm Monitoring Stations

1. Two alarm monitoring stations (AMS) shall provide centralized access control, intrusion detection, alarm monitoring, and event recording for the MRS Facility. The primary AMS shall be located in the Protected Area Gatehouse and the redundant AMS shall be located in the Security Building. With the exception of the intrusion detectors, access card readers, closed-circuit television (CCTV) cameras, and other detectors, all equipment at these two locations shall be duplicated.

2. The alarm monitoring stations shall be independent of all other systems. They shall be provided with independent battery backup power supplies. All detection/alarm devices, including transmission lines to annunciators, shall be failure- and tamper-indicating.

3. CRT terminals and printers for all security alarms, fire alarms, evacuation alarms, radiation alarms, criticality alarms, or any other alarms

that would require a security force response shall be provided for the alarm monitoring stations. Instrumentation shall also be provided with the capability of automatically activating appropriate visual and audible alarms located in the operating areas of the MRS Facility.

4. Instrumentation for monitoring the access control systems of the R&H Building and storage areas shall be provided for the alarm monitoring stations.

6.8.2.B. Closed-Circuit Television

1. The AMSs shall be provided with a CCTV system to assist in security surveillance. TV cameras shall be installed around the MRS Facility perimeter, various gatehouses, and Security Building. All TV cameras shall be designed for remote operation and control. Those used for surveillance, and possibly other TV cameras, shall have the capability for control and operation from at least two separate, monitoring stations. All TV cameras shall be designed to permit removal for maintenance.

2. The TV viewing monitors located in the redundant AMS shall back up those located in the primary AMS in order to provide an alternate capability for security operations if the primary AMS is compromised. All TV viewing monitors shall be provided with selective switching capabilities to enable them to monitor the area surveyed by any TV camera in the MRS Facility.

6.9 PIPING

6.9.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to restrooms, locker room, multipurpose room, janitor sinks, and water coolers. Safety showers and the eyewash station in the battery room shall also be provided and connected to the sanitary cold water system. Process water shall be provided to the mechanical equipment rooms, and shall be separated from the sanitary system by backflow preventers.

Sanitary sewer shall be provided in the restrooms, locker room, multipurpose room, janitor sinks, and other plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the mechanical equipment rooms.

6.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

6.9.2.A. Plumbing

Sanitary water is interpreted as potable water.

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office areas of the building. Piping runs shall be exposed in the mechanical equipment rooms and electrical equipment room of the building.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

A safety shower and eyewash station to comply with ANSI Z358.1 shall be provided in the battery room, and shall be supplied from the cold potable water system.

Hot and cold water piping shall be insulated.

6.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Fuel oil supply to the heating boiler shall be provided.

Natural gas supply to the heating boiler shall be provided as an alternate fuel, if available.

Meters shall be provided to monitor the fuel usage for the building.

Process water for heating system makeup shall be provided. Process water shall be supplied from the potable water system. The process water shall be separated from the potable water by backflow preventers.

Plant air and instrument air shall be supplied from equipment in the Security Building.

Plant air utility stations for air-tool use shall be provided in the boiler room, mechanical and electrical equipment rooms, and air compressor room.

Instrument air shall be provided in the boiler room and mechanical and electrical equipment rooms.

The plant air and instrument air systems shall provide plant air and instrument air to the Administration Building and the Fire Station.

Equipment and funnel drains shall be provided in the boiler room and connected to the oily sewer.

Boiler blowdown drain shall be provided in the boiler room and connected to the process sewer.

HVAC equipment drains shall be provided in the mechanical equipment room and shall be connected to the process sewer.

A floor sump shall be provided in the battery room, and shall be drained by portable pump when necessary.

The fuel oil supply, natural gas supply, process sewer, oily sewer, and plant air and instrument air shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

6.10 ELECTRICAL

6.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

6.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following design criteria shall be used.

6.10.2.A. Power Service

Normal building power shall be obtained from a double 4.16-kV primary feeder configuration system. Single, dry-type, indoor, load-center-unit substations shall transform the primary voltage to 480Y/277 volts for all power and lighting loads. If a failure of the normal feeder occurs, power shall switch to the standby feeder automatically, with minimum transfer time. Dry-type, 480-208Y/120-volt, 3-phase transformers and circuit-breaker distribution panels shall be used in a radial-type distribution system for receptacles, small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use.

In case of a normal primary feeder failure, critical building power shall be provided by a single 4.16-kV primary feeder from the standby generator system. A single, dry-type, indoor load-center-unit substation shall transform the primary voltage to 480Y/277 volts for critical power and lighting loads. A feeder shall be provided to supply the Protected Area Gatehouse standby loads.

An uninterruptible power supply (UPS) system shall be provided for surveillance monitoring, fire alarms, access control, computer, and emergency lighting. The inverter output shall be 480Y/277 volts, 3 phase, connected to a UPS bus from which all UPS loads shall be powered. The battery bank shall be rated at 125 volts, with ampere-hour capacity sufficient to sustain the entire UPS load for a period of 90 minutes with a final volts per cell not to be below 1.75.

6.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system may be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in areas where continuous work is to be performed, such as offices, control rooms, and corridors. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps.

Fluorescent fixtures in mechanical and electrical rooms shall be of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID lighting fixtures shall be used on the exterior of the building.

Essential lighting fixtures shall be connected to the UPS system.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be of the HID type with solar-compensated time-switch control and manual and/or photocell override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as janitors' closets.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during total power outage. Individual battery-operated fixtures or emergency lighting units shall be provided at stairways, corridors, and in the control room.

Wiring for the emergency system shall be in separate conduits. Emergency lighting circuits shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. General-purpose street and area lighting for ramps, parking areas, and lighting in outdoor and night operational areas shall be of the HID type. Lighting shall be photoelectric relay-controlled with manual switch override.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. The entire exit lighting system shall be considered as an emergency system, and shall be installed in conduit or tubing per Article 700 of the NEC. Illuminated exit signs shall be provided for all emergency exits and passageways, as required by NFPA Life Safety Code No. 101.

Only one switch and overcurrent device shall be installed in the supply circuit for exit lighting. The unit shall be tamperproof.

Exit lights and signs shall be combined in an internally illuminated fixture with translucent globe or letters, as approved by Underwriters' Laboratories, Inc., for this service.

6.10.2.C. Communications

1. Public Address System. A public address system shall be installed in the Security Building for paging. The system shall be provided with two paging zones, and shall operate as follows:

(1) Zone 1: All calls; this zone shall cover all areas of the Security Building.

(2) Zone 2: This zone initiates from the Site Services Building, and shall override Zone 1 for priority calls.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all large paging areas.

The public address system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station shall be determined during final design. The annunciator panel shall be located in the lobby area. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL listed; and shall be installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main Electronic Private Automatic Branch Exchange (EPABX) equipment shall be located in the Site Services Building. Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit unless otherwise directed.

4. Radio System. For security of communications, a land mobile UHF radio system, including handheld portable radios, shall be provided. This system shall have the capability of contacting local law-enforcement agencies.

5. Intrusion Alarm System. A central microprocessor shall be located in the Security Building to control, monitor, and scan security information relative to:

(1) Electrostatic field sensor
(2) Fence distrubance detection system
(3) Door alarms
(4) Card-key access control

All security system wiring shall be installed in a rigid metallic conduit system.

6. Intercommunication System. An intercommunication system shall be provided between the Security Building and card-key reader location to supplement the operation of the card access reader if it fails.

6.11 HVAC

6.11.1 DESIGN CRITERIA

No specific design criteria are cited.

6.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

6.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) systems shall provide the temperature, humidity, and ventiliation required for personnel comfort and equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

6.11.2.B. Specific Requirements

1. Inside Design Conditions: Summer. Inside design temperature for personnel comfort shall be 15°F less than the 2-1/2% outside dry bulb (DB) condition as given in the ASHRAE Handbook of Fundamentals, but shall not be less than 76°F DB or more than 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), inside temperature may be slightly higher, but not more than 90°F DB.

2. Inside Design Conditions: Winter. Inside design temperature for personnel comfort shall be 72°F DB for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), temperature may be slightly lower, but not less than 50°F DB.

Depending on outside design conditions, humidification may be required to raise indoor relative humidity to 20%, or as required for equipment operation.

3. Energy Conservation: Nonhardened Area. An energy conservation analysis shall be performed to optimize the HVAC system design and to evaluate the cost effectiveness of an economizer cycle.

Recirculation shall be employed to the maximum extent possible; therefore, heat recovery shall not be used for this area.

4. Energy Conservation: Hardened Control Room and UPS Area. Recirculation shall be used to the maximum extent possible; however, because of the very small size of this area, economizer or heat recovery shall not be used.

5. Cooling System: Nonhardened Area. The required cooling shall be provided by a split, direct-expansion cooling system using an air-handling unit and an air-cooled condensing unit.

6. Cooling System: Hardened Control Room and UPS Area. An indoor-type, single package air-cooled unit with a direct-expansion-type cooling coil shall provide the required cooling for the hardened area. The unit shall be located in a hardened mechanical equipment room.

7. Heating System. Hot water generated by a local hot water boiler shall be used to provide the required heating in both hardened and nonhardened areas.

8. Air Supply and Exhaust System: Nonhardened Area. Outside and recirculated air shall be filtered through 30% ASHRAE atomospheric dust spot efficiency prefilters and 85% ASHRAE atomospheric dust spot efficiency final filters. A supply fan shall distribute the air through a duct system to the different rooms within the building. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following minimum air-change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour

The air from the storage and toilet areas shall be exhausted to the outside. These areas shall also be maintained under negative pressure.

9. Air Supply and Exhaust System: Hardened Control Room and UPS Area. The single package cooling unit, with built-in cooling coil and a hot water heating coil inside the duct, shall be located in the hardened mechanical equipment room to provide conditioned air for this area.

A fixed quantity of outside air mixed with the recirculated air shall pass through 30% ASHRAE atomospheric dust spot efficiency prefilters and 85% ASHRAE atomospheric dust spot efficiency final filters, and shall be distributed to the different rooms through a duct system.

A return air fan shall not be used for this area; however, an exhaust fan shall be used for the exhaust of the battery rooms. Battery room ventilation rate shall be maintained at a minimum of 5 air changes per hour. An additional exhaust fan shall be provided for the exhaust of Halon after discharge. The Halon exhaust fan shall operate on an as-needed basis.

Airflow rates shall be maintained as required for temperature control and to meet ventilation and exhaust requirements.

10. Standby Power Requirements: Nonhardened Area. Standby power shall not be required for the HVAC equipment in this area.

11. Standby Power Requirements: Hardened Area. Standby power shall be provided for the entire HVAC system in the hardened area.

6.12 FIRE PROTECTION

6.12.1 DESIGN CRITERIA

No specific design criteria are cited.

6.12.2 BASIS FOR DESIGN

6.12.2.A. Fire Protection

Fire protection shall be provided throughout the Security Building. It shall include an automatic wet-pipe sprinkler system, a Halon 1301 system, and portable fire extinguishers.

6.12.2.B. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the facility except in electrical equipment rooms. The system shall be designed in accordance with NFPA 13 and shall be complete; piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping material at penetrations through walls, shall be provided.

Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

6.12.2.C. 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) shall be provided with a total-flooding Halon 1301 system (with sprinklers provided as a secondary system for basic building protection). The system (which shall consist of fixed piping manifolded racks, cylinders, detectors, circuits, alarms, and controls) shall be designed to provide detection, alarm, and extinguishment of fire in accordance with NFPA 12A.

The electrical equipment rooms shall be protected by the Halon 1301 system only.

6.12.2.D. Portable Fire Extinguishers

Portable fire extinguishers shall be provided for the Security Building in accordance with NFPA 10.

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SECTION 7

MAIN GATE/BADGEHOUSE

7.1 INTRODUCTION

7.1.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

7.1.2 BASIS FOR DESIGN

The Main Gate/Badgehouse shall provide for the requirements of Section 7.1.1. In addition, it shall provide the initial observation and inspection functions for all non-cask transport vehicles, as well as badge control for all visitors and personnel entering and leaving the site.

7.2 CIVIL AND SITE DEVELOPMENT

7.2.1. DESIGN CRITERIA

No specific design criteria are cited.

7.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

7.2.2.A. Parking

Parking for employees working in the Main Gate/Badgehouse shall be provided in the employee parking lot, which shall be located outside the Main Gate/Badgehouse. Additional parking shall be provided in the onsite parking lot between the Administration Building and the Main Gate/Badgehouse.

7.2.2.B. Landscaping

Landscaping shall be provided on all sides of the Main Gate/Badgehouse. The area between the employee parking lot and the Main Gate/Badgehouse shall also be landscaped.

7.3 STRUCTURAL

7.3.1 DESIGN CRITERIA

No specific structural design criteria are cited.

7.3.2 BASIS FOR DESIGN

The Main Gate/Badgehouse shall be constructed of concrete block walls, slab-on-grade floor, and metal deck roof. The guard booth shall be constructed of materials capable of a bullet-resistant rating as defined in Standard for Safety UL752 by Underwriters' Laboratories. The power rating for the projectile shall be the "High-Rifle" rating, as shown in Table 3.1 of that document.

7.3.2.A. Classification

The Main Gate/Badgehouse shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

7.3.2.B. Design Loads

The design loads shall be in accordance with applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)

7.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ L$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

7.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Wall footings	6
Sliding and overturning	FS = 1.5	7

7.3.2.E. Structural Materials

Structural materials shall include the following:

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185

Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

7.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind or seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

7.4 ARCHITECTURAL

7.4.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

7.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

7.4.2.A. General Requirements

The Main Gate/Badgehouse shall provide the initial observation and inspection functions for all vehicles (except transporter vehicles) entering the site, as well as badge control for all visitors (escorted and unescorted) and personnel entering and leaving the site. All transporter vehicles shall be inspected at the Inspection Gatehouse as described in Section 8.4.2.

1. The building shall be a single-story, reinforced masonry walled structure with structural steel roof framing and metal panel fascias and soffits. The vehicle inspection area shall be covered by a metal roof and fascia supported by structural steel columns and beams. The hardened guardroom shall have reinforced concrete and masonry walls and bullet-resistant glass windows. The roof shall be of reinforced concrete. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

2. The Main Gate/Badgehouse shall normally be occupied by three security personnel on each of four shifts: two guards and a badge/clearance processing clerk.

3. The Main Gate/Badgehouse shall contain three main rooms: a passage and waiting room, a badge clearance processing room, and a guardroom. Toilets for men and women shall be available to both visitors and employees. There shall also be an electrical equipment room.

4. Unescorted visitors and employees whose destination is the Administration Building shall be directed to a separate door and vestibule leading to an exterior fenced area. At the opposite end of this fenced area shall be the entrance to the Administration Building lobby. Employees and escorted and unescorted visitors, whose destination is one of the other areas of the site, shall pass through a vestibule and exit doors to the exterior. Most of the remaining site facilities shall be easily reached on foot and, in some instances, onsite vehicles may be used.

5. Normally, all private vehicles shall park offsite, not being allowed onsite past the Main Gate/Badgehouse. Only transport vehicles, delivery vehicles, and other authorized vehicles shall be permitted on the site.

6. The vehicle inspection area shall be a covered area, just inside the main gates, controlling entrance to and exit from the MRS Facility. The roadway shall pass directly through the inspection area, and shall be suitable for delivery vehicles and any other vehicles authorized for access to the site. Electrically controlled lift gates shall control traffic until inspections are complete.

7.4.2.B. Specific Requirements

Specific requirements for the design and construction of the Main Gate/Badgehouse are as follows:

(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)	Special equipment:	
	Passage and waiting room:	Seating
	Guardroom:	Table, chairs
	Toilets:	Toilet accessories Mirrors

7.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

7.5.1 DESIGN CRITERIA

No specific design criteria are cited.

7.5.2 BASIS FOR DESIGN

Heavy material-handling and maintenance equipment shall not be required in the Main Gate/Badgehouse. The normal maintenance and repair of the mechanical and electrical equipment in this building shall be supported by the Site Services Building.

7.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

7.7 MECHANICAL PROCESS

7.7.1 DESIGN CRITERIA

No specific design criteria are cited.

7.7.2 BASIS FOR DESIGN

The following utilities shall be provided: potable water for fire protection, drinking, and restrooms.

7.8 INSTRUMENTATION AND CONTROL

7.8.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

7.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to enable the guard(s) to transmit a security alarm-condition signal to the primary and backup alarm monitoring stations. A building alarm system shall also be provided.

7.9 PIPING

7.9.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to the restrooms and water cooler. Sanitary sewer shall be provided in the restrooms and other sanitary plumbed areas.

7.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

7.9.2.A. Plumbing

Sanitary water is interpreted as potable water.

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office areas of the building.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

Hot and cold water piping shall be insulated.

7.9.2.B. Piping

Not applicable to this building.

7.10 ELECTRICAL

7.10 1 DESIGN CRITERIA

No specific design criteria are cited.

7.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following criteria shall be used.

7.10.2.A. Power Service

Building power shall be obtained from a motor control center located at the Administration Building. The service feeder shall be 480Y/277 volts for distribution to all power and lighting loads. A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel shall be used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installations outdoors shall be of weatherproof construction.

7.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in all open areas. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps. Fluorescent fixtures in the electrical room shall be of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected Class P, CBM-certified, high-power-factor type, and of the energy-efficient type.

HID luminaires shall be used on the exterior of the building. Ballasts with integral fuses shall be suitable for use with HID lamps.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be time-switched with manual override control.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as rest rooms.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. This system shall consist of self-contained, battery-operated emergency equipment.

The battery shall have capacity for 90 minutes of continuous operation. Wiring for the emergency system shall be in a separate conduit. The emergency lighting circuit shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation.

Lighting shall be photoelectrically relay-controlled, with a manual switch override. Outdoor floodlighting shall be provided for the vehicle inspection area and the security fence perimeter.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. All exit lighting shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

Only one switch and overcurrent device shall be installed in the supply circuit for exit lighting.

7.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Main Gate/Badgehouse for paging. The system shall be provided with one paging zone and shall be initiated from the Site Services Building or by telephone access from selected locations within the Main Gate/Badgehouse.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station and Security Building shall be determined during final design. The annunciator panel shall be located at the guard station. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL-listed; and shall be installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Main Gate/Badgehouse as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

7.11 HVAC

7.11.1 DESIGN CRITERIA

No specific design criteria are cited.

7.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

7.11.2.A. General Requirements

The HVAC system shall provide the temperature and ventilation required for personnel comfort.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2.

7.11.2.B. Specific Requirements

1. Inside Design Conditions. Inside design temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as restrooms and equipment rooms), inside temperature shall be maintained between 65°F DB and 90°F DB. Humidification shall not be provided for this building.

2. Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas.

3. Heating and Cooling System. Heating and cooling shall be provided by a single packaged heat pump located outside the building.

4. Air Supply System. Outside and recirculated air shall pass through 30% ASHRAE atmospheric dust spot efficiency filters, and a supply fan shall distribute the air through a duct system to the different rooms within the area.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas. Toilet rooms shall be provided with an air change rate of 12 air changes per hour. The airflow from the toilet area shall be exhausted to the outside. This area shall be maintained under negative pressure.

5. Standby Power Requirement. Standby power shall not be required for the HVAC equipment in this building.

7.12 FIRE PROTECTION

7.12.1 DESIGN CRITERIA

No specific design criteria are cited.

7.12.2 BASIS FOR DESIGN

7.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the Main Gate/Badgehouse.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13. It shall be 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.

An automatic dry-pipe sprinkler system shall be provided for the sheltered area under the canopy.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for use as a secondary water supply for the installed sprinkler systems.

7.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 8

INSPECTION GATEHOUSE

8.1 INTRODUCTION

8.1.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

8.1.2 BASIS FOR DESIGN

The Inspection Gatehouse shall provide for the requirements of Section 8.1.1. In addition, it shall provide the initial observation and inspection functions for all rail and transport vehicles entering and leaving the site.

8.2 CIVIL AND SITE DEVELOPMENT

8.2.1. DESIGN CRITERIA

No specific design criteria are cited.

8.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

8.2.2.A. Parking

Parking shall be provided for the inspectors who are dispatched to the Inspection Gatehouse when a shipment arrives.

8.2.2.B. Landscaping

No landscaping shall be provided for this facility.

8.3 STRUCTURAL

8.3.1 DESIGN CRITERIA

No specific structural design criteria are cited.

8.3.2 BASIS FOR DESIGN

The Inspection Gatehouse shall be constructed of concrete block walls, slab-on-grade floor, and metal deck roof. The hardened guardroom shall be constructed of materials capable of a bullet-resistant rating as defined in Standard for Safety UL752 by Underwriters' Laboratories. The power rating for the projectile shall be the "High-Rifle" rating as shown in Table 3.1 of UL752. The steel canopy shall be designed as a rigid frame structure, pin supported at its base.

8.3.2.A. Classification

The Inspection Gatehouse shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

8.3.2.B. Design Loads

The design loads shall be in accordance with Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)

8.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ (L + H)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

8.3.2.D. Design Methods

The design methods shall comply with the applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Wall footings	6
Sliding and overturning	FS = 1.5	7

8.3.2.E. Structural Materials

Structural materials shall include the following:

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185

Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

8.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

8.4 ARCHITECTURAL

8.4.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

8.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

8.4.2.A. General Requirements

The Inspection Gatehouse shall provide the initial observation and inspection functions for all rail and transport vehicles entering the site on each of four shifts.

1. The building shall be a single-story, reinforced masonry walled structure with structural steel roof framing and metal panel fascias and soffits. The inspection area shall be covered by a metal roof and fascia supported by structural steel columns and beams. The hardened guard/inspector room shall have reinforced masonry walls and bullet-resistant glass windows. The roof shall be of reinforced concrete. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

2. The Inspection Gatehouse shall be temporarily occupied by three security personnel when needed, including one guard and two inspectors.

3. The Inspection Gatehouse shall contain a guard/inspector room, a storage room, and a toilet room.

4. The inspection area shall be 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 shall be split into two distinct areas: one for transport vehicle inspection, the other for railcar inspection.

5. Upon arrival at the inspection area, the offsite transport vehicle tractor shall be disengaged from the trailer and, using a turnaround area, shall be driven back out through the gates and offsite. An onsite tractor shall then be brought forth for attachment to the trailer. After the inspection is complete, the shipment shall be transported to the protected area for processing as appropriate.

6. A similar procedure shall be followed for handling rail shipments. An offsite locomotive shall be uncoupled from the rail transport cars at the inspection area, and a special onsite locomotive shall deliver the shipment to appropriate locations in the protected area.

7. Both the transport vehicle and the railcar inspection areas shall include pits for undercarriage inspection. All vehicles bearing shipments unacceptable because of radiation contamination or documentation irregularities shall be routed to an "off-normal" shipment storage area, located within the protected area of the site.

8.4.2.B. Specific Requirements

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.	Special equipment:	
	Toilet:	Toilet accessories Mirror

8.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

8.5.1 DESIGN CRITERIA

No specific design criteria are cited.

8.5.2 BASIS FOR DESIGN

Heavy material-handling and maintenance equipment shall not be required in the Inspection Gatehouse. The normal maintenance and repair of the mechanical and electrical equipment in this building shall be supported by the Site Services Building.

8.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

8.7 MECHANICAL PROCESS

8.7.1 DESIGN CRITERIA

No specific design criteria are cited.

8.7.2 BASIS FOR DESIGN

The following utilities shall be provided: Potable water for fire protection and restroom.

8.8 INSTRUMENTATION AND CONTROL

8.8.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

8.8.2 BASIS FOR DESIGN

(1) Instrumentation shall be provided to enable the guard(s) to transmit a security alarm condition signal to the primary and backup alarm monitoring stations. A building alarm system shall be also provided.

(2) Closed-circuit television (CCTV) cameras shall be provided to permit remote surveillance of the Inspection Gatehouse interior and the cask vehicle inspection area. TV cameras shall be designed with capability for remote control and operation, and to permit their removal for inspection and maintenance. The TV monitors shall have redundancy of viewing capability and operation, and shall be provided with selective switching capabilities to permit the monitoring of areas surveyed by any TV camera at the Inspection Gatehouse.

(3) Portable and, if required, permanently installed radiation monitors shall be provided for inspection of incoming vehicles (truck and railcar) delivering casks of nuclear material for processing at the MRS Facility.

(4) The monitoring instrumentation shall be independent of all other systems and shall be provided with independent battery backup power supplies. All detection/alarm devices, including transmission lines to the alarm monitoring stations, shall be failure- and tamper-indicating.

8.9 PIPING

8.9.1 DESIGN CRITERIA

Hot and cold water shall be provided to the restroom. Sanitary sewer shall be provided in the restroom.

8.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

8.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office areas of the building.

Hot potable water shall be supplied by an electric hot water heater.

Hot and cold water piping shall be insulated.

8.9.2.B. Piping

Not applicable to this building.

8.10 ELECTRICAL

8.10.1 DESIGN CRITERIA

No specific design criteria are cited.

8.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following criteria shall be used.

8.10.2.A. Power Service

Building power shall be derived from an outdoor pad-mounted transformer. The transformer shall transform the 4.16-kV primary voltage to 480Y/277 volts for distribution to all power and lighting loads. A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel shall be used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installations outdoors shall be of weatherproof construction.

8.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in office areas. Fluorescent fixtures shall have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type. HID luminaires with ballasts and integral mounted fuses shall be used on the exterior of the building..

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be on time-switch control with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as restrooms and storage rooms.

2. Emergency Lighting System. An emergency lighting system shall be provided for illumination during normal power outage. This system shall be automatically switched to emergency power upon loss of normal power, and shall consist of self-contained, individual battery-operated emergency equipment. Emergency lighting shall be installed at the guard/inspection room.

The batteries shall have capacity for 90 minutes of continuous operation. The emergency lighting circuit shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation of the inspection area.

Lighting shall be photoelectric relay-controlled, with a manual switch override.

4. Illumination Levels. The interior lighting intensities shall be 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 are determined to be needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

8.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Inspection Gatehouse and outdoor area for paging. The system shall be provided with one paging zone; it shall be initiated from the Site Services Building and by telephone access from selected locations within the Inspection Gatehouse.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include smoke detectors, fire sensors, manual fire alarm station, local audible alarm, and a coded transmitter for transmitting an alarm signal to the MRS Facility Fire Station and Security Building. The interface point with the MRS Facility Fire Station and Security Building shall be determined during final design. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; it shall be UL-listed and installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Inspection Gatehouse as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

8.11 HVAC

8.11.1 DESIGN CRITERIA

No specific design criteria are cited.

8.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

8.11.2.A. General Requirements

The HVAC system shall provide the temperature and ventilation required for personnel comfort.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2.

8.11.2.B. Specific Requirements

1. Inside Design Conditions. Inside temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as restrooms and storage rooms), inside temperature shall be maintained between 65°F DB and 90°F DB. Humidification shall not be provided for this building.

2. Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas.

3. Heating and Cooling System. Heating and cooling shall be provided by a single package heat pump located outside the building.

4. Air Supply System. Outside and recirculated air shall pass through 30% ASHRAE atmospheric dust spot efficiency filters, and a supply fan shall distribute the air through a duct system to the different rooms within the area.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas. Toilet rooms shall be provided with an air change rate of 12 air changes per hour. The air flow from the toilet area shall be exhausted to the outside. This area shall be maintained under negative pressure.

5. Standby Power Requirement. Standby power shall not be required for the HVAC equipment in this building.

8.12 FIRE PROTECTION

8.12.1 DESIGN CRITERIA

No specific design criteria are cited.

8.12.2 BASIS FOR DESIGN

8.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the Inspection Gatehouse. The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid. The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13. It shall be 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.

An automatic dry-pipe sprinkler system shall be provided for the vehicle inspection area.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

8.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 9

PROTECTED AREA GATEHOUSE

9.1 INTRODUCTION

9.1.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements. The Protected Area Gatehouse shall be a hardened, controlled access building.

9.1.2 BASIS FOR DESIGN

The Protected Area Gatehouse shall provide for the requirements of Section 9.1.1. In addition, it shall provide personnel monitoring and inspection for all employees, as well as the control alarm and remote surveillance functions.

9.2 CIVIL AND SITE DEVELOPMENT

9.2.1. DESIGN CRITERIA

No specific design criteria are cited.

9.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

9.2.2.A. Parking

Parking for the guards working in the Protected Area Gatehouse shall be provided outside the Main Gate/Badgehouse. Two parking spaces shall be provided adjacent to the Protected Area Gatehouse for onsite vehicles inside the protected area.

9.2.2.B. Landscaping

No landscaping shall be provided for this facility.

9.3 STRUCTURAL

9.3.1 DESIGN CRITERIA

The Protected Area Gatehouse shall be a hardened, controlled access building.

9.3.2 BASIS FOR DESIGN

The Protected Area Gatehouse shall be constructed of concrete block walls, slab-on-grade floor, and metal deck roof. The hardened guardroom and alarm monitoring station shall be constructed of materials capable of a bullet-resistant rating as defined in Standard for Safety UL752 by Underwriters' Laboratories. The power rating for the projectile shall be the "High-Rifle" rating as shown in Table 3.1 of UL752.

9.3.2.A. Classification

The Protected Area Gatehouse shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

9.3.2.B. Design Loads

The design loads shall be in accordance with reference Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)
Hoist load	13

9.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$$U = 1.4\ D + 1.7\ (L + H)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$$

2. Steel Structures.

$$S = D + L$$
$$1.33\ S = D + L + W$$
$$1.33\ S = D + L + E$$

9.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Wall footings	6
Sliding and overturning	FS = 1.5	7

9.3.2.E. Structural Materials

The following structural materials shall be used:

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

9.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

9.4 ARCHITECTURAL

9.4.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements. The Protected Area Gatehouse shall be a hardened, controlled access building.

9.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

9.4.2.A. General Requirements

1. The building shall be a two-level, reinforced masonry walled structure with structural steel roof framing and metal panel fascia and soffit. The lower level shall be entirely below grade, and shall be a hardened, reinforced concrete structure. The uncovered inspection area shall be in the open roadway adjacent to the building. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

The Protected Area Gatehouse shall provide 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.

2. The Protected Area Gatehouse shall normally be occupied by four security guards on each of four shifts.

3. The Protected Area Gatehouse shall contain two floors: a ground floor and a lower level. The ground floor shall contain a personnel monitoring room, where metal and explosive detectors shall be used, along with X-ray inspection. There shall also be an electrical equipment room, as well as hardened electrical and mechanical equipment rooms. A hardened access control room shall supervise passage to and from the protected area through electronically controlled turnstiles. The lower level shall house the primary alarm monitoring station (AMS) containing 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 floor. The entire lower level shall be hardened.

4. Only delivery vehicles and other authorized vehicles shall be permitted in the protected area. Vehicles approaching the double-fenced alarm zone shall come under the surveillance of the Protected Area Gatehouse, and shall be checked for authority to enter the protected area after passing through the alarm zone.

9.4.2.B. Specific Requirements

1.	UBC Occupancy Class:	B2
2.	Ceiling heights:	9'-4" for all rooms except 8'-0" for toilets 9'-4" for lower level control equipment and computer room control alarm and remote surveillance room 12'-0" for mechanical and electrical equipment rooms 11'-2" for lower level battery room and UPS room
3.	Kind of traffic:	Foot traffic in the building; delivery and other authorized vehicles in inspection area; pallet trucks for lower level access hatch
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 (Gates shall be controlled from Protected Area Gatehouse)
5.	Special equipment:	
	Toilets:	Toilet accessories Mirrors
	Access control, control alarm, and remote surveillance area:	Consoles

9.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

9.5.1 DESIGN CRITERIA

No specific design criteria are cited.

9.5.2 BASIS FOR DESIGN

Heavy material-handling and maintenance equipment shall not be required in the Protected Area Gatehouse. The normal maintenance and repair of the mechanical and electrical equipment in this building shall be by crawl-beam-mounted, 3-ton, hand-chain-operated hoist.

9.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

9.7 MECHANICAL PROCESS

9.7.1 DESIGN CRITERIA

No specific design criteria are cited.

9.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

Potable water for fire protection, restroom, and eyewash and safety showers.

9.8 INSTRUMENTATION AND CONTROL

9.8.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements. The Protected Area Gatehouse shall be a hardened, controlled access building.

The Security Building and central and secondary alarm monitoring stations shall provide facilities for the safeguards and security functions including alarm and surveillance supervisory systems housed in hardened, bullet-resistant areas.

9.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria shall be used.

9.8.2.A. Alarm Monitoring Stations

1. Two alarm monitoring stations (AMS) shall provide centralized access control, intrusion detection, alarm monitoring, and event recording for the MRS Facility. The primary AMS shall be located in the Protected Area

Gatehouse and the redundant AMS shall be located in the Security Building. With the exception of the intrusion detectors, access card readers, closed-circuit television (CCTV) cameras, and other detectors, all equipment at these two locations shall be duplicated.

2. The alarm monitoring stations shall be independent of all other systems. They shall be provided with independent battery backup power supplies. All detection/alarm devices, including transmission lines to annunciators, shall be failure- and tamper-indicating.

3. CRT terminals and printers for all security alarms, fire alarms, evacuation alarms, radiation alarms, criticality alarms, or any other alarms that would require a security force response shall be provided for the alarm monitoring stations. Instrumentation shall also be provided with the capability of automatically activating appropriate visual and audible alarms located in the operating areas of the MRS Facility.

4. Instrumentation for monitoring the access control systems of the R&H Building and storage areas shall be provided for the alarm monitoring stations.

9.8.2.B. Closed-Circuit Television

1. The AMSs shall be provided with a CCTV system to assist in security surveillance. TV cameras shall be installed around the MRS Facility perimeter, at various gatehouses, and in the Security Building. All TV cameras shall be designed for remote operation and control. Those used for surveillance, and possibly other TV cameras, shall have the capability for control and operation from at least two separate monitoring stations. All TV cameras shall be designed to permit removal for maintenance.

2. The TV viewing monitors located in the redundant AMS shall back up those located in the primary AMS to provide an alternate capability for security operations if the primary AMS is compromised. All TV viewing monitors shall be provided with selective switching capabilities to enable them to monitor the area surveyed by any TV camera in the MRS Facility.

9.9 PIPING

9.9.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to the restroom. The safety shower and eyewash station in the battery room shall also be provided and connected to the sanitary cold water system.

Sanitary sewer shall be provided in the restroom and other sanitary plumbed areas.

9.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

9.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Sanitary water is interpreted as potable water.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office area of the building. Piping runs shall be exposed in the mechanical equipment rooms of the building.

Hot potable water shall be supplied by an electric hot water heater.

A safety shower and eyewash station to comply with ANSI Z358.1 shall be provided in the battery room and shall be supplied from the cold potable water system.

Hot and cold water piping shall be insulated.

9.9.2.B. Piping

In addition to the criteria listed in Section 1.9.3, the following criteria shall be used.

HVAC drains shall be provided in the mechanical equipment rooms. These drains shall be collected and connected to the sanitary sewer system. A floor sump shall be provided in the battery room and shall be drained by a portable pump when necessary.

9.10 ELECTRICAL

9.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

9.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Sections 1.10.2 and 9.10.1, the following criteria shall be used.

9.10.2.A. Power Service

Building power shall be obtained from a unit substation located within the building. The substation shall transform the 4.16-kV primary voltage to 480Y/277 volts for feeders to the standby switchgear, which shall be located in the hardened area of the Protected Area Gatehouse. The standby switchgear shall be fed by a 480-volt, 3-phase, 4-wire feeder from the Security Building for distribution to all power and lighting loads. A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel shall be used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 enclosures for indoor use. Fixtures and installation outdoors shall be of weatherproof construction.

An uninterruptible power supply (UPS) system shall be furnished as the power supply to essential surveillance and access control instrumentation and equipment within the Protected Area Gatehouse. Input power shall be required by the standby power system at 480Y/277 volts, 3 phase. The battery bank shall be sized to maintain full inverter output for a period of 90 minutes.

9.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system may be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in all indoor areas. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID luminaires with ballasts and integral mounted fuses shall be used on the exterior of the building.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be time-switch controlled with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as storage rooms.

2. Emergency Lighting System. An emergency lighting system shall be provided for the control room, UPS room, and the battery room to permit continued operation of all surveillance and security devices in case of total power failure, and for safe egress lighting. Power for the emergency lighting system shall be provided by individual battery-operated unit equipment. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination during nighttime operation.

Lighting shall be photoelectric-relay-controlled, with a manual switch override. Outdoor floodlighting shall be provided for the vehicle inspection area and road lighting for roads within the protected area, including the west patrol road.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. All exit lighting shall be considered as part of the emergency system, and shall be installed in conduit or tubing per Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

9.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Protected Area Gatehouse for paging. The system shall be provided with one paging zone; it shall be initiated from the Site Services Building and by telephone access from selected locations within the Protected Area Gatehouse.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station and Security Building shall be determined during final design. The annunciator panel shall be located in the vestibule for easy access. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL-listed; and shall be installed in accordance with the NFPA-101 Life Safety Code.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Protected Area Gatehouse as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

4. Radio System. A fixed-base radio system shall be provided at the Protected Area Gatehouse for intercommunications with security personnel and to provide a communication link to local law enforcement.

9.11 HVAC

9.11.1 DESIGN CRITERIA

No specific design criteria are cited.

9.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

9.11.2.A. General Requirements

The HVAC system shall provide the temperature, humidity, and ventilation required for personnel comfort and equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2.

9.11.2.B. Specific Requirements

1. Inside Design Conditions: Hardened Areas. Inside design temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB for all normally occupied areas. For normally unoccupied areas (such as restrooms and equipment rooms), inside temperature shall be maintained between 65°F DB and 90°F DB. Humidification may be provided in the control room as required for proper equipment operation.

2. Inside Design Conditions: Nonhardened Areas (Corridors and Electrical Equipment Room). Temperature shall be maintained above 65°F during winter conditions. During summer conditions, the inside temperature may rise to a maximum of 10°F higher than the outside temperature.

3. Inside Design Conditions: Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas.

4. Inside Design Conditions: Cooling System. Each "level" of the hardened area shall be provided with an indoor-type, single package air-cooled cooling system to provide the required cooling for the area. Cooling shall not be provided for the nonhardened areas (corridors and electrical equipment room); ventilation shall be used to remove excess heat from these areas in the summer.

5. Inside Design Conditions: Heating System. Heating shall be provided by electric duct heaters in the hardened areas and by an electric heating coil in the nonhardened areas.

6. Inside Design Conditions: Air Supply System.

a. Hardened Areas. Outside and recirculated air shall pass through 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters before being distributed through a duct system to the different rooms. Separate cooling units shall be used to serve the lower level and the upper-level hardened areas.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following air change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour
Battery room:	5 air changes per hour

b. Nonhardened Areas (Corridors and Electrical Equipment Room). A heating and ventilating (H&V) unit, equipped with 30% ASHRAE atmospheric dust spot efficiency filters and electric heating coil, shall provide for minimum ventilation during winter and heat removal during summer.

7. Inside Design Conditions: Exhaust System. The air from the toilet and battery room areas shall be exhausted to the outside. Toilet rooms shall be maintained under negative pressure.

8. Inside Design Conditions: Standby Power Requirements.

a. Hardened Areas. Standby power shall be provided for the entire HVAC system in these areas.

b. Nonhardened Areas. Standby power shall not be required for these areas.

9.12 FIRE PROTECTION

9.12.1 DESIGN CRITERIA

No specific design criteria are cited.

9.12.2 BASIS FOR DESIGN

9.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the Protected Area Gatehouse except in the electrical equipment room, battery room, and computer/control rooms.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13. It shall be complete with the necessary attachments and devices to provide a hydraulic water motor alarm with an electric alarm and supervisory signal to the main fire protection annunciator.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided as a secondary water supply to the installed sprinkler systems.

9.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

9.12.2.C. Halon 1301 System

Areas of high value or of high program importance (e.g., computer areas/control alarm, electrical equipment/battery rooms, and remote surveillance room) shall be provided with a total-flooding Halon 1301 system. The system shall consist 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.

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SECTION 10

STORAGE AREA GATE STATION

10.1 INTRODUCTION

10.1.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

10.1.2 BASIS FOR DESIGN

The Storage Area Gate Station shall provide for the requirements of Section 10.1.1. In addition, it shall provide radiation detection and monitoring for all personnel leaving the site SF, HLW, and HAW/RHTRU Storage Facilities.

10.2 CIVIL AND SITE DEVELOPMENT

10.2.1. DESIGN CRITERIA

No specific design criteria are cited.

10.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

10.2.2.A. Parking

Parking shall be provided for site vehicles serving the Storage Area Gate Station.

10.2.2.B. Landscaping

No landscaping shall be provided for this facility.

10.3 STRUCTURAL

10.3.1 DESIGN CRITERIA

No specific design criteria are cited.

10.3.2 BASIS FOR DESIGN

The Storage Area Gate Station shall be constructed of concrete block walls, slab-on-grade floor, and metal deck roof.

10.3.2.A. Classification

The Storage Area Gate Station shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

10.3.2.B. Design Loads

The design loads shall be in accordance with applicable portions of reference Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)

10.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ L$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

10.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Wall footings	6
Sliding and overturning	FS = 1.5	7

10.3.2.E. Structural Materials

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

10.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

10.4 ARCHITECTURAL

10.4.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

10.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

10.4.2.A. General Requirements

1. The building shall be a single-story, reinforced-masonry-walled structure with structural metal decking. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied space shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

2. The Storage Area Gate Station shall provide radiation detection and monitoring for all employees leaving the storage area.

3. The Gate Station shall not be occupied by any assigned personnel. It shall be used only by personnel leaving the storage area for radiation-contamination detection and communication with other facilities.

4. The Gate Station shall contain only one room - a monitoring room equipped with radiation-detection equipment and a telephone.

10.4.2.B. Specific Requirements

The following specific requirements shall be used:

(1)	UBC Occupancy Class:	B2
(2)	Ceiling heights:	8'-8"
(3)	Kind of traffic:	Foot traffic
(4)	Size of access openings:	3'-0" x 7'-0" exterior personnel door
(5)	Special equipment:	
	Monitoring room:	Radiation detection equipment Telephone Table, chair

10.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

10.5.1 DESIGN CRITERIA

No specific design criteria are cited for the material handling, maintenance, and remote systems requirement in the Storage Area Gate Station.

10.5.2 BASIS FOR DESIGN

No heavy material-handling and maintenance equipment shall be required in the Storage Area Gate Station. Normal maintenance and repair of the mechanical and electrical equipment in this building shall be supported by the Site Services Building.

10.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

10.7 MECHANICAL PROCESS

Not applicable to this facility.

10.8 INSTRUMENTATION AND CONTROL

10.8.1 DESIGN CRITERIA

Gatehouses, standby generator, water and waste treatment, and other support buildings shall be constructed to satisfy the facility requirements.

10.8.2 BASIS FOR DESIGN

Card reader access and CCTV cameras shall be provided for remote security surveillance of the storage facility entrance and that of incoming/outgoing personnel and vehicles. Portable, hand-held monitors shall be provided for self-survey of outgoing personnel.

10.9 PIPING

Not applicable to this facility.

10.10 ELECTRICAL

10.10 1 DESIGN CRITERIA

No specific design criteria are cited.

10.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria shall be used.

10.10.2.A. Power Service

Building power shall be obtained from an outdoor substation. The substation shall also serve the security fence and patrol road lighting. Electrical power at 480Y/277 volts and 208Y/120 volts shall be available at the Storage Area Gate Station for distribution to all power and lighting loads. The distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installations outdoors shall be of weatherproof construction.

10.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

Light fixtures above exterior doors shall be time-switch-controlled with manual override.

2. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation.

Lighting shall be photoelectric-relay-controlled with manual switch override. Outdoor floodlighting shall be provided for the gate entrance area.

3. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

10.10.2.C. Telephone System

The main EPABX equipment shall be located in the Site Services Building. A telephone instrument shall be provided at the Storage Area Gate Station.

The telephone system shall be installed in conduit unless otherwise directed.

10.11 HVAC

10.11.1 DESIGN CRITERIA

No specific design criteria are cited.

10.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

10.11.2.A. General Requirements

The heating, ventilating, and air-conditioning system (HVAC) shall provide the temperature required for personnel comfort and equipment operation.

The support for the HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

10.11.2.B. Specific Requirements

1. Inside Design Conditions. Inside design temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB.

2. Heating, Cooling, and Air-Supply System. Heating, cooling, and air supply shall be provided by a wall-thru single package heat pump with auxiliary electric heating coil to maintain required indoor design temperatures.

The unit shall be provided with 30% ASHRAE atmospheric dust spot efficiency filters and all associated controls.

3. Standby Power Requirement. Standby power shall not be required for the HVAC equipment in this building.

10.12 FIRE PROTECTION

10.12.1 DESIGN CRITERIA

No specific design criteria are cited.

10.12.2 BASIS FOR DESIGN

Portable fire extinguishers shall be sized, located, and installed in the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 11

SITE SERVICES BUILDING

11.1 INTRODUCTION

11.1.1 DESIGN CRITERIA

The Site Services Building shall include all maintenance, mockup, and fabrication shops. This building shall accommodate shop management, offices, and support functions, as well as the physical plant operations personnel and engineering personnel.

11.1.2 BASIS FOR DESIGN

The Site Services Building shall provide for all of the requirements of Section 11.1.1. In addition, the facility shall be designed to accommodate the requirements of a multiple-working-shift operation.

11.2 CIVIL AND SITE DEVELOPMENT

11.2.1. DESIGN CRITERIA

No specific design criteria are cited.

11.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

11.2.2.A. Parking

Parking for employees working in the Site Services Building shall be provided outside the Main Gate/Badgehouse. Parking shall be provided adjacent to the entrance to the Site Services Building for site vehicles serving the building.

11.2.2.B. Landscaping

The entrance area of the Site Services Building shall be landscaped.

11.3 STRUCTURAL

11.3.1 DESIGN CRITERA

The Site Services Building shall be constructed of noncombustible materials. The floors should be slab-on-grade reinforced concrete.

11.3.2 BASIS FOR DESIGN

The Site Services Building shall consist of low-bay areas, where wall construction shall be of concrete block, and high-bay areas, where wall construction shall be of braced steel with metal siding. Roof construction shall consist of steel framing with metal deck diaphragms. Foundations shall be spread footings and wall footings with slab-on-grade floor.

11.3.2.A. Classification

The Site Services Building shall be designed as a Non-Category I structure.

11.3.2.B. Design Loads

The design loads shall be in accordance with reference Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Vehicle load	3
Snow load	4
Impact load	5
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)
Hoist load	13

11.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4D + 1.7 (L + H)$
$U = 0.75 (1.4 D + 1.7 L + 1.7 W)$
$U = 0.75 (1.4 D + 1.7 L + 1.87 E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + 1 + W$
$1.33\ S = D + L + E$

11.3.2.D. Design Methods

The design methods shall comply with the applicable portions of Section 1.3.2.F, a summary of which is as follows:

Materials/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings	6
Sliding and overturning	FS = 1.5	7

11.3.2.E. Structural Materials

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

11.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

11.4 ARCHITECTURAL

11.4.1 DESIGN CRITERIA

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

11.4.1.A. Functions

1. The Site Services Building shall include all maintenance and fabrication shops, such as:

- Machine
- Millwright
- Pipefitting
- Welding
- Sheetmetal
- Carpentry
- Plastics/glass/ceramic
- Electrical
- Instrument
- Paint
- Steam cleaning area
- Hot cell mockup and training

Radioactively contaminated objects shall not normally be permitted in these shops.

2. This building shall accommodate shop management and support functions, the physical plant operations personnel, and engineering personnel. It shall also include 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.

3. In addition to the shops and offices, it shall include a computer room, a lunchroom, training, conference, copy machine, locker rooms, janitorial facilities, mechanical equipment rooms, a small first-aid room, and other supporting spaces. A small, separate paint/solvent storage and paint shop building shall be provided at the appropriate distance from the maintenance facilities. A small lumber storage area and oil storage building shall also be provided near the maintenance facilities.

11.4.1.B. Requirements

1. The Site Services Building shall be constructed of noncombustible materials. The floors should be slab-on-grade reinforced concrete.

2. The standard clear height in the shops shall be 14 ft. All trusses, overhead ventilation ducts, electrical bus ducts and conduits, piping, fire protection sprinklers, lighting fixtures, and other appurtenances shall be located above that height. The mockup shop shall be designed to permit full-height mockups of cask-cell transfers and in-cell manipulations.

3. Exposed roof trusses are acceptable in shop, equipment rooms, and warehouse areas; all other areas shall have suspended ceilings. Shop, equipment room, and warehouse floors shall be painted; all other areas shall have floor covering. Outdoor assembly/storage pads shall be provided adjacent to the shop areas.

4. The shop areas shall be separated from each other by partitions and/or curtains where appropriate. Craft-related offices shall be located adjacent to the shops.

5. Locker rooms, restrooms, and a lunchroom shall be located between the shop area and the general office area of the building.

6. Sound-attenuating fire walls shall separate the shop area from the locker room/lunchroom area and that area from the general office area.

7. The large training/multi-use room shall be provided for groups up to approximately 100 people. A projection screen shall be provided at one end of the room. Storage space shall be provided for projection equipment, additional chairs, and other equipment. No fixed seating shall be provided.

8. All shop equipment and building furnishings shall be included.

9. A delivery dock, adjacent to the warehouse area, shall be provided.

11.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

11.4.2.A. General Requirements

1. The Site Services Building shall be a single-story, mixed-occupancy, steel-framed structure of varying heights according to interior needs. The exterior wall material shall be an insulated, panelized wall system above concrete block apron walls. Where facias and soffits are provided for solar control, a noninsulated, fluted or ribbed panel shall be used. All exterior walls, roofs, and roof-ceiling assemblies shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required and necessary for occupancy.

The building shall consist of four major areas:

(1) Office area
(2) Shop area
(3) Warehouse and mockup area
(4) Storage areas

Remaining areas shall consist of:

(1) Support functions
(2) Building services
(3) Circulation

2. Office Area. The office area shall be designed to house the following:

Assignment	Number of Personnel by Shift				Total
	Day	2nd	3rd	4th	
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

The functional requirements of the office area shall be as follows:

(1) All offices shall be designed to accommodate specific functions. The physical plant operation personnel office shall be primarily an open office, where furniture and furnishings define individual work stations. A private office for the Supervisor shall be located adjacent to the open office. Other functions with fewer personnel shall be housed in appropriately sized open and private office combinations.

(2) A conference room, sized for 20 occupants, shall be centrally located within the office area, accessible from the corridor and near the lunchroom.

(3) A control room and UPS shall be located at one corner of the office area, accessible from the main corridor. A dust-sealed access flooring system shall be provided.

(4) A photocopy machine alcove shall be located in the office area, adjoining the corridor.

(5) The counting room shall be shielded as required to reduce background radiation.

3. Shop Area. The shop area shall be 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				0
Steam-cleaning area	0				0
Tool crib	1				1
Total	29	4	4	4	41

The functional requirements of the shop area shall be as follows:

(1) The shop area shall have exposed structural roof framing and a hardened, painted, reinforced concrete, slab-on-grade floor. Shop functions not requiring complete enclosure shall be separated from others by 10-ft-high partitions.

(2) A clear height of 20 ft-0 in. above the shop floor shall be provided. All structural members and mechanical and electrical systems shall be located above 20 ft-0 in.

(3) Craft-related offices shall be located adjacent to various shop functions and, in some cases, shall be shared by two or more functions when a single supervisor for more than one craft is sufficient.

(4) Locker rooms, restrooms, and the lunchroom shall be integrated into the office area of the building, and shall also be convenient to the shop area. Additional restrooms shall be located in the shop area.

4. Warehouse and Mockup Area. A warehouse area shall be provided within the building for general storage, and shall be convenient to the shops. The clear height overhead shall be the same as in the shop area. Two large exterior doors and one large interior door shall be provided to afford sufficient access to the warehouse area. A receiving office shall be located adjacent to the warehouse and unloading area.

An enclosed mockup area, occupied by 10 dayshift personnel, shall be provided within the building. The overhead clear height required for the planned mockups shall be 40 ft. One large door to the shop area aisle shall be provided for items and materials to be moved in and out of the mockup area.

5. Storage Buildings. Small separate storage buildings shall be provided for the storage of potentially hazardous bulk materials, including:

(1) Lumber storage (near carpentry shop)
(2) Paint storage (including a paint-spray booth)
(3) Oil storage

As Group H occupancies (UBC), the storage buildings shall be separated from the office and shop Group B occupancies by a minimum of 40 ft of open space. Although there is no specific UBC requirement for this 40-ft separation, a physical separation shall facilitate access around these buildings, as well as the main building. In addition, the storage areas shall also be separated from each other by 40 ft.

6. Support Functions. Support functions throughout the building shall consist of the following:

Assignment	Number of Personnel by Shift				Total
	Day	2nd	3rd	4th	
Mailroom	2				2
Warehouse	2				2
Reproduction	2				2
Telephone	1				1
Copy	0				0
Lockers	0				0
Lunchroom	0				0
Janitorial facilities	6	6	0	0	12
Certified vendors' information	0				0
Training room	0				0
Total	13	6	0	0	19

(1) Tool crib - The tool crib shall be centrally located within the shop area for convenience. A small office within the tool crib shall be provided for the attendants.

(2) Mailroom - A central MRS Facility mailroom shall be provided in the office area. Mail shall be sorted, processed, and distributed to other facilities as applicable.

(3) Reproduction - A reproduction room, containing blueline printers and other equipment, shall be located near the engineering function.

(4) Copy - A photocopy machine alcove shall be provided off the corridor, convenient to the office functions and adjacent to the engineering function.

(5) Locker rooms - Locker rooms containing lockers and showers shall be located adjacent to both the men's and women's toilet rooms.

(6) Lunchroom - A lunchroom, adequately sized for 90 persons, shall be provided in the office area, and shall also be convenient to the shop area. An area for vending machines and self-service microwave ovens shall be provided.

(7) Janitorial facilities - A storage room for toilet supplies for the entire MRS Facility shall be provided near the service entrance, along with an office for the Janitorial Supervisor.

(8) Certified Vendors' Information (CVI) - A room containing Certified Vendors' Information shall be provided adjacent to the Purchasing Office.

(9) Training room - A training room shall be provided, adjacent to the lobby, large enough to accommodate 100 persons, with movable seating. A storage room for tables, chairs, and training materials shall also be provided. Front projection shall be used for showing films and slides, as desired.

7. Building Services. Space shall be provided for the following building services for the normal operation of the building:

(1) HVAC equipment
(2) Electrical equipment
(3) Telephone equipment
(4) Plumbing equipment (restrooms, etc.)

8. Circulation. Adequate space shall be provided for both visitor and personnel circulation throughout the building. All normal pedestrian entrances and exits shall be provided with vestibules for weather protection. The lobby at the main entrance shall open into a double-corridor system providing access throughout the office area. A shop entrance for personnel shall be provided separate from the lobby.

11.4.2.B. Specific Requirements

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	23'-0" (minimum to bottom of structure)
	Mockup	40'-0"
	Warehouse	23'-0" (minimum to bottom of structure)
3.	Kind of traffic:	Foot traffic Forklift Portable cranes, dollies, 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.	Special equipment:	
	Lobby, offices, and conference:	Fixtures, furnishings, and equipment
	Control room:	Consoles, fixtures, furnishings, and equipment
	Toilets, lockers, and showers:	Metal toilet partitions, metal lockers Toilet and shower accessories Mirrors Clothing storage racks Soiled laundry collection hampers
	Radiation protection/counting:	Laboratory furniture and equipment
	Lunchroom:	Vending machines Microwave ovens Tables, chairs
	Training room:	Audio-visual equipment Training equipment
	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 and storage areas:	Storage shelving, cabinets, etc.

11.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

11.5.1 DESIGN CRITERIA

The Site Services Building shall include all maintenance, mockup, and fabrication shops, such as:

- Machine
- Millwright
- Pipefitting
- Welding
- Sheetmetal
- Carpenter
- Plastics, glass, and ceramics
- Electrical
- Instrument
- Paint
- Steam-cleaning area
- Hot cell mockup and training

Radioactively contaminated objects shall not normally be permitted in these shops.

11.5.2 BASIS FOR DESIGN

The Site Services Building shall be equipped to provide uncontaminated maintenance, repair, and modification services in support of the MRS Facility. Material handling in the fabrication shops shall be performed by using jib cranes, portable mobile floor cranes, portable hoisting units, and dollies.

11.5.2.A. Machine Shop

The machine shop shall be equipped with the following required machining equipment:

(1) Two metal lathes, light duty, 10 in. swing by 126 in. long, with capability of turning material stock 8 in. dia and 8 ft long.

(2) One metal lathe, hollow-spindle style, 15 in. swing by 126 in. long, with capability of handling material stock 5 in. dia by 20 ft long.

(3) One metal lathe, heavy duty, 24 in. swing by 157 in. long. This lathe will be automatic CNC controlled, and will be capable of machining material 18 in. dia by 10 ft long.

(4) One milling machine, horizontal, universal type, bed size 71 in. by 15 in., capable of milling stock 47 in. long; automatic CNC controlled.

(5) One milling machine, turret style, with 54 in. by 11 in. bed, capable of milling stock 24 in. long.

(6) One Bridgeport Mill No. 2 or approved equal. This machine will be capable of milling stock in longitudinal travel of 30 in. and cross travel of 15 in.

(7) One 20-in. shaper machine with capability of a maximum stroke of 13 in. and 16 gear speeds.

(8) One radial-arm drill press, capable of drilling 49-in. stock.

(9) One H-frame, 75-ton press machine.

(10) One pedestal-mounted drill press, capable of drilling 2-in. stock.

(11) One floor-mounted grinder, 12-in. by 1-1/4-in. wheel, for rough grinding.

(12) One optical comparator with 30-in. screen.

(13) One steel-top layout bench, 48 in. by 120 in., capable of handling material of 2,000 lb.

(14) One glove-box blaster machine, 60 in. by 24 in.

(15) One tool and cutter grinder unit.

(16) One bench-mounted press, manually operated, with 3-ton operating force capacity.

(17) One grinder, carbide-wheel style.

(18) One drill-sharpening machine.

(19) One Black Diamond drill grinder or approved equal.

(20) One grinder used for surface grinding, capable of surface grinding of 18-in. by 48-in. plate.

(21) One grinder for round-spindle grinding, capable of grinding round stock of 8 in. dia.

(22) Bench-mounted, 10-in. pipejaw-face vises, with swivel base, shall be provided based on shop requirements.

(23) Steel-top work benches, supply storage cabinet, and bins shall be provided based on shop requirements.

11.5.2.B. Millwright Shop

The millwright shop shall require a receiving and delivery area located at the front of the shop and adjacent to the service aisle. This area shall be equipped with a 48-in. x 120-in. steel-top table, a receiving 4,000-lb jib crane, and mobile floor handling carts.

The millwright shop shall be equipped with the following related millwright operating equipment:

(1) One mobile floor crane capable of handling equipment of 2,000 lb.

(2) One A-frame hoisting unit with a rated capacity of 2 tons.

(3) One parts cleaning unit required for equipment cleaning. Unit shall be sized to handle small machine parts.

(4) Ten-inch, bench-mounted vise units shall be provided in various areas of shop; vises shall have pipejaw face and be equipped with swivel bases.

(5) One grinder, bench-mounted, 8-in. by 1-in. wheel for finished grinding.

(6) Steel-top work benches, supply storage bins, and cabinets shall be provided per shop requirements.

(7) One bench-mounted, No. 2-1/2 arbor-type press, capable of pressing 3 tons.

(8) Portable hoisting equipment, slings, and tackles.

11.5.2.C. Pipefitting Shop

The pipefitting shop shall be capable of handling, cutting, threading, and bending pipe stock of 6 in. dia maximum. It shall also be capable of repairing and hydrostatic testing of pipe flanges and valves of sizes 6 in. and smaller.

The pipefitting shop shall be equipped with the following related pipefitting equipment:

(1) One pipe-bender machine capable of bending 6-in.-dia pipe.

(2) One pipe-cutting and threading machine, capable of cutting and threading 6-in.-dia pipe stock.

(3) Gas, oxygen, and acetylene welding unit, supplied from central outside gas storage manifold to the shop. Unit shall be located for exhaust ventilating and shielding.

(4) Three styles of grinding machines:

(a) Pedestal-mounted, 12-in. by 1-1/4-in. wheel, for rough grinding
(b) Bench-mounted, 8-in. by 1-in. wheel, for small stock material
(c) Abrasive belt grinder, for finish grinding

(5) One floor-mounted drill press for drilling stock of 2-in. thickness.

(6) Ten-inch, bench-mounted pipe vises shall be provided in various areas of the shop; vises shall have pipejaw face and be equipped with swivel bases.

(7) Steel-top work benches, supply storage bins, and cabinets shall be provided based on shop requirements.

11.5.2.D. Welding Shop

The welding shop shall be located adjacent to the sheetmetal shop. The welding shop shall be capable of handling, welding, cutting, and grinding large steel structural shapes for fabrication and repair maintenance. The welding shop area shall be provided with a laydown or layout area for structural and pattern layout. This area shall be equipped with a 48-in. by 120-in. steel-top table and jib crane, capable of handling structural shapes of 2,000 lb.

The welding shop area shall be equipped with the following related welding equipment:

(1) One iron-working machine, capable of handling structural shapes from 22 gauge to 1/4-in. stock, and to punch 7/8-in.-dia holes.

(2) Two steel-top welding and cutting tables, capable of handling working stock of 2,000 lb; table shall be located in a shielded central location.

(3) Gas, oxygen, and acetylene welding units shall be provided from a central compressed-gas-cylinder storage area, manifolded to feed the shop area. Units shall be located to provide shielding and exhausting ventilation.

(4) One electric welding machine, with rating of 600 A, shall be provided for welding capabilities of 22-gauge to 1/4-in. stock. Unit shall be located adjacent to welding tables and positioners to allow for good access and shielding.

(5) One welding-wire feeder machine, capable of welding shapes from 0.030 to 1/8 in. This unit shall be located in welding shop section to allow for shielding.

(6) One coordinate-drive, flame-cutting machine, capable of cutting shapes of 46 in. by 60 in. This unit shall be located in welding shop section to allow for shielding.

(7) One plasma-arc welder unit for plasma welding.

(8) One welding positioner unit, capable of handling structural shapes of 1,000 and 2,500 lb; unit shall be located in shielded shop sections and adjacent to gas and electric welding units.

(9) Two styles of grinding machines: pedestal-mounted large grinders for rough grinding and bench-mounted units for fine, finished grinding.

(10) Ten-inch, bench-mounted vises shall be provided in various areas of the shop; vises shall have pipejaw face and be equipped with swivel bases.

(11) Steel-top work benches, supply storage bins, cabinets, and quench tanks shall be provided based on shop requirements.

11.5.2.E. Sheetmetal Shop

The sheetmetal shop shall be capable of handling, cutting, shearing, bending, rolling, and punching structural steel shapes, plates, and sheets. It shall have a laydown area for structural pattern layout work.

The sheetmetal shop shall be equipped with the following related metal-working equipment:

(1) One hydraulic shear machine, capable of shearing plate stock 3/8 in. by 10 ft, equipped with a 2,000-lb jib crane unit for handling large plate stock.

(2) One hydraulic bending brake, capable of bending plate stock 1/4 in. by 8 ft, equipped with a 2,000-lb jib crane for handling large plate stock.

(3) One metal and angle rolling machine capable of rolling plate 1/4 in. by 10 ft and 3-in. by 3-in. by 1/4-in. angle stock; equipped with a 2,000-lb jib crane for handling large plate stock.

(4) One power bandsaw for cutting round and square bar stock of 8 in.

(5) One power hacksaw for cutting smaller round and square bar stock of 4 in.

(6) One spot-welding machine, capable of spot welding 1/4-in stock.

(7) Laydown area shall be equipped with a 48-in. by 120-in., steel-top table and a jib crane capable of handling structural shapes of 2,000 lb maximum.

(8) Ten-inch, bench-mounted vise units shall be provided in various areas of shop; vises shall have pipejaw face and be equipped with swivel bases.

(9) Steel-top workbenches, supply storage bins, and cabinets shall be provided per shop requirements

11.5.2.F. Carpentry Shop

The carpentry shop shall be capable of handling rough and finish carpentry work. The equipment in the carpentry shop shall have the capability of milling lumber up to 4 in. thick and sheets up to 4 ft by 8 ft. Milling operations shall include cutting, ripping, planing, drilling, routing, jointing, and sanding.

The carpentry shop shall be equipped with the following woodworking shop equipment:

(1) One 12-in. woodworking jointer machine.

(2) One 14-in. circular bandsaw.

(3) One 15-in. radial arm saw.

(4) One 14-in. table saw.

(5) One combination wood sander machine.

(6) One floor-mounted, 20-in. drill press unit.

(7) Hardwood workbench equipped with woodworking vises shall be provided based on shop requirements.

(8) Storage cabinets, bins, and rotary parts bin shall be provided based on shop requirements.

(9) Floor-rolling, material-handling carts, capable of carrying 500 lb.

11.5.2.G. Plastics, Glass, and Ceramic Shop

The plastics, glass, and ceramic shop shall be capable of cutting, grinding, and drilling plastics, glass, and ceramic materials.

The plastics, glass, and ceramic shop shall be equipped with the following related equipment:

(1) One 20-in., metal-cutting bandsaw for plastic and ceramic shaping.

(2) One 20-in., abrasive and masonry saw.

(3) One abrasive-belt grinding unit for shaping plastic and ceramic materials.

(4) One marble-top cutting table, 24 in. by 72 in., for cutting of glass and plastic materials.

(5) One pedestal-mounted drill, capable of drilling 2-in. stock.

(6) Two vertical storage racks for glass and plastic material storage.

(7) Hardwood workbenches and storage cabinets shall be provided based on shop requirements.

11.5.2.H. Electrical and Instrument Shop

The electrical and instrument shop shall be capable of servicing, repairing, calibrating, and testing electrical machinery, instruments, and controls. It shall be equipped as follows:

(1) One despatch oven unit, capable of handling small electrical motors and armatures, 48 in. by 67 in. by 62 in.

(2) One 40-in. insulation shear machine for shearing wire insulation.

(3) Workbenches, storage cabinets, and storage bin shall be provided based on shop requirements.

(4) One pedestal-mounted, 20-in. drill press, capable of drilling stock up to 2 in.

(5) One bench-mounted grinder, with 8-in. by 1-in. wheel.

(6) One bench-mounted, 1-1/2-in. manual press machine, capable of pressing 1,000 lb.

11.5.2.I. Paint Shop

The paint shop shall provide the capability of painting of equipment and components with different types of paints and coatings, using industrial painting equipment. The paint shop shall be equipped with the following painting equipment:

(1) One spray-gun painter unit.

(2) One spray booth, 26 ft by 16 ft, equipped with fume-exhaust ventilation and drying heat lamps.

(3) Two steel-top workbenches, 48 in. by 72 in., for paint mixing.

(4) An enclosed area for paint storage, equipped with storage shelving and cabinets.

(5) Three vibrating paint-mixer units.

(6) One shower and eyewash station for employee safety.

11.5.2.J. Steam Cleaning Area

The steam cleaning area shall provide the capability to degrease and clean equipment and components, using hot water at 210°F minimum and pressure of 2,000 psi; flow rate of hot water shall be 10 gpm.

The steam cleaning area shall have floor area sloped toward a central drain for collection of wash water, soap, and grease.

The equipment and components requiring cleaning shall be moved into and out of the steam cleaning area, using rolling material-handling carts, forklift trucks, and mobile floor cranes.

11.5.2.K. Mockup Area

The mockup area shall provide the capability of full-height mockup of cask-to-cell transfers and remote manipulations in the hot cells of the R&H Building. The mockup area shall be a high bay adjacent to the shops in the Site Services Building.

The mockup area shall be equipped with a movable wall system to depict the hot-cell walls of the R&H Building. The wall system shall have false viewing windows and through-wall manipulators identical to the manipulators in the hot cells. The area depicting the hot cell shall be equipped with remote-handling equipment and an overhead crane identical to those provided in the hot cells of the R&H Building.

11.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

11.7 MECHANICAL PROCESS

11.7.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to facilities such as restrooms, locker rooms, lunchroom, janitor sinks, and water coolers. Safety showers and eyewash stations in the shop areas shall also be provided and connected to the

sanitary cold water system. Process water shall be provided to other areas and shall be separated from the sanitary system by backflow preventers.

Compressed air shall be provided to all shops.

A compressed gas cylinder storage area shall be provided near the welding shop and gas bottles shall be manifolded to feed the gases to the shop.

Sanitary sewer shall be provided in the lunchroom, restrooms, locker rooms, janitor sinks, and other sanitary plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the shops and from the steam cleaning area.

Fire protection shall be provided by a wet-pipe sprinkler system inside and hydrants outside.

11.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Plant air, at 125 psi, for operation of 20 pneumatic tools at 100 scfm.

(2) Instrument air, at 100 psi, for operation of 30 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and process water for hot water boiler based on a duty of 1,536 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in. fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, eyewashes, safety showers, drinking, and restrooms.

(7) Compressed gas cylinders for shops.

11.8 INSTRUMENTATION AND CONTROL

11.8.1 DESIGN CRITERIA

The Site Services Building shall include all maintenance and fabrication shops.

Radioactively contaminated objects shall not normally be permitted in these shops.

This building shall accommodate shop management and support functions, the physical plant operations personnel, and engineering personnel. It shall also include purchasing and stores for all plant functions, shop warehousing, plant mail and reproduction facilities, and radiation protection facilities, including radiological calibrations and low-level counting room.

In addition to the shops and offices, it shall include a computer room; a lunchroom; training, conference, copy-machine, and locker rooms; storage spaces; restrooms; janitorial facilities; mechanical equipment rooms; and other supporting spaces.

11.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 11.8.1, the following criteria shall be used.

11.8.2.A. Control Room

A control room with access floor shall be provided to house the distributed control system (DCS) mainframe components, including the DCS operator's console, CRT terminals, printers, and disk memory storage units. This redundant DCS shall provide backup control and monitoring capability in case the primary DCS in the R&H Building control room becomes inoperable because of equipment failure or emergency. Other equipment located in the control room shall include the following:

(1) Process CCTV monitors and controls used to observe the remote handling and processing operations in the R&H Building.

(2) A computer terminal (CRT, keyboard, and printer) interconnected to the general-purpose computer in the Administration Building to meet the needs of purchasing and engineering personnel.

(3) A central processing terminal that shall serve as the interface between the operator, the DCS, and the radiation-monitoring and criticality instrumentation located throughout the MRS facilities.

This terminal shall generate historical data, provide visual indication, visual and audible alarms, and centalized and remote instrumentation for alarm status indication, data logging, printout, and retransmission of alarm status information to remote locations.

11.8.2.B. Radiation Protection Facilities

An area shall be provided for radiation protection facilities, including a radiological instrument calibration laboratory and a low-level counting room. Localized shielding shall be provided to reduce the background radiation to the required levels.

Standardized instrumentation shall provide the capability for radiation calibration and counting.

11.9 PIPING

11.9.1 DESIGN CRITERIA

Hot and cold water shall be distributed throughout the building. Sanitary water shall be provided to restrooms, locker rooms, lunchroom, janitor sinks, and water coolers. Safety showers and eyewash stations in the shop areas shall also be provided and connected to the sanitary cold water system. Process water shall be provided to other areas and shall be separated from the sanitary system by backflow preventers.

Compressed air shall be provided to all shops.

A compressed gas cylinder storage area shall be provided near the welding shop and gas bottles shall be manifolded to feed the gases to the shop.

Sanitary sewer shall be provided in the lunchroom, restrooms, locker rooms, janitor sinks, and other sanitary plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the shops and from the steam cleaning area.

The standard clear height in the shops shall be 20 ft. All trusses, overhead ventilation ducts, electrical bus ducts and conduits, piping, fire protection sprinklers, lighting fixtures, and other appurtenances shall be located above that height.

11.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

11.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Sanitary water is interpreted as potable water.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office area of the building. Piping runs shall be exposed in the shop, equipment rooms, and warehouse areas of the building.

Overhead piping shall be located above a clear height of 14 ft.

A safety shower and eyewash station to comply with ANSI Z358.1 shall be provided in the paint shop work area, and shall be supplied from the cold potable water system.

Eyewash stations to comply with ANSI Z358.1 shall be provided in the other shops.

Hot potable water shall be supplied by electric hot water heaters.

Hot and cold water piping shall be insulated.

Electric (drinking) water coolers shall be provided.

11.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Piping runs shall be exposed in the shops, equipment rooms, and warehouse area.

Overhead piping shall be located above a clear height of 20 ft in shop areas and warehouse and 10 ft in equipment rooms.

Plant air and instrument air shall be supplied from equipment located in the compressor room of the building.

Plant air utility stations for air-tool use shall be provided in the boiler room, mechanical equipment room, shops, and mockup area. A supply shall also be provided for the H-frame press and glove-box blaster.

Instrument air shall be provided in the boiler room, mechanical equipment room, and mockup area.

Hot water at 210°F and 2,000 psig shall be provided in the steam-cleaning room, supplied from a hot water cleaning machine installed in the area.

Inert gas (nitrogen), oxygen, and acetylene gas shall be supplied from the cylinders in the gas bottles storage room, and manifolded to feed the gases to the welding shop.

Fuel oil supply to the heating boiler shall be provided.

Natural gas supply to the heating boiler shall be provided as an alternate fuel, if available.

Meters shall be provided to monitor the fuel usage for the building.

Process water for heating system makeup and utility stations in the shops for washdown, filling of tanks, and other uses shall be provided. Process water shall be supplied from the potable water system. The process water shall be separated from the potable water by backflow preventers.

Equipment and funnel drains shall be provided in the boiler room and connected to the oily sewer.

A boiler blowdown drain shall be provided in the boiler room and connected to the process sewer.

HVAC equipment drains shall be provided in the mechanical equipment room and connected to the process sewer.

A floor drain shall be provided in the steam cleaning room, installed with a grease trap, and connected to the process sewer.

The fuel oil supply, natural gas, process sewer, oily sewer, and plant air shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

11.10 ELECTRICAL

11.10.1 DESIGN CRITERIA

The following electrical criteria shall apply.

11.10.1.A. Power Service

Electrical power shall be supplied by a building substation fed from the MRS Facility main electrical substation. Electrical distribution shall be 480Y/277 volts, 3 phase, 4 wire and 208Y/120 volts, 3 phase, 4 wire. All shops shall be provided with 480-volt, 208-volt, and 120-volt services. Plug-in bus ducts shall distribute 480-volt, 3-phase power in the machine shop. Auxiliary outlets at 208 volts and 120 volts shall be provided at outdoor service aisles and assembly/storage pads. Convenience outlets (120 volts) shall be provided throughout the building. Isolated and/or regulated voltage shall be provided to the radiation protection calibration/counting room and computer stations. The computer room shall be provided with standby power, if required.

11.10.1.B. Lighting

Indoor lighting shall be provided by 277-volt, high-efficiency fluorescent fixtures. Outdoor lighting shall be provided by a type of high-intensity discharge (HID) luminaire.

Emergency lighting shall be provided in key corridors. Exit lights shall be provided at all exits.

11.10.1.C. Communications

The central MRS Facility telephone switchboard shall be located in the Site Services Building. All other buildings with telephone service shall be tied

into this facility. The building telephone system shall consist of conduits and cable distributed throughout the building.

A fire alarm system shall be provided throughout the building. It shall include manual pull stations at all exits, audible evacuation alarms, sprinkler and box zone annunciation, and modular control panel with supply valve supervisory circuits. The alarm system shall be connected with the MRS Facility Fire Station and the Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable. Evacuation alarms shall also be provided.

11.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 11.10.1, the following criteria shall be used.

11.10.2.A. Power Service

Building power shall derive from an outdoor, pad-mounted transformer with a primary selective feeder arrangement for the normal power service. A transformer shall transform the primary voltage to 480Y/277 volts for distribution to all power and lighting loads.

Standby power shall be available from a feeder coming from the Security Building. An uninterruptible power supply (UPS) system shall provide service continuity to the computer equipment during power outages. In addition, the telephone system shall be provided with its own battery backup power system.

The shop areas shall be provided with 480-volt, 3-phase, plug-in bus duct service. Auxiliary outlets shall be provided at 208 volts and 120 volts at service aisles and assembly/storage pads.

Isolated and/or regulated voltage shall be provided at the radiation protection/counting room and at the computer station.

11.10.2.B. Lighting

1. General. In general, 277 volts shall be used for HID and fluorescent lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in areas where continuous work is to be performed, such as offices, control room, workshop areas, and corridors. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps. Fluorescent fixtures in shop areas and mechanical and electrical rooms shall be of the industrial type, with rapid-start lamps. HID lighting shall be used in low- and high-bay areas. All ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID luminaires shall be used on the exterior of the building. HID light fixtures shall be equipped with separate tungsten-halogen lamps, connected to provide reduced illumination during restrike periods. Ballasts with integral fuses shall be suitable for use with HID lamps.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be on time-switch control with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as janitors' closets.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. Individual emergency equipment units shall be located at stairways, corridors, control room, and shop areas.

The battery units shall have capacity for 90 minutes of continuous operation. The emergency lighting units shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. General-purpose street and area lighting for ramps, parking areas, and lighting in outdoor and night operational areas shall be of the HID type.

Lighting shall be photoelectric relay-controlled with manual switch override. Outdoor floodlighting shall be provided as required for drive-up and parking areas.

4. 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. The entire exit lighting system shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided for all emergency exits and passageways, as required by NFPA Life Safety Code No. 101.

The electrical power source for the exit lighting system shall be connected to the standby power source. When battery-powered, individual emergency lighting units are used, these may be considered as separate standby systems, but shall be served from the same normal supply serving the exit lighting in the immediate area of application.

Exit lights and signs shall be combined in an internally illuminated fixture with translucent globe or letters, as approved by Underwriters' Laboratories, Inc., for this service.

6. Explosionproof Lighting Fixtures. Lighting fixtures and installation in the paint/storage, spray booth, oil storage area, and gas storage/manifold area shall be explosionproof in accordance with Chapter 5, Article 500, of the NEC.

11.10.2.C. Communications

1. Telephone System. The main EPABX equipment for the MRS Facility shall be located in the Site Services Building. The system shall include, but not be limited to, the basic switching equipment, station equipment, battery backup, distribution frame, house cable, and all other peripheral or ancillary equipment necessary to satisfy the functional requirements. The EPABX shall be solid-state, digital design, and linked to the national telephone network via cable or a private microwave system. Provision shall be made for direct ringdown (hot lines) for use by security or other emergency requirements. The switch shall be wholly compatible with the public switched network and the Federal Telecommunications System (FTS) Common Control Switching Arrangement (CCSA) network. The EPABX shall be the primary system for all other communications systems, and interfacing with the public address system, mobile-fixed radio system, and security system shall be provided.

2. Public Address System. A public address system shall be installed in the Site Services Building for paging. The public address system shall be accessed through the telephone system from selected locations. The system shall be provided with 12 paging zones, and shall operate as follows:

(1) Zone 1: All calls; this zone shall cover 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 shall provide paging for other buildings.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all large paging areas.

The public address system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

3. Fire Alarm and Detection System. An electrically supervised, noncoded, zoned, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station shall be determined during design. The annunciator panel shall be located in the lobby area. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL-listed; and shall be installed in accordance with the NFPA-101 Life Safety Code.

11.11 HVAC

11.11.1 DESIGN CRITERIA

The heating, ventilating, and air-conditioning (HVAC) system shall be designed to provide personnel comfort conditions throughout the facility.

11.11.1.A. General Requirements

Refer to Section 1.3.1.C, Classifications, and Section 1.3.1.D.2, Design Loads, Non-Category I Structures.

11.11.1.B. Specific Requirements

The following specific requirements shall be included in the criteria.

1. Inside Design Conditions.

a. Office Area. Temperatures of individual offices shall be maintained by zone temperature control.

b. Shop Area and Warehouse. Warehousing areas may have temperatures as low as 50°F and as high as 85°F at normal working levels. Ventilators may be used in these areas to remove excess heat in the summer.

c. Paint Spray and Paint Storage Building. No specific criteria requirement established.

d. Storage Buildings. No specific design criteria are cited.

2. Energy Conservation. Recirculation shall be employed to the maximum extent practicable, and an economizer cycle should be used to take advantage of free cooling.

3. Cooling System. No specific design criteria are cited.

4. Heating System. No specific design criteria are cited.

5. Air Supply System. Outside air entering the building shall be filtered to remove at least 75% of atmospheric dust.

6. Exhaust System.

a. Office Area. No specific design criteria are cited.

b. Shop Area and Warehouse. The carpentry, plastics, machine, and welding shops shall require individual exhaust systems, which shall operate on an as-needed basis. The carpentry and plastics shops shall need a particle collection system using cyclone separators and filters. Special exhausters shall be required at welding stations and certain machines in the machine shop.

c. Paint Spray and Paint Storage Building. No specific design criteria are cited.

d. Storage Buildings. No specific design criteria are cited.

7. Standby Power Requirements. No specific design criteria are cited.

11.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 11.11.1, the following criteria shall be used.

11.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) system shall provide the temperature, humidity, and ventilation required for personnel comfort and equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

11.11.2:B. Specific Requirements

1. Inside Design Conditions.

a. Office Area. The following indoor conditions (temperatures) shall be maintained by the use of zone temperature controls:

(1) Summer

Inside design temperature for personnel comfort shall be 15°F less than the 2-1/2% outside dry bulb (DB) temperature, but shall not be less than 76°F DB or more than 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), inside temperature may be slightly higher, but not more than 90°F DB.

Humidification shall not be provided during summer conditions.

(2) Winter

Inside design temperature for personnel comfort shall be 72°F for all normally occupied areas.

For normally unoccupied areas (such as storage and equipment rooms), temperature may be slightly lower, but not less than 50°F DB.

Depending on outside design conditions, humidification may be required to raise indoor relative humidity to 20%.

b. Shop Area and Warehouse. All shop areas (including warehouse) shall be maintained between 65°F and 85°F, year around, by an air-handling unit equipped with heating and cooling coils.

c. Paint Spray and Paint Storage Building. Temperature shall be maintained above 65°F during winter conditions. During summer conditions, inside temperature may be a maximum of 10°F higher than the outside temperature.

d. Storage Buildings (Lumber, Oil). During summer conditions, inside temperature may rise to a maximum of 10°F higher than the outside temperature. Temperature shall not be controlled during winter conditions.

2. Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas except the paint-spray and paint-storage building.

In addition, an energy conservation analysis shall be performed to optimize the HVAC system design and to evaluate the cost effectiveness of an economizer cycle for the office and shop areas only.

3. Cooling System.

a. Office Area. The required cooling for all office areas (including the computer room) shall be provided by a split, direct-expansion cooling system. In addition, a computer room air-conditioning unit, with an air-cooled condenser located on the roof, shall provide cooling for the computers.

b. Shop Area and Warehouse. Cooling shall be provided by a separate, split, direct-expansion cooling system.

c. Paint Spray and Paint Storage Area. Cooling shall not be provided for this area. Ventilation shall be used to remove excess heat in the summer.

d. Storage Buildings (Lumber, Oil). Cooling shall not be provided for these buildings. Ventilation shall be used to remove excess heat in the summer.

4. Heating System.

a. Office, Shop Areas, and Warehouse. Hot water generated by a local hot water boiler shall be used to provide the required heating for the office, shop areas, and warehouse.

b. Paint Spray and Paint Storage Building. Electric heating shall be used for this area. The electric heating coil shall be located inside the rooftop air-handling unit.

c. Storage Buildings (Lumber, Oil). Heating shall not be provided for these areas.

5. Air Supply System. Outside and recirculated air (where used) shall pass through 30% ASHRAE atmospheric dust spot efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters before distribution to all areas.

a. Office Area. A supply fan shall distribute air through a duct system to the different rooms within the area. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

The computer room air-conditioning unit shall deliver the air to the computers via an underfloor duct system.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following air change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour
Battery room:	5 air changes per hour

b. Shop Area and Warehouse. A separate air-handling unit shall be located inside the mechanical equipment room to provide the supply air for the various shops. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

Airflow rates shall be maintained as required for adequate air change, temperature control, and for makeup of exhaust requirements for the individual shop areas.

c. Paint Spray and Paint Storage Building. A two-speed, rooftop, makeup air unit with an electric heating coil shall supply the air required for ventilation and heating. The low speed shall be used to provide the air requirements when the spray booth is not in operation, and full speed shall be used when the paint spray booth is operational.

Airflow rates shall be maintained at a minimum of 3 air changes per hour when no painting is being performed and 20 air changes per hour (or as required by the size of the spray booth) when painting is being performed.

d. Storage Buildings (Lumber, Oil). Each storage building shall be provided with motorized inlet dampers to provide exhaust makeup air.

6. Exhaust System.

a. Office Area and Warehouse. The air from the toilet areas shall be exhausted by individual exhaust fans. These areas shall be maintained under negative pressure.

b. Shop Areas and Warehouse. Local exhausters shall be provided on an as-needed basis for all shops and the warehouse, as indicated in the Design Criteria [Section 11.11.1.G(2)].

In addition, as mentioned in the Design Criteria, a dust-collection system, using a cyclone separator and bag filters, shall be provided for the carpentry and plastics shops. The dust-collection system shall operate on an as-needed basis.

c. Paint Spray and Paint Storage Building. Two exhaust fans shall provide for the exhaust of this area. One fan shall provide for the exhaust requirements when the spray booth is not in operation. A separate exhaust fan shall be interlocked to the high speed of the air-handling unit fan to provide spray booth exhaust on an as-needed basis.

d. Storage Buildings (Lumber, Oil). An exhaust fan shall be provided in each storage building to provide required ventilation and heat removal.

7. Standby Power Requirements. Standby power shall be provided for the computer room air-conditioning unit only.

11.12 FIRE PROTECTION

11.12.1 DESIGN CRITERIA

Fire protection shall be provided by a wet-pipe sprinkler system inside and hydrants outside.

11.12.2 BASIS FOR DESIGN

Fire protection shall be provided for the Site Services Building as follows:

1. Wet-Pipe Sprinkler System. An automatic wet-pipe sprinkler system shall be provided throughout the Site Services Building except in rooms protected by the Halon 1301 system.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13. It shall be complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment, including fire-stopping materials at penetrations through walls.

In addition to NFPA 13, the design shall also consider NFPA 30 (Flammable and Combustible Liquid Smoke) and NFPA 30 (Spray Applications Using Flammable and Combustible Materials) for paint storage and spray booth buildings.

Fire Department connections shall be provided for a secondary water supply system for the installed sprinkler.

2. Portable Fire Extinguishers. Portable fire extinguishers shall be provided for the Site Services Building in accordance with NFPA 10.

3. Halon 1301 System. Areas of high value or of high program importance (e.g., computer/control room, electrical equipment room, and battery room) shall be provided with a total-flooding Halon 1301 system. The system shall consist 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.

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SECTION 12

WAREHOUSE

12.1 INTRODUCTION

12.1.1 DESIGN CRITERIA

The Warehouse, located near the Site Services Building, shall be of similar construction. The Warehouse shall be provided with both truck and rail access. A delivery dock, adjacent to the warehouse area, shall be provided.

12.1.2 BASIS FOR DESIGN

The Warehouse shall provide for the requirements of Section 12.1.1. In addition, it shall provide all necessary office functions, toilet facilities, loading docks, and storage facilities.

12.2 CIVIL AND SITE DEVELOPMENT

12.2.1. DESIGN CRITERIA

Refer to Section 12.1.1.

12.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

12.2.2.A. Parking

Parking for the employees working in the Warehouse shall be provided outside the Main Gate/Badgehouse. Additional parking shall be provided adjacent to the Warehouse for onsite vehicles.

12.2.2.B. Landscaping

No landscaping shall be provided for this facility.

12.3 STRUCTURAL

12.3.1 DESIGN CRITERIA

The Warehouse, located near the Site Services Building, shall be of similar construction.

12.3.2 BASIS FOR DESIGN

The Warehouse shall be primarily a braced steel building with metal roof, spread footings, and slab-on-grade floor. Office and support areas shall be constructed of light-gauge framing. Truck and rail access shall be provided to this building.

12.3.2.A. Classification

The Warehouse building shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

12.3.2.B. Design Loads

The design loads shall be in accordance with reference Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Impact load	5
Wind load	7
Earthquake load	8(1)

12.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$$U = 1.4\ D + 1.7\ L$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$$

2. Steel Structures.

$$S = D + L$$
$$1.33\ S = D + L + W$$
$$1.33\ S = D + L + E$$

12.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Wall footings	6
Sliding and overturning	FS = 1.5	7

12.3.2.E. Structural Materials

1. Concrete: 3,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185
   Masonry reinforcing steel: ASTM A615, Grade 40

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

4. Masonry: ASTM C90, Grade N, f'm = 1,350 psi

12.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill or natural soil
    15,000 psf for bedrock or unweathered rock
(2) Friction: 0.5
(3) Frost line: 2 ft below grade

12.4 ARCHITECTURAL

12.4.1 DESIGN CRITERIA

The Warehouse, located near the Site Services Building, shall be of similar construction. The Warehouse shall be provided with both truck and rail access.

12.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

12.4.2.A. General Requirements

The Warehouse shall be located near the Site Services Building, and shall serve as the main storage location for the MRS Facility.

1. The building shall be 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 shall have a preformed metal canopy and fascia. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

2. The Warehouse shall normally be 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

3. The Warehouse shall have a waiting area, receiving room, and restrooms for both men and women. A room shall be provided for electrical equipment.

12.4.2.B. Specific Requirements

1.	UBC Occupancy Class:	B-2
2.	Ceiling heights:	9'-0" for waiting, receiving, and electrical equipment rooms 8'-0" for toilets 24' (approximate) for high-bay storage areas
3.	Kind of traffic:	Foot traffic Forklifts 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.	Special equipment:	
	Lobby, offices:	FF&E Vending machines
	Toilets:	Metal toilet partitions Toilet accessories Mirrors
	Warehouse (storage area):	Storage racks

12.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

12.5.1 DESIGN CRITERIA

No specific design criteria are cited.

12.5.2 BASIS FOR DESIGN

Standard material-handling equipment shall be provided to unload trucks/railcars and to store materials in a rack system. The material-handling equipment shall include industrial trucks with forklift and drum-handling attachments.

12.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

12.7 MECHANICAL PROCESS

12.7.1 DESIGN CRITERIA

No specific design criteria are cited.

12.7.2 BASIS FOR DESIGN

Potable water for fire protection, drinking, and restrooms shall be provided.

12.8 INSTRUMENTATION AND CONTROL

12.8.1 DESIGN CRITERIA

No specific design criteria are cited.

12.8.2 BASIS FOR DESIGN

A general-purpose computer terminal shall be provided for inventory keeping. The terminal shall be linked to the general-purpose computer in the Administration Building.

12.9 PIPING

12.9.1 DESIGN CRITERIA

No specific design criteria are cited.

12.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

12.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office areas and restrooms. Piping runs shall be exposed in the Warehouse.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

Hot and cold water piping shall be insulated.

12.9.2.B. Piping

Not applicable to this building.

12.10 ELECTRICAL

12.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

12.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following criteria shall be used.

12.10.2.A. Power Service

Building power shall be obtained from an outdoor, pad-mounted transformer. The transformer shall transform the 4.16-kV primary voltage to 480Y/277 volts for a motor control center distribution unit located within the Warehouse area. A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel shall be used in a radial-type distribution system for receptacles and other small loads.

The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use.

12.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

High-output, industrial, open-type fluorescent lighting or HID fixtures shall be used in the storage areas. Fluorescent fixtures in office areas shall have prismatic lenses and rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID luminaires with ballasts and integrally mounted fuses shall be used on the exterior of the building.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be time-switch controlled with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as closets.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. This system shall consist of self-contained, battery-operated, emergency equipment with 120-volt ac output.

The batteries shall have a capacity for 90 minutes of continuous operation. The emergency lighting circuit shall be panel-switched. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation.

Lighting shall be photoelectric relay-controlled with manual switch override. Outdoor floodlighting shall be provided for the dock and ramp area of the Warehouse building.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. All exit lighting shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

12.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Warehouse building for paging. The system shall be provided with three paging zones, and shall be 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 - office area

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, zoned fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station and Security Building shall be determined during final design. The annunciator panel shall be located in the waiting or receiving area. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; it shall be UL-listed and shall be installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Warehouse building as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit unless otherwise directed.

12.11 HVAC

12.11.1 DESIGN CRITERIA

No specific design criteria are cited.

12.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

12.11.2.A. General Requirements

The HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

12.11.2.B. Specific Requirements

1. Inside Design Conditions. The Warehouse area shall be maintained above 50°F during winter conditions. During summer conditions, inside temperature may be a maximum of 10°F higher than the outside temperature.

The receiving room and waiting area shall be maintained between 72°F DB and 80°F DB.

2. Cooling System. Cooling shall not be provided for the Warehouse area. Ventilation shall be used to remove excess heat in the summer.

For the receiving room and waiting area, a split, direct-expansion system shall provide the required cooling.

3. Heating System. Electric unit heaters shall be used for the Warehouse area.

An electric heating coil, located in the supply air ductwork, shall provide heating for the receiving room and waiting area.

4. Air Supply System. The Warehouse area shall be provided with damper-operated intake louvers, located near floor level, and 30% ASHRAE atmospheric dust spot efficiency filters to provide inlet air for thermostatically operated roof exhausters.

An air-handling unit equipped with 30% ASHRAE atmospheric dust spot efficiency filters and cooling coil shall provide the air supply for the receiving room and waiting area.

5. Exhaust System. Thermostatically operated power roof exhausters shall be used in the Warehouse area.

A localized exhaust fan shall provide toilet exhaust in the receiving room and waiting area.

6. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this building.

12.12 FIRE PROTECTION

12.12.1 DESIGN CRITERIA

No specific design criteria are cited.

12.12.2 BASIS FOR DESIGN

Fire protection shall be provided for the Warehouse as described below.

1. Wet-Pipe Sprinkler System. An automatic wet-pipe sprinkler system shall be provided throughout the Warehouse. The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13, and shall be 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.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

2. Portable Fire Extinguishers. Portable fire extinguishers shall be a part of the fire-protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 13

VEHICLE MAINTENANCE BUILDING

13.1 INTRODUCTION

13.1.1 DESIGN CRITERIA

Facilities shall be included for all motor vehicle service and maintenance, routine service and minor maintenance of railroad yard engines, shielded transporters, and related rolling stock. This area shall be served by a rail spur.

Underground storage tanks and related dispensing equipment shall be provided for servicing site vehicles.

A service station for disbursing fuel and oil to motor vehicles shall be located in the vicinity of the Vehicle Maintenance Building.

13.1.2 BASIS FOR DESIGN

The Vehicle Maintenance Building shall provide for the requirements of Section 13.1.1. In addition, it shall provide all specialty shops and facilities for a full range of services, as well as fuel and oil disbursement facilities. A separate service station shall not be provided.

13.2 CIVIL AND SITE DEVELOPMENT

13.2.1. DESIGN CRITERIA

No specific design criteria are cited.

13.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2, the following criteria shall be used.

13.2.2.A. Parking

Parking for employees working in the Vehicle Maintenance Building shall be provided outside the Main Gate/Badgehouse. A parking area shall be provided adjacent to the Vehicle Maintenance Building for vehicles waiting for service.

13.2.2.B. Landscaping

No landscaping shall be provided for this facility.

13.3 STRUCTURAL

13.3.1 DESIGN CRITERIA

The Vehicle Maintenance Building shall be constructed of noncombustible materials.

13.3.2 BASIS FOR DESIGN

The Vehicle Maintenance Building shall consist of low-bay areas, where wall construction shall be of concrete block, and high-bay areas, where wall construction shall be of braced steel with metal siding. Roof construction shall consist of steel framing with metal deck diaphragms. Foundations shall be spread and wall footings with slab-on-grade floor.

13.3.2.A. Classification

The Vehicle Maintenance Building shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

13.3.2.B. Design Loads

The design loads shall be in accordance with reference Section 1.3.2.D, a summary of which is as follows:

Design Load	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Vehicle load	3
Snow load	4
Impact load	5
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)
Crane and hoist load	13

13.3.2.C. Load Combinations (Reference Section 1.3.2.E)

1. Concrete structures:

$$U = 1.4\ D + 1.7\ (L + H)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$$

2. Steel structures:

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

13.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

13.3.2.E. Structural Materials

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

13.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill and natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

13.4 ARCHITECTURAL

13.4.1 DESIGN CRITERIA

The Vehicle Maintenance Building shall be constructed of noncombustible materials. Vehicle service and maintenance areas may have open-truss ceilings. Facilities shall be included for all motor vehicle service and maintenance, routine service and minor maintenance of railroad yard engines, shielded transporters, and related rolling stock. This area shall be served by a rail spur.

The office area, restrooms, locker room, and lunchroom shall have suspended ceilings. A sound-attenuating fire wall should separate the general office area from the shops and service areas.

A service station for disbursing fuel and oil to motor vehicles should be located adjacent to the Vehicle Maintenance Building. The structure shall comply with the applicable NFPA codes for fuel-dispensing areas.

13.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

13.4.2.A. General Requirements

The Vehicle Maintenance Building shall provide facilities for routine maintenance and service of 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 building shall be a single-story, reinforced masonry walled structure with structural steel roof framing and metal panel fascias and soffits. All exterior walls, roofs, and roof-ceiling assemblies that enclose occupied spaces shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

2. The Vehicle Maintenance Building shall normally be 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

3. The Vehicle Maintenance Building shall contain several rooms and spaces clustered around a central aisle and workspaces. One corner of the building shall contain a Shop Manager's Office, Service Advisor's counter, lunchroom, toilets and lockers, storage, parts, tool crib, and electrical equipment room. Another corner shall be occupied by mechanical equipment. Enclosed bays in a third corner shall be for painting and body shop and for wash and steam cleaning, each with separate outside vehicle entrances. Also with outside vehicle entrances shall be an alignment bay, overhaul, and lube pit. The fourth corner shall contain a semitruck repair and a railcar service area. Adjacent to the central area shall be a machine shop, a tire shop, glass and upholstery shop, a battery storage room, and spaces for tuneup, lubrication, overhaul, and maintenance.

4. The Vehicle Maintenance Building shall be a completely separate structure with separate entrances and exits to various service and maintenance areas. All rooms and spaces shall also be accessible from the interior.

5. Both the heavy-vehicle and the railcar service areas shall include pits for undercarriage service. Lube and oil storage alcoves shall be located adjacent to the service areas.

6. Adjacent to the Vehicle Maintenance Building shall be a vehicle service island, providing four diesel pumps and two unleaded gasoline pumps. The pumps shall be of the self-service type, actuated by magnetic identification cards. Two underground storage tanks (a 5,000-gal unleaded gasoline tank and a 10,000-gal diesel fuel tank) shall be provided. No overhead canopy shall be provided.

13.4.2.B. Specific Requirements

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 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 heavy vehicle access doors
	12' x 15' at light vehicle access doors
	12' x 10', 10' x 10' at mechanical equipment and machine shop

5. Special equipment:

Parts and tool crib:	Storage shelving
Toilets and showers:	Metal toilet partition Toilet accessories Mirrors Lockers Shower facilities
Offices and lunchroom:	Desks, chairs, filing cabinets, tables, chairs, etc.

13.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

13.5.1 DESIGN CRITERIA

Facilities shall be included for all motor vehicle and maintenance, routine service and minor maintenance of railroad yard engines, shielded transporters, and related rolling stock.

13.5.2 BASIS FOR DESIGN

All shop equipment selected shall meet the appropriate requirements of the latest edition of the codes specified in Section 1.5.1.A.

The Vehicle Maintenance Building shall be equipped with shop equipment for all maintenance to be performed on motor and rail vehicles. The Vehicle Maintenance Building shall be designed on a unit operation basis to fulfill overall plant vehicle maintenance requirements. Selection of equipment in the Vehicle Maintenance Building shall be primarily based on vehicle servicing, parts replacement, and emergency repair and overhaul. All of the selected servicing equipment shall be capable of servicing and hoisting vehicles with gross weight of 6,000 to 18,000 lb.

The following equipment shall be provided as minimum required equipment:

(1) One front-end alignment unit (Visualiner or approved equal); unit shall handle tire sizes up to 11:20 x 20 and axle loading of 14,000 lb.

(2) One dual-column lifting hoist unit, rated 24,000-lb capacity.

(3) One single-post lifting hoist unit, rated 8,000-lb capacity.

(4) One overhead multiple-reel lube unit (air operated); 4-reel unit for lube, grease, air, and oil.

(5) Two rollabout portable lube units (air operated), one for grease and one for gear oil.

(6) Various hand-operated lube guns and accessories.

(7) One passenger car tire-changing machine, able to handle rim sizes to 16 in.

(8) One truck tire-changing machine, able to handle rim sizes 49 to 57 in.

(9) One tire-balancing machine.

(10) One water testing tank for tires.

(11) Two tire storage rack units, each unit three tier, 48 in. wide x 16 in. deep x 84 in. high.

(12) One five-bar safety inflation cage, able to handle all tire sizes to 14:00 x 24.

(13) Miscellaneous air wrenches and tools.

(14) One tire and wheel carrier cart.

(15) Two heavy-duty floor jacks, one 2-ton capacity and one 4-ton capacity.

(16) Two steel-top workbenches, 36 x 72 in. and 34 in. high.

(17) One tuneup analyzer.

(18) One movable floor-lift crane, 2,000-lb capacity.

(19) One parts and block cleaning unit, size 36 in. long x 23-3/4 in. wide x 24 in. deep, electric fired.

(20) One bearing cap grinder machine.

(21) One heavy-duty brake drum lathe machine.

(22) One motor and transmission positioner, rated capacity of 2,000 lb.

(23) One A-frame hoisting unit with 2,000-lb, chain-operated hoisting unit.

(24) One stationary battery-charging unit, operates on 115/230-volt, single-phase power, charges 4-20 (12V) and 8-40 (6V) batteries.

(25) Two portable battery-charging units, operating charging rate of 120/90/60 A, cranking power 300 A.

(26) Two pedestal-mounted grinding machines, one 12-in. x 1-1/4-in. wheel for rough grinding and one 8-in. x 1-in. wheel for finished grinding.

(27) One pedestal-mounted drill press, size 20 in. for drilling 2-in. stock.

(28) Four rollabout tool-chest units

(29) One hydraulic-pump tester machine.

(30) Four parts storage bin units, size 3 ft wide x 1 ft deep and 6-1/2 ft high.

(31) Two bench-mounted, 10-in. pipejaw-face vises; units to have swivel base mounting.

(32) One electric welding machine, 450 A.

(33) One engine-block honing machine (SUNNEN-LBB 1810 or approved equal).

(34) One portable Hot-Tot steam-cleaning unit, operating wash of 2,000 psi.

(35) One portable oxygen and acetylene welding kit, complete with hose, gauges, and cutting and welding tips.

(36) One Kwik-Way or approved equal valve service equipment (Basic Kit).

(37) One Kwik-Way valve-seat grinder machine.

(38) One H-frame press unit, 25-ton capacity.

(39) One engine-block grinder machine (Bergo-RSC-950 or approved equal).

(40) One engine-head grinder machine (Kwik-Way 855 or approved equal).

(41) One engine-boring machine (Tobin-ARP-TA-20 or approved equal).

(42) One diesel-power analyzer, Dynequip-1032 (portable) or approved equal.

(43) One 20-ton bridge crane, railroad and truck bay area.

(44) Hydraulic hose assembler machine (Parker 432 or approved equal).

(45) One jib crane, 4-ton capacity.

(46) One 7-1/2-ton carry deck crane.

(47) One 40-ton crawler-style crane.

(48) Nine mid-compact passenger vehicles.

(49) Five patrol vehicles, 4x4-wheel drive, Blazer or Bronco.

(50) Two patrol vehicles, 4x4-wheel drive, van style.

(51) Utility vehicle, 2-ton truck style.

(52) Two 3/4-ton service trucks; one with side-mount storage compartments, and one with side-mount storage compartments and portable welding unit.

(53) Service truck, 4-ton capacity, 4-wheel drive.

(54) Truck with telescoping manlift, 2-ton capacity, with flatbed-style box.

(55) Tow truck, 2-ton capacity, 4-wheel drive, with hoisting arm crane and sling.

(56) Three forklift trucks, 10,000-lb capacity; electric powered.

(57) Three forklift trucks, 10,000-lb capacity; gasoline engine powered.

(58) Two railcar mover vehicles, on-track/off-track style.

(59) Front-end loader, 6 cylinder, diesel powered.

(60) One backhoe tractor unit, with trench-digging bucket and 3/4-yd, front-mount bucket unit.

(61) Two lowboy trailer support dolly trailer units, equipped with 5th-wheel connection adaptor.

(62) Two trailer jockey truck-style units, with 5th-wheel adaptor.

(63) Cask transfer trailer, 300,000-lb load capacity.

(64) Emergency lighting trailer, 4-wheel, tow-style trailer, with power generator and floodlights.

13.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

13.7 MECHANICAL PROCESS

13.7.1 DESIGN CRITERIA

No specific design criteria are cited.

13.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Plant air, at 125 psi, for operation of 10 pneumatic tools at 50 scfm.

(2) Instrument air, at 100 psi, for operation of 20 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and process water for hot water boiler based on a duty of 2,640 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in. fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, drinking, restrooms, eyewash, and safety showers.

13.8 INSTRUMENTATION AND CONTROL

13.8.1 DESIGN CRITERIA

No specific design criteria are cited.

13.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria shall be used.

A general-purpose computer terminal shall be provided for computerized parts inventory. The terminal shall be linked to the general-purpose computer in the Administration Building.

13.9 PIPING

13.9.1 DESIGN CRITERIA

Sanitary water shall be provided to restrooms, locker room, lunchroom, janitor sinks, and water coolers. Safety showers and eyewash station in the battery storage room shall also be provided and connected to the sanitary cold water system. Process water shall be provided to other areas and shall be separated from the sanitary system by backflow preventers.

Compressed air shall be provided to all shops.

Sanitary sewer shall be provided in the lunchroom, restrooms, locker room, janitor sinks, and other sanitary plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the shops and steam cleaning area.

The standard clear height in the shops shall be 20 ft. All trusses, overhead ventilation ducts, electrical bus ducts, conduits, piping, fire protection sprinklers, lighting fixtures, and other appurtenances shall be located above that height.

13.9.2 BASIS FOR DESIGN

Refer to Section 1.9.2.

13.9.2.A. Plumbing

Sanitary water is interpreted as potable water.

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office area, restrooms, locker room, and lunchroom.

Piping shall be exposed in the vehicle service and maintenance areas of the building.

A safety shower and eyewash station to comply with ANSI Z358.1 shall be provided in the battery storage room, and supplied from the cold potable water system.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

Hot and cold water piping shall be insulated.

13.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Piping runs shall be exposed in the shop area of the building.

Plant air and instrument air shall be supplied from equipment installed in the mechanical equipment room. Plant air utility stations for tools shall be provided in the boiler room, mechanical equipment room, and shop. A supply shall also be provided for the H-frame press, tire-changing machine, and vehicle lube equipment. Instrument air shall be provided in the boiler room and mechanical equipment room.

The plant air and instrument air systems shall provide plant air and instrument air to the Water Treatment Facility.

Utility stations of cold process water shall be provided.

Process water for heating system makeup and utility stations in the shops for washdown, tire-test tank filling, and other uses shall be provided.

Process water shall be supplied from the potable water system. The process water shall be separated from the potable water system by backflow preventers.

Fuel oil supply to the heating boiler shall be provided.

Natural gas supply to the heating boiler shall be provided as an alternate fuel, if available.

Meters shall be provided to monitor the fuel usage for the building.

Hot water at 210°F and 2,000 psig shall be provided in the steam-cleaning room, supplied from a hot water cleaning machine installed in the area.

Equipment drains and funnel drains shall be provided in the boiler room and connected to the oily sewer.

Boiler blowdown drain shall be provided in the boiler room and connected to the process sewer.

HVAC equipment drains shall be provided in the mechanical equipment room and connected to the process sewer.

Floor drains shall be provided in the wash and steam-cleaning room, installed with a grease trap and connected to the process sewer.

The fuel oil supply, natural gas, process sewer, oily sewer, and plant and instrument air shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

13.10 ELECTRICAL

13.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

13.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.10.2, the following criteria shall be used.

13.10.2.A. Power Service

Building power shall be obtained from an outdoor, pad-mounted transformer located near the Vehicle Maintenance Building. The transformer shall be used to provide 480Y/277-volt service for all lighting loads and for all 480-volt, 3-phase power loads. A dry-type transformer shall serve all 208Y/120V receptacles, small power loads, and motors less than 1/2 hp in size. The electrical distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installation outdoors shall be of weatherproof construction.

Welding receptacles and special power and/or regulated power supplies shall be provided as required.

13.10.2.B. Lighting

1. General. In general, 277 volts shall be used for fluorescent and high-intensity discharge (HID) lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in all open areas. Fluorescent fixtures shall have prismatic lenses and rapid-start lamps. In the shop areas, fluorescent fixtures shall be of the industrial type with rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID luminaires with ballasts and integral mounted fuses shall be used on the exterior of the building.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be time-switch controlled with manual override.

Incandescent fixtures shall be provided in small rooms and in areas that are to be used intermittently, such as restrooms.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. This system shall consist of individual battery-operated emergency equipment with 120-volt ac output.

The batteries shall have capacity for 90 minutes of continuous operation. Wiring for the emergency system shall be in separate conduit. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation.

Lighting shall be photoelectric-relay-controlled with manual switch override. Outdoor floodlighting shall be provided at vehicle entrance areas, as required.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. All exit lighting shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

13.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Vehicle Maintenance Building for paging. The system shall be provided with a paging zone from the Site Services Building and a second paging zone shall be accessed through the telephone system from within the Vehicle Maintenance Building.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system will employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station and Security Building shall be determined during final design. The annunciator panel shall be located near the entrance vestibule. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; it shall be UL-listed, and shall be installed in accordance with the NFPA 101 Life Safety Code.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Vehicle Maintenance Building as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

13.11 HVAC

13.11.1 DESIGN CRITERIA

The shop area shall have an exhaust system to remove the vehicle exhaust fumes.

13.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2 and 13.11.1, the following criteria shall be used.

13.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) system shall provide the temperature, humidity, and ventilation required for personnel comfort and equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

13.11.2.B. Specific Requirements

1. Inside Design Conditions: Office Area. Inside design temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as equipment room and storage areas), the temperature shall be maintained between 65°F DB and a maximum of 10°F higher than outside dry-bulb temperature.

Humidification shall not be used in this building.

2. Inside Design Conditions: Shop Area. All shop areas shall be maintained between 65°F DB and a maximum of 10°F higher than outside dry-bulb temperature.

3. Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas. In addition, an energy-conservation analysis shall be performed to evaluate the cost effectiveness of an economizer cycle.

4. Cooling System

(1) Office Area. Cooling shall be provided by a split, direct-expansion cooling system for all normally occupied areas.

(2) Shop Area. Cooling shall not be provided for the shop areas. Ventilation shall be used to remove excess heat in the summer.

5. Heating System. Heating shall be provided by hot water generated by a local hot water boiler.

Additional electric heating shall be provided for the paint shop by an electric coil located inside the makeup air unit.

6. Air Supply System

(1) Office. Air shall be distributed by a supply fan through a duct system to the different rooms within the area.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following minimum air-change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour
Battery room:	5 air changes per hour

(2) Shop Area. An air-handling unit shall be located inside the mechanical equipment room to provide the supply air for the various shops. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

Airflow rates shall be maintained as required for adequate air change, temperature control, and for makeup of exhaust requirements for the individual shop areas.

A supplemental makeup air unit shall be used to provide the supply air requirements when painting is being performed. During the painting operation, an airflow rate of 20 air changes per hour shall be maintained.

7. Exhaust System. Local exhausters shall be provided for the exhaust of the paint shop, paint storage, battery room, welding shop (with exhaust hood), machine shop, lockers, and restrooms.

A second exhaust fan (interlocked with supplemental makeup air fan) shall be provided to operate on an as-needed basis when painting is being performed.

A tailpipe exhaust system shall also be provided to operate on an as-needed basis.

8. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this building.

13.12 FIRE PROTECTION

13.12.1 DESIGN CRITERIA

No specific design criteria are cited.

13.12.2 BASIS FOR DESIGN

Fire protection shall be provided for the Vehicle Maintenance Building as described below.

13.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the Vehicle Maintenance Building.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13. It shall be 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 shall also consider NFPA 30 (Flammable and Combustible Liquid Storage) and NFPA 30 (Spray Applications Using Flammable and Combustible Materials).

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

13.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire-protection system. They shall be sized, located, and installed throughout the building in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 14

FIRE STATION

14.1 INTRODUCTION

14.1.1 DESIGN CRITERIA

The MRS Facility Fire Station shall include facilities for fire protection personnel, including locker rooms, lunchroom, training room, fire protection equipment rooms, and ambulance and paramedic facilities. The Fire Station shall include the plant emergency and industrial first-aid facilities.

14.1.2 BASIS FOR DESIGN

The Fire Station shall provide for all functions required by Section 14.1.1.

14.2. CIVIL AND SITE DEVELOPMENT

14.2.1. DESIGN CRITERIA

No specific design criteria are cited.

14.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

14.2.2.A. Parking

Parking for employees working in the Fire Station shall be provided outside the Main Gate/Badgehouse. Additional parking shall be provided in the Security Building parking lot.

14.2.2.B. Landscaping

Landscaping shall be provided around the entrance to the Fire Station.

14.3 STRUCTURAL

14.3.1 DESIGN CRITERIA

No specific design criteria are cited.

14.3.2 BASIS FOR DESIGN

The Fire Station shall be a concrete block wall building with steel-framed, metal-deck roof, wall footings, and slab-on-grade floor.

14.3.2.A. Classification

The Fire Station building shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

14.3.2.B. Design Loads

The design loads shall be in accordance with reference Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Vehicle load	3
Snow load	4
Wind load	5
Earthquake load	8(1)

14.3.2.C. Load Combinations (Section 1.3.2.E)

1. Concrete Structures.

$U = 1.4\ D + 1.7\ L$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures.

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

14.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

14.3.2.E. Structural Materials

(1) Concrete: 3,000 psi @ 28 days

(2) Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

Wire mesh: ASTM A185
Masonry reinforcing steel: ASTM A615, Grade 40

(3) Structural steel: ASTM A36

Bolts: ASTM A325F

(4) Masonry: ASTM C90, Grade N, f'm = 1,350 psi

14.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill and natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind and seismic

(2) Friction: 0.5

(3) Frost line: 2 ft below grade

14.4 ARCHITECTURAL

14.4.1 DESIGN CRITERIA

The MRS Facility Fire Station shall include facilities for fire protection personnel, including locker rooms, lunchroom, training room, fire protection equipment rooms, and ambulance and paramedic facilities. The Fire Station shall include plant emergency and industrial first-aid facilities.

14.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

14.4.2.A. General Requirements

1. The Fire Station shall provide 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.

2. The building shall be single story, with reinforced masonry walls and structural steel roof framing and with metal panel fascia. It shall be divided into three major functional areas:

(1) Firefighting apparatus and equipment
(2) Personnel facilities
(3) Mechanical/electrical equipment

The main apparatus room shall be flanked by the remaining facilities at both ends, thus providing ready access to the firefighting apparatus from any point in the building. The apparatus shall be parked side-by-side in a single row, providing direct access to the exterior for each unit.

All exterior walls, roofs, and roof-ceiling assemblies shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupancy.

3. Personnel for the Fire Station shall be as follows:

Function	Number of Full-Time Personnel by Shift				Number of On-Call Personnel (all shifts)	Total Full time
	Days	2nd	3rd	4th		
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

4. The following rooms shall be 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 and shower
Mechanical equipment room
Electrical room
Janitor's room
First aid, nurse's reception, waiting, exam/treatment, and medical storage (for plant emergency and industrial first aid)

14.4.2.B. Specific Requirements

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, nurse's reception, waiting, examination/ treatment rooms, and medical storage:	9'-0"
	Toilets, lockers, showers:	8'-0"
3.	Kind of traffic:	Foot traffic Firefighting apparatus vehicles
4.	Size of access openings:	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's automobile
5.	Special equipment:	
	Offices, kitchen, lunch/squad room:	FF&E, unit kitchen
	Nurse's reception, waiting, examination/treatment, medical storage:	FF&E, examination table, first-aid equipment cabinets, counter with sink, medical stores shelving

Toilets, showers, lockers:	Metal toilet and shower partitions Toilet and shower accessories Mirrors Lockers (double-tier)

14.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

14.5.1 DESIGN CRITERIA

The MRS Facility Fire Station shall include facilities for fire protection personnel, including locker rooms, lunchroom, training room, fire protection equipment rooms, and ambulance and paramedic facilities.

14.5.2 BASIS FOR DESIGN

The fire-protection equipment shall provide the additional capability to fight and control a fire in the buildings that have an automatic wet-pipe sprinkler system and portable fire extinguishers. It shall also provide capabilities to fight and control fires in remote areas of the site that are not provided with fire-protection systems. An ambulance shall be provided to respond to medical emergencies and to transport patients to the hospital for treatment.

All firefighting equipment shall meet the appropriate requirements of the latest edition of the following codes:

(1) Occupational Safety and Health Administration (OSHA) Standards
(2) National Fire Protection Association (NFPA) Pamphlet 1901

The following firefighting equipment shall be provided as minimum required equipment:

(1) One 750-gpm pumper truck with 2-stage pump unit.

(2) One 1,500-gpm pumper truck with 2-stage pump unit.

(3) One 750-gpm pumper truck with Spartan Telesquirt or approved equal, with a 30-ft ladder and spray nozzle.

(4) Two tanker trucks, 1,250-gal water tank capacity.

(5) One ambulance unit, equipped with paramedic equipment, siren, and emergency lights.

(6) One Fire Chief van unit, equipped with siren and emergency lights.

(7) One hose-drying oven.

(8) Accessory firefighting equipment:

- Fire-retarding clothing
- Firemen helmets
- Fire hose and nozzles
- Firemen axes and picks
- First-aid kits
- Oxygen cylinders and breathing apparatus
- Fire extinguishers
- Gloves and boots

14.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

14.7 MECHANICAL PROCESS

14.7.1 DESIGN CRITERIA

No specific design criteria are cited.

14.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Plant air, at 125 psi, for operation of one pneumatic tool at 25 scfm.

(2) Instrument air, at 100 psi, for operation of 10 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and process water for hot water boiler based on a duty of 672 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in. fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, drinking, and restrooms.

(7) Breathing air.

14.8 INSTRUMENTATION AND CONTROL

14.8.1 DESIGN CRITERIA

No specific design criteria are cited.

14.8.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.8.2, the following criteria will be used.

All of the fire alarms in the MRS Facility shall be 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 shall be instantly transmitted to the DCS, where it shall be presented as a group alarm.

14.9 PIPING

14.9.1 DESIGN CRITERIA

Sanitary water shall be provided to restrooms, janitor sinks, examination treatment room, lunch/squad room, and water coolers. Process water shall be provided and shall be separated from the sanitary system by backflow preventers.

Sanitary sewer shall be provided in the restrooms, janitor sinks, lunch/squad room, and other sanitary plumbed areas. Process sewer shall be provided for floor drains and funnel drains in the equipment rooms.

14.9.2 BASIS FOR DESIGN

14.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Sanitary water is interpreted as potable water.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the personnel quarters of the building.

Piping shall be exposed in the apparatus room.

Hot potable water shall be supplied by an electric hot water heater.

An electric (drinking) water cooler shall be provided.

14.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following design criteria shall be used.

Fuel oil supply to the heating boiler shall be provided.

Natural gas supply to the heating boiler shall be provided as an alternate fuel, if available.

Meters shall be provided to monitor the fuel usage for the building.

Process water for heating system makeup shall be provided. Process water shall be supplied from the potable water system. The process water shall be separated from the potable water by backflow preventers.

Plant air and instrument air shall be supplied from the Security Building air systems. Plant air utility stations for air tools shall be provided in the boiler room and the mechanical equipment room. Instrument air shall be provided in the boiler room and the mechanical equipment room.

Equipment drains and funnel drains shall be provided in the boiler room and connected to the oily sewer.

A boiler blowdown drain shall be provided in the boiler room and connected to the process sewer.

HVAC equipment drains shall be provided in the mechanical equipment room and connected to the process sewer.

The fuel oil supply, natural gas, process sewer, oily sewer, and plant air and instrument air shall be extended to an interface 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

14.10 ELECTRICAL

14.10 1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

14.10.2 BASIS FOR DESIGN

In addition to the criteria listed in Sections 1.10.2 and 14.10.1, the following criteria shall be used.

14.10.2.A. Power Service

Building power shall be obtained from the normal and standby bus located at the Security Building, at 480Y/277 volts, for distribution to all power and lighting loads. A dry-type, 480-208Y/120-volt, 3-phase transformer and circuit-breaker distribution panel shall be used in a radial-type distribution system for receptacles, other small loads, and motors less than 1/2 hp in size. The entire distribution system shall be coordinated for selective fault protection. Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installations outdoors shall be of weatherproof construction.

An integrated, uninterruptible power supply (UPS) system shall be provided for the fire alarm equipment and the radio. Input power shall be 480 volts, 3 phase, and inverter output shall be 120 volts, 1 phase. The battery shall be built into the UPS equipment, and shall be sized to carry the full inverter ouput for 90 minutes.

14.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system may be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits.

Fluorescent lighting fixtures shall be used in all office areas. Fluorescent fixtures in these areas shall have prismatic lenses and rapid-start lamps. HID luminaires shall be used in the main apparatus room. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

HID luminaires with ballasts and integral mounted fuses shall be used on the exterior of the building.

Panel-switched night-lighting circuits shall be provided. Light fixtures above exterior doors shall be time-switch controlled with manual override.

Incandescent fixtures may be provided in small rooms and in areas that are to be used intermittently, such as storerooms.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during total power outage. This system shall be automatically switched to emergency power upon total loss of power, and shall consist of individual battery-operated emergency equipment with 120-volt ac output. Emergency power shall be supplied to lights at the dispatch room.

The batteries shall have capacity for 90 minutes of continuous operation. Wiring for the emergency system shall be in separate conduit. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Outdoor Floodlighting and Area Lighting. Outdoor floodlighting and area lighting shall be provided to allow illumination for nighttime operation.

Lighting shall be photoelectric relay-controlled with manual switch override. Outdoor floodlighting shall be provided for the vehicle parking and driveway areas.

4. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

5. Exit Lighting. All exit lighting shall be considered as part of the emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

14.10.2.C. Communications

1. Public Address System. Public address system speakers shall be installed in the Fire Station for paging. The system shall be provided with one paging zone and shall be initiated from the Site Services Building or by access through the telephone system from within the Fire Station building.

The public address system shall provide a paging sound level of approximately 6 db and shall be consistent within 3 db for all paging areas.

The public address speaker system shall employ only solid-state devices, and shall represent the most current state-of-the-art in concept and engineering.

Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. A local fire alarm system shall be provided for the Fire Station. The alarm annunciator panel shall be located in the dispatch room. The system shall include smoke detectors, fire sensors, manual fire alarm stations, and a local audible alarm. The dispatch room shall also contain the central fire alarm computer and event recorder/printer for the plantwide fire alarm system. The fire alarm computer shall be UL-listed and shall be connected with equipment in the redundant alarm monitoring stations. A repeater system shall be located in the Security Building. The actual method of signal transmission and the interface point with the various buildings and facilities shall be determined during final design. All fire alarm systems shall 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 systems and equipment shall be UL listed and/or FM approved, installed and located in accordance with NFPA 101, Life Safety Code. All fire alarm systems shall be connected to the radio dispatch room at the Fire Station alarm monitoring stations.

3. Telephone System. The main EPABX equipment shall be located in the Site Services Building. All telephone communication equipment shall be provided at the Fire Station as necessary.

Location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in conduit, unless otherwise directed.

4. Radio. A fixed-base and mobile UHF radio system shall be provided to support communications between the Fire Station and mobile firefighting equipment personnel.

14.11 HVAC

14.11.1 DESIGN CRITERIA

No specific design criteria are cited.

14.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

14.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) systems shall provide the temperature, humidity, and ventiliation required for personnel comfort and equipment operation.

14.11.2.B. Specific Requirements

The HVAC system shall be designed to meet earthquake requirements specified in the Design Criteria (Section 1.3.1.D.2).

1. Inside Design Conditions: Office Area. Inside design temperature for personnel comfort shall be maintained between 72°F DB and 80°F DB for all normally occupied areas.

For normally unoccupied areas (such as restrooms, locker rooms, and storage and equipment rooms), the temperature shall be maintained between 65°F DB and 90°F DB.

Humidification shall not be provided for this area.

2. Inside Design Conditions: Main Apparatus Room. Inside temperature for this area shall be maintained between 65°F DB and a maximum of 10°F higher than the outside dry-bulb temperature. Humidification shall not be provided.

3. Energy Conservation. Recirculation shall be used to the maximum extent practicable in the office area. In addition, an energy-conservation analysis shall be performed to evaluate the cost effectiveness of an economizer cycle for the office area HVAC system.

4. Cooling System. Cooling for the office area shall be provided by a split, direct-expansion system.

Cooling shall not be provided for the main apparatus room. Exhaust fans interlocked with a makeup air unit shall be used to remove excess heat during summer conditions.

5. Heating System. Heating shall be provided by hot water generated by a local hot water boiler.

6. Air Supply System: Office Area. Outside and recirculated air shall be filtered through 30% efficiency prefilters and 85% ASHRAE atmospheric dust spot efficiency final filters before being distributed to the different rooms within the area by a supply fan through a duct system. A return air fan shall be used to return and/or exhaust the air if an economy cycle is used.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation requirements for all normally occupied areas.

For normally unoccupied areas, the following minimum air-change rates shall be applied:

Toilet rooms/janitor's closet:	12 air changes per hour
Equipment rooms:	6 air changes per hour
Storage rooms:	6 air changes per hour

7. Air Supply System: Main Apparatus Room. A makeup air unit equipped with a fan, 30% ASHRAE atmospheric dust spot efficiency filters, and mixing dampers shall be used to provide minimum ventilation during winter and exhaust makeup for heat removal during summer.

8. Exhaust System. The air from the toilet areas shall be exhausted to the outside by independent exhaust fans. This area shall be maintained under negative pressure.

One exhaust fan shall be provided for the minimum ventilation of the main apparatus room. Additional thermostatically operated exhaust fans shall be used for heat removal during summer conditions.

9. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this area.

14.12 FIRE PROTECTION

14.12.1 DESIGN CRITERIA

No specific design criteria are cited.

14.12.2 BASIS FOR DESIGN

14.12.2.A. Fire Protection

Fire protection shall be provided throughout the Fire Station. It shall include an automatic wet-pipe sprinkler system and portable fire extinguishers.

14.12.2.B. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the facility. The system shall be designed in accordance with NFPA 13 and shall be complete, including piping, valves, fittings, sprinkler heads, and all required accessories and equipment.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions.

Fire Department connections shall be provided for a secondary water supply for the sprinkler systems.

14.12.2.C. Portable Fire Extinguishers

Portable fire extinguishers shall be a part of the fire protection system provided for the Fire Station. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10.

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SECTION 15

STANDBY GENERATOR BUILDING

15.1 INTRODUCTION

15.1.1 DESIGN CRITERIA

Standby power shall be provided by generators centrally located to serve the required loads. The generators shall provide service to standby transformers at the various buildings via a distribution system that is installed in underground ducts separate from the normal power system. Interruption of both normal power sources shall automatically separate the normal power feeders from the standby bus in each building, and shall automatically switch the load to the standby lines.

Loss of normal power to the site shall also start the standby generators and connect them to the standby power grid.

15.1.2 BASIS FOR DESIGN

The Standby Generator Building shall provide for all of the functions required in Section 15.1.1. Refer to Drawing No. H-3-56714, Hot Water Boiler and Standby Generator Systems flow diagram in Section 1, which forms the basis for design.

15.2 CIVIL AND SITE DEVELOPMENT

15.2.1 DESIGN CRITERIA

No specific design criteria are cited.

15.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

15.2.2.A. Parking

Parking shall be provided adjacent to the facility for maintenance vehicles.

15.2.2.B. Landscaping

No landscaping shall be provided for this facility.

15.3 STRUCTURAL

15.3.1 DESIGN CRITERIA

No specific design criteria are cited.

15.3.2 BASIS FOR DESIGN

The Standby Generator Building shall be a reinforced concrete, box system structure of monolithic, poured-in-place construction.

15.3.2.A. Classification

The Standby Generator Building shall be designed as a Category I structure in accordance with Section 1.3.2.C.

15.3.2.B. Design Loads

The design loads shall be in accordance with Section 1.3.2.D, a summary of which is as follows:

	Design Load		Reference Subsection of Section 1.3.2.D
1.	Dead load:		1
2.	Live load:		2
	- Roof: 20 psf or 2,000-lb concentrated load		
	- Floor: 200 psf or equipment weight, whichever is larger		
3.	Snow loads: (ground snow = 25 psf)		4
4.	Impact Loads	Increase of Moving Load	5
	Light machinery	20%	
	Reciprocating machinery	50%	
5.	Thermal loads: ($\Delta T = 50°F$)		6
6.	Wind loads: (100-mph wind)		7
7.	Earthquake load:		8
	- Design Basis Earthquake (DBE)		
	- Operating Basis Earthquake (OBE)		

Design Load	Reference Subsection of Section 1.3.2.D
8. Tornado loads: (maximum wind speed = 360 mph)	9
9. Lateral earth pressure:	10

- Static earth pressure:

  Active earth pressure: 30 pcf
  At-rest earth pressure: 55 pcf
  Surcharge: 300 psf or 20,000-lb wheel load

- Dynamic earth pressure:

  DBE: $P = 10.3\ H^2$ lb/ft
  OBE: $P = 5.15\ H^2$ lb/ft

15.3.2.C. Load Combinations

Applicable load combinations are derived from DOE 6430.1, NRC SRP 3.8.4, and ACI 349. The most stringent cases are listed below:

$U = 1.4\ D + 1.7\ (L + H) + 1.9\ Eo$
$U = 1.4\ D + 1.7\ (L + H) + 1.7\ W$
$U = 0.9\ D + 1.7\ H + 1.9\ Eo$
$U = 0.9\ D + 1.7\ H + 1.7\ W$
$U = 0.75\ [1.4\ D + 1.7\ (L + H + To) + 1.9\ Eo]$
$U = 0.75\ [1.4\ D + 1.7\ (L + H + To + W)]$
$U = 1.1\ (D + L + H + To) + Ed$
$U = 1.1\ (D + L + H + To) + Wt$
$U = 0.9\ D + H + To + Ed$
$U = 0.9\ D + H + To + Wt$
$S = D + L + Eo$
$1.5\ S = D + L + Ed$

15.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Methods	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Seismic	Equivalent static load analysis	4(3)
Tornado	Energy balance method NDRC formula	5
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5 FS = 1.1 (tornado and DBE)	7

15.3.2.E. Structural Materials

1. Concrete: 4,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

15.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

(1) Bearing capacity: 4,000 psf for compacted fill and natural soil
15,000 psf for bedrock or unweathered rock
1/3 increase for wind, seismic, and OBE
1/2 increase for tornado and DBE

2. Active soil pressure: Section 1.3.2.D.10

3. Passive soil pressure: 400 pcf

4. Modulus of subgrade reaction: 400 k/ft^3

5. Friction coefficient: 0.5

6. Frost line: 2 ft below grade

15.4 ARCHITECTURAL

15.4.1 DESIGN CRITERIA

No specific design criteria are cited.

15.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

15.4.2.A. General

The Standby Generator Building shall normally be unoccupied except for routine maintenance personnel.

The Standby Generator Building shall be a single-story structure, and shall contain five main generator rooms. Each room shall be configured to contain a diesel-generator unit and all accessory equipment, including a mezzanine for filters. A sixth room shall house all electrical switchgear.

15.4.2.B. Specific

1.	UBC Occupancy Class:	B2
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 panel equipment 3'-0" x 7'-0" exterior personnel doors

15.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

15.5.1 DESIGN CRITERIA

No specific design criteria are cited.

15.5.2 BASIS FOR DESIGN

A monorail beam shall be provided above each generator unit to facilitate use of manually operated chain hoists for lifting heavy components during the repair of the generator units. Each monorail beam shall be sized for a 4-ton-capacity hoist.

15.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this building.

15.7 MECHANICAL PROCESS

15.7.1 DESIGN CRITERIA

No specific design criteria are cited.

15.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Oil-free, dried, instrument air at 100 psig for operation of eight pneumatic dampers at 0.5 scfm per damper. Air supply equipment is located in the R&H Building.

(2) Fuel oil for standby generators.

(3) Process sewer for standby generator drainage.

(4) Oily sewer for draining of oil from the fuel-oil day tank.

(5) Process water for generator cooling makeup.

15.8 INSTRUMENTATION AND CONTROL

15.8.1 DESIGN CRITERIA

No specific design criteria are cited.

15.8.2 BASIS FOR DESIGN

Instrumentation shall be provided in the Standby Generator Building for monitoring and alarming abnormal or out-of-tolerance conditions, remotely as well as locally.

CCTV cameras shall be provided for remote security surveillance of the building interior.

15.9 PIPING

15.9.1 DESIGN CRITERIA

No specific design criteria are cited.

15.9.2 BASIS FOR DESIGN

15.9.2.A. Plumbing

The roof drainage shall be designed in accordance with Section 1.9.2. There are no other requirements for plumbing in the Standby Generator Building.

15.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

The piping systems shall be designed to meet the requirements of Section 1.3.2 of the Structural Basis for Design.

In general, piping runs shall be in trenches to maintain the overhead clearance required for maintenance of diesel engines.

Instrument air shall be provided by equipment located in the R&H Building. Starting air shall be provided by equipment located in the building.

Diesel fuel shall be provided to the building from underground storage tanks located adjacent to the building.

An oily sewer system shall be provided to collect equipment drains and funnel drains.

Nonoily equipment and funnel drains shall be provided, and shall be connected to the process sewer.

Process water shall be supplied from the potable water system. The process water shall be separated from the potable water by a backflow preventer.

Water usage for the building shall be metered.

The diesel-fuel supply and return, instrument air, oily sewer, and process sewer piping shall be extended to an interface point 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

15.10 ELECTRICAL

15.10.1 DESIGN CRITERIA

For design criteria, see Section 15.1.1.

15.10.2 BASIS FOR DESIGN

15.10.2.A. General

The Standby Generator Building shall be a Category I structure, housing the diesel-generator units for the MRS Facility standby power system. In addition, the building shall include the associated standby power and main substation switchgear.

15.10.2.B. Power System

The standby power system shall consist of four installed diesel-generator units with space for a future fifth unit. The skid-mounted, diesel-generator units shall be located in separate compartments, each with its own radiator, control panel, day tank, and roof-mounted exhaust silencer. The standby power shall be 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 shall be configured in three main sections: Bus No.1, Transfer Bus, and Bus No. 2.

Normal operation shall be 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 shall assume the full MRS Facility load after the isolation of the failed power source. At that time, all double-ended substation feeders can be transferred to the now-preferred normal power source.

If a second power failure of the other normal power source occurs, both tie-breakers and feeder breakers shall open. The concurrent startup and synchronization of three diesel-generator units shall then be initiated, and shall supply power to all standby power loads, when all substations that can transfer to standby power have transferred.

In each of the above conditions for starting the standby generators, the voltage at the bus of the standby unit substations shall be zero. Therefore, automatic synchronizing of the standby generators shall only be necessary between generators. Manual synchronizing shall be provided to facilitate testing of the standby generators. Alarms shall be provided to annunciate loss of secondary voltage at all unloaded substation transformers, as well as the loaded transformers.

Provisions shall be made to periodically exercise the diesel generators under load to maintain their operational readiness.

Building power shall be obtained from a separate, dry-type transformer at 4.16 kV-480/277 volts for all low-voltage motor and lighting loads. The electrical distribution system shall be coordinated for selective fault protection, and served from a standby Bus "T." Electrical equipment and installation shall conform to NEMA-1 type enclosures for indoor use. Fixtures and installation outdoors shall be of weatherproof construction.

15.10.2.C. Lighting

1. General. High-efficiency fluorescent lighting fixtures shall be used throughout the interior of the building. Fixtures shall be of the industrial type, with rapid-start lamps. Fluorescent lamp ballasts shall be of the thermally protected, Class P, CBM-certified, high-power-factor type, and shall be of the energy-efficient type.

High-intensity discharge (HID) luminaires, with ballasts and integrally mounted fuses, shall be used on the exterior of the building.

2. Emergency Lighting System. An emergency lighting system shall be provided for safe egress during normal power outage. This system shall be automatically switched to emergency power upon loss of normal power and shall consist of individual, battery-operated, emergency equipment.

The batteries shall have a capacity for 90 minutes of continuous operation. Wiring for the emergency system shall be in a separate conduit. All wiring of the emergency lighting system shall conform to the applicable requirements of Article 700 of the NEC.

3. Illumination Levels. The interior lighting intensities shall be 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 needed for special tasks, personnel safety, or security reasons, they shall be provided in accordance with the recommendations of the Illuminating Engineering Society (IES), as contained in the 1981 IES Lighting Handbook.

4. Exit Lighting. All exit lighting shall be considered as an emergency system, and shall be installed in conduit or tubing in accordance with Article 700 of the NEC. Illuminated exit signs shall be provided as required by NFPA Life Safety Code No. 101.

15.10.2.D. Communications

1. Public Address System. Public address system speakers shall be installed in the Standby Generator Building for paging. The system shall be provided with one paging zone from the Site Services Building only. Unless otherwise directed, all speaker cables shall be installed in conduit.

2. Fire Alarm and Detection System. An electrically supervised, noncoded, fire alarm system shall be provided. The system shall include 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 interface point with the MRS Fire Station and Security Building shall be determined during final design. The fire alarm system shall be in accordance with NFPA 72A, 72D, and 72E; shall be UL-listed; and shall be installed in accordance with NFPA 101, Life Safety Code.

3. Telephone System. The main Electronic Private Automatic Branch Exchange (EPABX) equipment shall be located in the Site Services Building. A telephone instrument shall be provided in the Standby Generator Building. The telephone system shall be installed in a conduit unless otherwise directed.

15.11 HVAC

15.11.1 DESIGN CRITERIA

No specific design critera are cited.

15.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

15.11.2.A. General Requirements

The heating and ventilating system shall provide the temperature and ventilation requirements for proper equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in Design Criteria Section 1.3.1.D.1.

15.11.2.B. Specific Requirements

1. Inside Design Conditions. The Standby Generator Building shall be maintained between 50°F DB and a maximum of 10°F higher than the outside dry-bulb temperature.

2. Cooling System. Cooling shall not be provided for this building. Ventilation shall be used to remove excess heat in the summer.

3. Heating System. Electric unit heaters with built-in thermostats shall be used to provide the required heating for the generator rooms. Electric heating coils, located inside each air-handling unit, shall provide the heating requirements for the switchgear room.

4. Air Supply and Exhaust System

   (1) Electrical Switchgear Room. Two air-handling units, equipped with electric heating coils, shall provide a constant volume of supply air for the area. Filtered and heated (as needed) air shall be distributed to the room through a duct system, and either returned or relieved to the outside through a barometric damper.

   Recirculation shall be used to the maximum extent practicable.

(2) Generator Rooms. Each generator room shall be equipped with an exhaust fan, sized to provide minimum ventilation requirements. The generator fan shall be used to provide additional ventilation when the generator is in operation.

Required outside air shall be drawn into the generator rooms through outside air-intake dampers and filters.

5. Standby Power Requirements. Standby power shall be provided for the entire HVAC system in this building.

15.12 FIRE PROTECTION

15.12.1 DESIGN CRITERIA

Fire protection shall be provided by a wet-pipe sprinkler system fed from the MRS Facility water distribution grid.

15.12.2 BASIS FOR DESIGN

15.12.2.A. Wet-Pipe Sprinkler System

An automatic wet-pipe sprinkler system shall be provided throughout the building except in electrical equipment rooms. The system shall be designed in accordance with NFPA 13, and shall be complete with piping, valves, fittings, sprinkler heads, and all required accessories and equipment.

Fire Department connections shall be provided for a secondary water supply for the installed sprinkler systems.

15.12.2.B. Portable Fire Extinguishers

Portable fire extinguishers shall be sized, located, and installed throughout the building in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 16

SEWAGE TREATMENT FACILITY

16.1 INTRODUCTION

16.1.1 DESIGN CRITERIA

Sewage shall be treated and disposed of in compliance with applicable water pollution policies and laws.

Sanitary sewer and process sewer grids shall connect the various plant sources with central treatment facilities. All liquid effluent streams from the R&H Building shall be monitored for radioactive content before release.

16.1.2 BASIS FOR DESIGN

The Sewage Treatment Facility shall provide for all of the requirements of Section 16.1.1. The Sewage Treatment Facility shall provide noncontaminated process sewage treatment. Noncontaminated process sewage treatment shall be by neutralization tanks, clarifier, press filter, and, where appropriate, either a soil-adsorption or offsite disposal system. Where appropriate, sanitary sewer treatment shall either be by septic tank or by an extended aeration process and released to a soil-absorption or offsite disposal system. In addition, combined office and laboratory space shall be provided. Refer to Drawing No. H-3-56713, Sewer and Drain Systems flow diagram in Section 1, which forms the basis for design for this facility.

16.2 CIVIL AND SITE DEVELOPMENT

16.2.1 DESIGN CRITERIA

Refer to Section 16.1.1.

16.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Sections 1.2.2 and 16.2.1, the following criteria shall be used.

16.2.2.A Parking

Parking shall be provided for the site vehicles that will service the facility.

16.2.2.B Landscaping

No landscaping shall be provided for this facility.

16.3 STRUCTURAL

16.3.1 DESIGN CRITERIA

No specific design criteria are cited.

16.3.2 BASIS FOR DESIGN

The Sewage Treatment Facility shall be a small, single-story, concrete block building. The building shall have a metal deck roof, continuous wall footings, and slab-on-grade floor.

16.3.2.A. Classification

The Sewage Treatment Facility shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

16.3.2.B. Design Loads

The design loads shall be in accordance with the applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)

16.3.2.C. Load Combinations (Reference Section 1.3.2.E)

1. Concrete Structures

$$U = 1.4\ D + 1.7\ L$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$$

2. Steel Structures

S = D + L
1.33 S = D + L + W
1.33 S = D + L + E

16.3.2.D. Design Methods

The design methods shall comply with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

16.3.2.E. Structural Materials

1. Concrete: 3,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185

   Masonry reinforcing steel: ASTM A615, Grade 40

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

4. Masonry: ASTM C90, Grade N, f'm = 1,350 psi

16.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

- Bearing capacity: 4,000 psf for compacted fill or natural soil
  15,000 psf for bedrock or unweathered rock
  1/3 increase for wind and seismic
- Frost line: 2 ft below grade
- Friction coefficient: 0.5
- Passive soil pressure: 400 pcf

16.4 ARCHITECTURAL

16.4.1 DESIGN CRITERIA

No specific design criteria are cited.

16.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

16.4.2.A. General Requirements

The Sewage Treatment Facility shall include an enclosure for process and, if required, sanitary sewage treatment equipment, chemical storage, laboratory, and mechanical/electrical equipment rooms. Except for routine maintenance personnel and those concerned with sampling, the building shall normally be unoccupied.

All exterior walls, roof, and roof-ceiling assemblies that enclose heated spaces shall be insulated to governing energy-insulation requirements.

All fixtures, furnishings, and equipment (FF&E) shall be provided as required for operation.

16.4.2.B. Specific Requirements

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 buildings 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

16.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE HANDLING

16.5.1 DESIGN CRITERIA

No specific design criteria are cited.

16.5.2 BASIS FOR DESIGN

Portable, manually operated equipment shall be provided for handling chemical materials in 55-gal drums and bags.

16.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

16.7 MECHANICAL PROCESS

16.7.1 DESIGN CRITERIA

No specific design criteria are cited.

16.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Oil-free, dried, compressed at 125 psi plant air for operation of two pneumatic tools at 25 scfm each.

(2) Oil-free, dried, compressed at 100 psi instrument air for operation of 20 pneumatic valves at 0.5 scfm per valve.

(3) Potable water for fire protection, utility stations, eyewash, and safety shower.

16.8 INSTRUMENTATION AND CONTROL

16.8.1 DESIGN CRITERIA

No specific design criteria are cited.

16.8.2 BASIS FOR DESIGN

Instrumentation shall be provided for the various operating functions of the facility.

16.9 PIPING

16.9.1 DESIGN CRITERIA

No specific design criteria are cited.

16.9.2 BASIS FOR DESIGN

16.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Pipe runs shall be exposed in the Sewage Treatment Facility.

Hot potable water shall be supplied by an electric hot water heater.

A safety shower and eyewash station shall be provided near the chemical handling area, and shall be supplied from the cold potable water system.

16.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Plant air and instrument air shall be supplied from equipment installed in the Sewage Treatment Facility. Plant air shall be supplied to the filter press and sludge pumps. Utility stations of plant air for tools and process water shall be provided.

Cold process water shall be supplied from the potable water system. The process water shall be separated from the potable water system by backflow preventers.

Floor drains, equipment drains, and laboratory sink drains shall be provided and connected to the MRS Facility process sewer.

16.10 ELECTRICAL

16.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

16.10.2. BASIS FOR DESIGN

16.10.2.A. Power Service

Power at 480Y/277 volts, 3 phase, 4 wire shall be provided at the Sewage Treatment Facility from a service feeder that originates from the Cask Manufacturing Facility. The service feeder shall terminate in an indoor motor control center for distribution to all power loads.

16.10.2.B. Lighting

A 480-208Y/120-volt, dry-type transformer shall provide power for small motor and receptacle loads.

A lighting panel shall provide distribution and protection for all lighting circuits. Area and indoor lighting shall be 277 volts.

Individual unit equipment shall be provided for emergency lighting requirements.

Outdoor lighting shall be provided to illuminate entrance and walkway areas.

All indoor lighting fixtures shall be of the industrial fluorescent type. All outdoor and laboratory area fixtures shall be of the high-intensity discharge (HID) type.

16.11 HVAC

16.11.1 DESIGN CRITERIA

No specific design criteria are cited.

16.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

16.11.2.A. General Requirements

The heating and ventilating system shall provide the necessary temperature and ventilation requirements for proper equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2.

16.11.2.B. Specific Requirements

For inside design conditions, the Sewage Treatment Facility shall be maintained between 50°F DB and a maximum of 10°F higher than outside dry-bulb temperature.

1. Cooling System. Cooling shall not be provided for this building. Ventilation shall be used to remove excess heat in the summer.

2. Heating System. Electric unit heaters with built-in thermostats shall be used to provide for heating requirements.

3. Air Supply and Exhaust. Roof exhaust fans, located in each room, shall provide continuous ventilation for their respective areas by drawing unfiltered, untreated outside air into the building through wall and/or door louvers.

4. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this building.

16.12 FIRE PROTECTION

16.12.1 DESIGN CRITERIA

No specific design criteria are cited.

16.12.2 BASIS FOR DESIGN

An automatic wet-pipe sprinkler system shall be provided throughout the Sewage Treatment Facility.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13; it shall be 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 annunicator.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 17

WATER TREATMENT FACILITY

17.1 INTRODUCTION

17.1.1 DESIGN CRITERIA

Water shall be provided by deep wells at the site or by a local supply of sufficient reliability and capacity. Water from the source shall be treated in an MRS Facility water treatment plant. After treatment, the water shall be pumped to a water storage tank sized to accommodate both the facility process use and maximum credible firewater demand.

17.1.2 BASIS FOR DESIGN

Refer to Drawing No. H-3-56710, Water Treatment System flow diagram, which forms the basis for design for this process.

The Water Treatment Facility shall provide for all functions required by Section 17.1.1

17.2 CIVIL AND SITE DEVELOPMENT

17.2.1 DESIGN CRITERIA

Refer to Section 17.1.1.

17.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Sections 1.2 and 17.2.1, the following criteria shall be used.

17.2.2.A. Parking

Parking shall be provided for the site vehicles that service the facility.

17.2.2.B. Landscaping

No landscaping shall be provided for this facility.

17.3 STRUCTURAL

17.3.1 DESIGN CRITERIA

No specific design criteria are cited.

17.3.2 BASIS FOR DESIGN

The Water Treatment Facility shall be a small, concrete block building. The building shall have a metal deck roof, continuous wall footings, and a slab-on-grade floor.

17.3.2.A. Classification

The Water Treatment Facility shall be designed as a Non-Category I structure in accordance with Section 1.3.2.C.

17.3.2.B. Design Loads

The design loads shall comply with the applicable portions of Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Wind load	7
Earthquake load	8(1)

17.3.2.C. Load Combinations (Reference Section 1.3.2.E)

1. Concrete Structures

$U = 1.4\ D + 1.7\ L$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$
$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$

2. Steel Structures

$S = D + L$
$1.33\ S = D + L + W$
$1.33\ S = D + L + E$

17.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

17.3.2.E. Structural Materials

1. Concrete: 3,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185

   Masonry reinforcing steel: ASTM A615, Grade 40

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

4. Masonry: ASTM C90, Grade N, f'm = 1,350 psi

17.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

- Bearing capacity: 4,000 psf for compacted fill or natural soil
  15,000 psf for bedrock or unweathered rock
  1/3 increase for wind and seismic

- Friction: 0.5

- Frost line: 2 ft below grade

17.4 ARCHITECTURAL

17.4.1 DESIGN CRITERIA

No specific design criteria are cited.

17.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

17.4.2.A. General Requirements

The Water Treatment Facility shall provide enclosures for the chlorination system, the firewater pump system, the well-water or freshwater system, and all related pumps, controls, and equipment.

The Water Treatment Facility shall normally be unoccupied except for routine maintenance personnel.

The Water Treatment Facility shall contain four main rooms: an electrical equipment room, a main equipment room, a firewater pumproom, and a chemical storage room.

The Water Treatment Facility shall be a separate structure with separate entrances to each room. Its location shall be in close proximity to the water storage tank.

All exterior walls, roofs, and roof-ceiling assemblies that enclose heated spaces shall be insulated to governing energy-insulation requirements.

All fixtures, furnishings, and equipment (FF&E) shall be provided as required for occupation.

17.4.2.B. Specific Requirements

1.	UBC Occupancy Class:	B-2
2.	Ceiling heights:	13'-0" minimum for all rooms (sloped)
3.	Kind of traffic:	Foot traffic in the building Forklift
4.	Size of access openings:	3'-0" x 7'-0" personnel doors
		3'-0" x 9'-4" equipment access doors
		6'-0" x 9'-4" equipment access doors
		14'-0" x 10'-0" equipment access doors

17.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

17.5.1 DESIGN CRITERIA

No specific design criteria are cited.

17.5.2 BASIS FOR DESIGN

Portable, manually operated equipment shall be provided for handling chemical materials in 55-gal drums and bags.

17.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

17.7 MECHANICAL PROCESS

17.7.1 DESIGN CRITERIA

No specific design criteria are cited.

17.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Oil-free, dried, compressed at 125 psi plant air for operation of two pneumatic tools at 25 scfm.

(2) Oil-free, dried, compressed at 100 psi instrument air for operation of 20 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil for auxiliary firewater pump.

(4) Process sewer for draining of water treatment equipment.

(5) Oily sewer for drips from auxiliary firewater pump and the fuel-oil day tank.

(6) Potable water for fire protection, utility stations, eyewash, and safety shower.

17.8 INSTRUMENTATION AND CONTROL

17.8.1 DESIGN CRITERIA

No specific design criteria are cited.

17.8.2 BASIS FOR DESIGN

Instrumentation shall be provided for the various operating functions of the facility.

17.9 PIPING

17.9.1 DESIGN CRITERIA

No specific design criteria are cited.

17.9.2 BASIS FOR DESIGN

17.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Pipe runs shall be exposed in the Water Treatment Facility.

A safety shower and eyewash station shall be provided near the chemical handling area, and shall be supplied from the cold potable water system.

17.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Plant air and instrument air shall be supplied from equipment installed in the Vehicle Maintenance Building. Utility stations of plant air for tools and process water shall be provided.

Cold process water shall be supplied from the potable water system. The process water shall be separated from the potable water system by backflow preventers.

Floor drains and equipment drains shall be provided and connected to the MRS Facility process sewer.

The process drain and plant and instrument air piping shall be extended to an interface point 5 ft outside the building, where a connection shall be made between interior piping and exterior piping of the MRS Facility systems.

17.10 ELECTRICAL

17.10.1 DESIGN CRITERIA

A fire alarm system shall be provided. The alarm system shall be connected to the MRS Fire Station and Security Building. The alarm system shall be connected to an emergency power supply. Battery power sources are acceptable.

17.10.2. BASIS FOR DESIGN

17.10.2.A. Power Service

Power at 480Y/277 volts, 3 phase, 4 wire shall be provided at the Water Treatment Facility from a service feeder that originates from the Vehicle Maintenance Building. The service feeder shall terminate in an indoor motor control center for distribution to all power loads, including loads located at the transfer pump station.

17.10.2.B. Lighting

A 480-240/120-volt, single-phase, dry-type transformer shall provide power for small motor and receptacle loads.

A lighting panel shall provide distribution and protection for all lighting circuits. Area and indoor lighting shall be 277 volts.

Individual unit equipment shall be provided for emergency lighting requirements.

Outdoor lighting shall be provided to illuminate entrance and walkway areas.

All indoor lighting fixtures shall be of the industrial fluorescent type. All outdoor fixtures shall be of the high-intensity discharge (HID) type.

17.11 HVAC

17.11.1 DESIGN CRITERIA

No specific design criteria are cited.

17.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

17.11.2.A. General Requirements

The heating and ventilating system shall provide the necessary temperature and ventilation requirements for proper equipment operation.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.1.D.2. In addition, the HVAC design shall consider impact of volcanic ashfall for this building to minimize the adverse effects on HVAC equipment.

17.11.2.B. Specific Requirements

For inside design conditions, the Water Treatment Facility shall be maintained between 50°F DB and a maximum of 10°F higher than outside dry-bulb temperature.

1. Cooling System. Cooling shall not be provided for this building. Ventilation shall be used to remove excess heat in the summer.

2. Heating System. Electric unit heaters with built-in thermostats shall be used to provide for heating requirements.

3. Air Supply and Exhaust. Roof exhaust fans, located in each room, shall provide continuous ventilation for their respective areas by drawing unfiltered, untreated outside air into the building through wall and/or door louvers.

4. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this building.

17.12 FIRE PROTECTION

17.12.1 DESIGN CRITERIA

No specific design criteria are cited.

17.12.2 BASIS FOR DESIGN

An automatic wet-pipe sprinkler system shall be provided throughout the Water Treatment Facility.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13; it shall be 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.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided as a secondary water supply for the installed sprinkler systems.

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 18

CASK MANUFACTURING FACILITY

18.1 INTRODUCTION

18.1.1 DESIGN CRITERIA

The sealed storage casks may be fabricated in a cask manufacturing plant in an assembly line process at or near the site. The manufacturing plant shall be located to facilitate the cask loading and storage functions. When completed, the casks are placed in a staging area.

18.1.2 BASIS FOR DESIGN

The Cask Manufacturing Facility shall provide for all functions required by Section 18.1.1.

18.2 CIVIL AND SITE DEVELOPMENT

18.2.1 DESIGN CRITERIA

No specific design criteria are cited.

18.2.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall also be used.

18.2.2.A. Parking

Parking shall be provided for the employees working at this facility and site vehicles serving this facility.

18.2.2.B. Landscaping

No landscaping shall be provided for this facility.

18.3 STRUCTURAL

18.3.1 DESIGN CRITERIA

No specific design criteria are cited.

18.3.2 BASIS FOR DESIGN

The Cask Manufacturing Facility shall consist of a steel-framed building for the concrete batch plant, cask forming area, and staging area, and a steel canopy for the rebar fabrication and liner storage. The conveyors shall be supported by steel trusses on columns and isolated footings. The unloading stations shall have concrete pits and steel platforms. The building shall be a steel-framed structure with metal deck roof and metal siding. The 225-ton bridge cranes shall be supported by the building columns on isolated footings.

18.3.2.A. Classification

The Cask Manfacturing Facility canopies and buildings shall be designed as Non-Category I structures complying with Section 1.3.2.C.

18.3.2.B. Design Loads

The design loads shall be in accordance with applicable portions of reference Section 1.3.2.D, a summary of which is as follows:

Design Loads	Reference Subsection of Section 1.3.2.D
Dead load	1
Live load	2
Snow load	4
Impact load	5
Wind load	7
Earthquake load	8(1)
Lateral earth pressure	10(1)
Crane and hoist load	13

18.3.2.C. Load Combinations (Reference Section 1.3.2.E)

1. Concrete Structures

$$U = 1.4\ D + 1.7\ L$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.7\ W)$$
$$U = 0.75\ (1.4\ D + 1.7\ L + 1.87\ E)$$

2. Steel Structures

$$S = D + L$$
$$1.33\ S = D + L + W$$
$$1.33\ S = D + L + E$$

18.3.2.D. Design Methods

The design methods shall be in accordance with applicable portions of Section 1.3.2.F, a summary of which is as follows:

Material/Loading	Design Method	Reference Subsection of Section 1.3.2.F
Reinforced concrete	Strength design	1
Steel	Working stress	2
Masonry	Working stress	3
Seismic	Chapter 23 of UBC	4(1)
Foundation design	Spread footings Wall footings	6
Sliding and overturning	FS = 1.5	7

18.3.2.E. Structural Materials

1. Concrete: 3,000 psi @ 28 days

2. Reinforcing steel: ASTM A615, Grade 60 and Grade 40 (ties and stirrups)

   Wire mesh: ASTM A185

   Masonry reinforcing steel: ASTM A615, Grade 40

3. Structural steel: ASTM A36

   Bolts: ASTM A325F

4. Masonry: ASTM C90, Grade N, f'm = 1,350 psi

18.3.2.F. Soil

For final design, the soil parameters shall be based upon the actual geological investigation of the site. For conceptual design, however, the following parameters shall be used:

- Bearing capacity: 4,000 psf for compacted fill or natural soil
  15,000 psf for bedrock or unweathered rock
  1/3 increase for wind and seismic

- Friction coefficient: 0.5

- Passive soil pressure: 400 pcf

- Frost line: 2 ft below grade

18.4 ARCHITECTURAL

18.4.1 DESIGN CRITERIA

No specific design criteria are cited.

18.4.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.4.2, the following criteria shall be used.

18.4.2.A. General Requirements

The building shall be a single-story, steel-framed structure consisting of a twin-span, main high-bay shop building (approximately 216 ft wide by 460 ft long), with lower attached appendages of varying heights, according to interior needs. The exterior wall material shall be an insulated, panelized wall system above concrete block apron walls. All exterior walls, roofs, and roof-ceiling assemblies shall be insulated to governing energy-insulation requirements. All fixtures, furnishings, and equipment (FF&E) shall be provided as required or as necessary for occupancy.

The Cask Manufacturing Facility shall have five major functional areas:

(1) Office area
(2) Twin shop areas
(3) Materials storage
(4) Laboratory
(5) Building services

1. Office Area. The office area shall include two offices designed to house two shift supervisors for each of three shifts.

Locker rooms, toilet and locker/shower rooms, and a lunchroom shall be provided near the office area and convenient to the shop area.

2. Twin Shop Areas.

(1) The twin shop areas shall be designed to accommodate the following:

- Concrete batch plants
- Cask forming areas
- Rebar fabrication areas
- Staging areas

(2) The Cask Manufacturing Facility shall be 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	1	-	3
Total	51	46	21	118

(3) The specific requirements of the shop areas shall be as follows:

(a) The shop areas shall 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 shall be provided. All structural members and mechanical and electrical systems shall be located above this height.

(c) Two 225-ton-capacity bridge cranes (with 25-ton auxiliary), each with a maximum hook height of 40 ft, shall be provided. The bridge cranes shall bridge the width of each span and the runway rails shall travel the length of the building.

The bridge cranes shall be used primarily to move the cast concrete casks to the curing areas; they shall also assist in the various manufacturing operations.

3. Materials Storage. An attached, roofed, outside storage area shall be provided for the storage of prefabricated rebar, liner, and shop-related items. The storage area shall be adjacent to the shop area. A 10,000-lb-capacity forklift shall be provided for handling materials.

4. Laboratory. A laboratory for storing and testing concrete samples of the mixes used in cask fabrication shall be provided near the casting area.

5. Building Services. Space shall be 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) Janitorial equipment

18.4.2.B. Specific Requirements

1. UBC Occupancy Class:

Office areas:	B2
Shop area:	B4
Storage areas:	B4

2. Ceiling heights:

Office areas:	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:

Offices:	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
Shops: (see Section 18.5)	All shop equipment, as required
Storage areas:	Storage shelving, cabinets, etc.

18.5 MATERIAL HANDLING, MAINTENANCE, AND REMOTE SYSTEMS

18.5.1 DESIGN CRITERIA

No specific design criteria are cited.

18.5.2. BASIS FOR DESIGN

In addition to the criteria listed in Section 1.5.2, the following criteria shall be used.

18.5.2.A. Throughput Rates

The Cask Manufacturing Facility shall have the capability of producing 442 casks and shield plugs per year. This production is based on 3,600 MTU per year being processed in the MRS Facility.

A total of five types of casks shall be produced. The maximum weight of the largest cask, with its shielding, shall be 187 tons.

18.5.2.B. Facility Requirements

An area within the MRS site, approximately 900 ft square, shall contain the Cask Manufacturing Facility. The following supporting facilities shall be provided within this area:

1. A concrete batch mixing plant for supplying concrete to the forms.

2. A railroad spur for receiving incoming materials (sand, aggregate, cement, cask liners, and preformed rebars).

3. An enclosed structure for the cask forming area to protect it from adverse atmospheric conditions during the curing period of the formed casks. This structure shall also provide structural support for the 225-ton bridge cranes, which shall be used to remove the formed casks from the forms and in transporting them to the staging area.

4. A covered staging area for the casks.

5. A covered storage area for the cask inner liners, which shall be fabricated offsite.

6. Areas adjacent to the cask forming area for the assembly of the rebar cages and construction of the shielding plugs.

7. Areas for stockpiling of an 11-day supply of sand and aggregate. Silos shall house the cement.

18.6 PROCESS (RADWASTE TREATMENT)

Not applicable to this facility.

18.7 MECHANICAL PROCESS

18.7.1 DESIGN CRITERIA

No specific design criteria are cited.

18.7.2 BASIS FOR DESIGN

The following utilities shall be provided:

(1) Oil-free, dried, compressed at 125 psi plant air for operation of 10 pneumatic tools at 5 scfm each.

(2) Oil-free, dried, compressed at 100 psi instrument air for operation of 100 pneumatic valves at 0.5 scfm per valve.

(3) Fuel oil, natural gas, and potable water for hot water boilers based on a duty of 1,000 MBtu/hr for building heating requirements.

(4) Process sewer for occasional hot water boiler blowdown and drainage.

(5) Oily sewer for periodic draining of off-specification oil from the fuel-oil day tank. A 6-in., fuel-oil heel from the day tank shall be drained twice a year.

(6) Potable water for fire protection, drinking, utility stations, and restrooms.

18.8 INSTRUMENTATION AND CONTROL

18.8.1 DESIGN CRITERIA

No specific design criteria are cited.

18.8.2 BASIS FOR DESIGN

Instrumentation shall be provided for the various operating functions of the facility.

18.9 PIPING

18.9.1 DESIGN CRITERIA

No specific design criteria are cited.

18.9.2 BASIS FOR DESIGN

18.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Piping runs shall be concealed in ceilings, walls, and furred spaces in the office area of the building. Piping runs shall be exposed in the shop and equipment room of the building.

Hot potable water shall be supplied by an electric hot water heater.

Eyewash stations shall be provided and supplied from the cold potable water system.

An electric (drinking) water cooler shall be provided.

18.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

Utility stations of plant air for tools and cold process water shall be provided.

Cold process water shall be supplied from the potable water system. The process water shall be separated from the potable water system by backflow preventers.

A settling sump shall be provided to collect effluent from floor drains and funnel drains from the manufacturing area. The sump pump discharge shall be connected to the process sewers.

Equipment drains shall be provided in the mechanical equipment room, and shall be connected to the process sewer.

Plant air and instrument air shall be supplied from equipment installed in the Cask Manufacturing Facility.

18.10 ELECTRICAL

18.10.1 DESIGN CRITERIA

No specific design criteria are cited.

18.10.2 BASIS FOR DESIGN

18.10.2.A. Power Service

Power service to the Cask Manufacturing Facility shall be obtained from an outdoor unit substation. Primary power at 4.16 kV shall be transformed to 480Y/277 volts for distribution by a motor control center to all power loads. Dry-type, 480-208Y/120-volt, 3-phase transformers and distribution panelboards shall be used for service to receptacles, other small loads, and motors less than 1/2 hp in size.

Electrical equipment located outdoors shall be installed in NEMA Type 3R enclosures. All major indoor electrical equipment shall be installed in pressurized NEMA Type 12 enclosures. The entire electrical distribution system shall be coordinated for selective fault protection.

18.10.2.B. Lighting

1. General. In general, 277 volts shall be used for high-intensity discharge (HID) and fluorescent lighting. In some cases, the lighting system shall be 120 volts when incandescent fixtures are used. Local switching shall be provided on all lighting circuits, when feasible.

Fluorescent light fixtures shall be used in all indoor areas except the forming, pouring, and curing areas. HID lighting shall be used for all high bays, for outdoor areas, and on the crane.

2. Emergency Lighting. Individual, self-contained, battery-operated, emergency unit equipment shall be used throughout the facility to permit safe egress for personnel and safe process control shutdown.

3. Outdoor Floodlighting. Outdoor floodlighting and area lighting shall be provided for illumination during nighttime operation. Lighting shall be photoelectric relay-controlled, with manual override.

18.10.2.C. Communications

1. Public Address System. Public address speakers shall be installed in the concrete cask manufacturing area for paging. The system shall be provided with two paging zones and shall be initiated by telephone.

2. Telephone System. Telephone station equipment shall be provided as required for the Cask Manufacturing Facility, and shall be connected to the main EPABX located in the Site Services Building.

The location and type of station equipment shall be developed during the final design phase. All telephone systems shall be installed in a conduit.

18.11 HVAC

18.11.1 DESIGN CRITERIA

No specific design criteria are cited.

18.11.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.11.2, the following criteria shall be used.

18.11.2.A. General Requirements

The heating, ventilating, and air-conditioning (HVAC) systems shall provide the temperature, humidity, and ventilation required for personnel comfort and equipment operation. The HVAC system shall be designed in accordance with ERDA Manual 6301 and ASHRAE Standard 90-75.

The Cask Manufacturing Facility shall be divided into three areas: office, shop, and storage.

The HVAC system shall be designed to meet earthquake requirements specified in Section 1.3.2.D.2.

18.11.2.B Specific Requirements

1. Inside Design Conditions

   (1) Office Area. The office area shall be maintained between 72°F DB and 80°F DB year around.

   Humidification shall not be provided for this area.

   (2) Shop Area. All shop areas shall be maintained between 65°F and a maximum of 10°F higher than outdoor temperature.

   (3) Storage Area. Temperature shall not be controlled in the storage area.

2. Energy Conservation. Recirculation shall be used to the maximum extent practicable in all areas equipped with mechanical ventilation.

3. Cooling System

   (1) Office Area. The required cooling shall be provided by a split, direct-expansion cooling system.

   (2) Shop Area. Cooling shall not be provided for the shop area. Ventilation shall be used to remove excess heat in the summer.

4. Heating System. Hot water, generated by a local hot water boiler, shall be distributed to the air-handling units to provide for the building heating requirements.

5. Air Supply System

   (1) Office Area. Outside and recirculated air shall pass through 30% efficiency filters, cooling coils, and/or heating coils before being distributed to the offices, restrooms, and changeroom by a supply fan.

(2) Shop Area. Two separate air-handling units shall provide for ventilation and heat removal. Outside air shall pass through 30% efficiency filters and heating coils (if heating is required) before being distributed throughout the shop area.

Airflow rates shall be maintained as required for temperature control and to meet minimum ventilation and exhaust requirements.

6. Exhaust System. The air from the toilet areas shall be exhausted by individual exhaust fans. These areas shall be maintained under negative pressure.

Local exhausters and dust collectors shall be provided, as required, to operate on an as-needed basis throughout the shop area.

7. Standby Power Requirements. Standby power shall not be required for the HVAC equipment in this building.

18.12 FIRE PROTECTION

18.12.1 DESIGN CRITERIA

No specific design criteria are cited.

18.12.2 BASIS FOR DESIGN

An automatic wet-pipe sprinkler system shall be provided throughout the Cask Manufacturing Facility.

The automatic wet-pipe sprinkler system shall be fed from the MRS Facility water distribution grid.

The automatic wet-pipe sprinkler system shall be designed in accordance with NFPA 13; it shall be 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.

Fire-stopping material shall be provided for closing pipe and conduit penetrations in fire-resistive structural partitions. Fire Department connections shall be provided for a secondary water supply to the installed sprinkler systems.

Portable fire extinguishers shall be a part of the fire protection system. They shall be sized, located, and installed throughout the facility in accordance with NFPA 10 to provide a means to fight a fire in its incipient stage.

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SECTION 19

ELECTRICAL DISTRIBUTION SYSTEM

19.1 INTRODUCTION

19.1.1 DESIGN CRITERIA

Plant utilities shall be obtained from local systems where feasible. Electrical power shall be obtained by constructing power lines from the nearest commercial or public utility capable of meeting the MRS Facility requirements. Standby electrical power shall be provided by standby generators at the site. Telephone service shall be obtained from the nearest telephone company.

Energy conservation measures shall be considered in the design of power supply, transmission, and user systems. A demand controller shall be used where practical to reduce peak loads. Capacitor banks shall be installed to provide system reactive current corrections. High-output lamps and high-efficiency appliances shall be used to the maximum extent practicable.

19.1.2 BASIS FOR DESIGN

The electrical distribution system shall be designed to meet the requirements of Section 19.1.1.

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

19.8.1 DESIGN CRITERIA

No specific design criteria are cited.

19.8.2 BASIS FOR DESIGN

Instrumentation shall be installed to permit monitoring and controlling of the system under the intended operating conditions.

19.9 PIPING

Not applicable to this system.

19.10 ELECTRICAL

19.10.1 DESIGN CRITERIA

19.10.1.A. Electrical

Normal electrical power shall be provided by constructing dual offsite transmission lines delivering high voltage (i.e., 230 kV) to two primary transformers at the MRS Facility electrical substation. An underground distribution system shall provide power to the individual building substations from the MRS Facility main substation. Dual power feeders shall serve the R&H Building. Standby power shall be provided by generators centrally located to serve the required loads. The generators shall provide service to standby transformers at the various buildings via a distribution system that is installed in underground ducts separate from the normal power system. Interruption of both normal power sources shall automatically separate the normal power feeders from the standby bus in each building and shall automatically switch the load to the standby lines.

Loss of normal power to the site shall also start the standby generators and connect them to the standby power grid.

19.10.1.B. Telephone

An MRS Facility telephone system shall be provided. Trunk lines shall provide telephone service to the site. The trunk lines shall feed a central telephone switching station located in the Site Services Building. In-plant phone lines shall be connected to the central switching station.

19.10.1.C. Alarms

Central fire, evacuation and security alarm systems shall be routed from the various plant facilities to the Fire Station and Security Building, as appropriate.

19.10.2 BASIS FOR DESIGN

19.10.2.A. Power Service and Distribution

Normal electrical power shall be provided by dual 230-kV or similar available service lines from the nearest electrical utility that is capable of meeting the MRS Facility requirements. The transmission lines may originate at the same utility substation or switchyard, but shall be routed on separate steel towers to the MRS Facility. The transmission lines shall be constructed for the seismic zone appropriate to the area, and shall be segregated laterally so that a tornado-generated missile 1 ft-2 in. dia and 35 ft long shall not cause simultaneous failure of both transmission lines. Design of the transmission lines shall produce clearances above ground of at least 125% of the minimum required by the National Electrical Safety Code (Table 232-1). Tower spacing and height shall be designed to limit the maximum stress to 75% of the allowable stress for the selected conductors. Overall lightning-protection ground wires shall be provided for each transmission line. Footing design shall include an overturning factor of safety of 100% above the maximum uplift produced by working loads under the most severe conditions. Power ground grids shall be provided.

The transmission lines shall terminate at the MRS Facility main substation in an outdoor switchyard structure. The last tower in each line shall be of the dead-end type, designed to withstand 150% of the maximum design stress, and shall be located 1/4 mile outside the MRS Facility. The incoming power lines shall then be routed underground to avoid interference with the MRS perimeter security and surveillance system.

The MRS Facility main substation shall include an outdoor, high-voltage switchyard; power transformers; and indoor, medium-voltage switchgear. The switchyard shall include one 3-pole, high-voltage power circuit breaker, SF_6 insulated, with two 3-pole, high-voltage, group-operated, air-interrupter disconnect switches for each transmission line. All high-voltage protective relays, controls, and metering shall be in cubicles in the 5-kV switchgear lineup located in the hardened Standby Generator Building. A battery bank shall provide closing and tripping power for the switchyard. Primary transmission line protection shall be a directional-comparison, pilot-wire system that provides relay and breaker failure backup, and

simultaneous tripping of both the sending-end and the receiving-end power circuit breakers. One reclosing attempt shall be made. The maximum voltage rating for the switchyard shall be determined by the servicing utility. The power transformers shall be of the outdoor, oil-immersed type, on air/forced air (OA/FA), 55/65°C temperature rise, 5-kV, Delta-Wye, with resistance neutral grounding. The OA rating of each transformer shall be equal to or greater than 100% of the entire load of the MRS Facility at the 55°C rating. Each transformer shall be furnished complete with the following:

(1) Primary line bushings

(2) 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 shall include harmonic-restraint differential relays and secondary-backup overcurrent relays.

The secondary bus duct to the medium-voltage switchgear shall be a 4.16-kV, nonsegregated-phase bus with epoxy-coated conductors. The minimum current rating shall be 125% of the maximum full-load amperes (FLA) rating of the transformer.

The medium-voltage switchgear shall be of the 5-kV class, indoor, air- or vacuum-break, metal-clad type. Three switchgear assemblies shall be provided [one for each of the power transformers and one for the transfer/generator (T/G) bus]. Each assembly shall include one incoming main circuit breaker, except that the T/G bus shall have four 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 shall be provided, and shall be actuated by loss of voltage. Time restraint shall allow one reclosure of the primary power circuit breaker. Breaker control shall be by direct current from battery banks contained within the switchroom building. Each assembly shall contain a metering cubicle with summation transducers to indicate kVA (with maximum demand), kV-AR, and kWh for each transformer, and for the total facility.

Power shall be distributed from the medium-voltage switchgear to unit substations at or near the respective buildings via underground duct banks. Cables pertaining to one switchgear assembly shall be segregated from those pertaining to the other assembly to ensure that no single failure could compromise both systems. Dual feeders shall be provided to each double-ended unit substation and for each primary selective substation. All feeders shall be for a radial-type distribution service. All cables shall be 5 kV, 3-conductor, with ground wires, rubber or thermosetting insulation, 90°C, moisture- and flame-retardant, with overall moisture-resistant jacket.

Double-ended unit substations shall be provided for all essential services where standby power is also required. Each substation within the protected area shall be inside the respective building. Transformers shall be 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 may be outdoor-type walk-in-aisle switchgear, with liquid-cooled transformers. One common substation shall be provided for two or more buildings where the required load is small. Transformers for nonessential buildings shall be of the outdoor, liquid-cooled, pad-mounted type, with adjoining oil-filled, pad-mounted primary selector switches. Such switches shall have load-break/fault-make capability to manually select the alternate normal feeder, when one feeder is down. Primary fuses shall be provided for each transformer where two or more share a common radial feeder. Unfused primary-disconnect switches shall be provided for all other transformers. Secondary switchgear for all double-ended unit substations, and for the Site Services Building, shall be of the drawout type, airbreak, with solid-state, direct-acting tripping, manual closing. Local kWh metering shall be provided at each substation. A local main-disconnect switch shall be provided at all subfed distribution panels and motor control centers. Nonautomatic, molded-case circuit breakers shall not be used for this service. Where secondary selective tripping is required, the main disconnect shall be rated to withstand the maximum prospective short-circuit fault current for the time necessary for the downstream power-feeder breaker to trip on short time setting. Where secondary selective tripping is not necessary, the main disconnect may be an automatic, molded-case circuit breaker. Motors of less than 250 hp shall be controlled by combination motor starters, either contained within a motor control center or local. Motors 250 hp and larger shall be controlled by circuit breakers of the unit substation switchgear or by 5-kV fused motor controllers in 5-kV MCCs.

Standby power shall be generated onsite by diesel-engine-driven generators. Four generators shall be provided, each with a continuous rating of at least 33% of the maximum standby load. The diesel-generator sets shall be generally in accordance with IEEE Standard 387-IEEE: Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations. The voltage rating shall be 4,160 volts, 3 phase, 60 Hz. The generator shall be of the brushless, synchronous type. The diesel engine shall be equipped for automatic starting under conditions of total power failure. The starting system shall support three consecutive attempts to start, synchronize, and accept power. The generator shall be Wye-connected, with neutral grounding, to avoid third harmonics. The

generator breakers shall form part of an assembly of 5-kV switchgear. The assembly shall be of the indoor, air- or vacuum-break, metal-clad type, complete with metering, synchronizing controls, and relaying, controls, and metering. A battery bank shall provide closing and tripping power for the switchgear lineup.

Within each building where standby power is required, power shall be distributed from the 5-kV standby switchgear to standby unit substations via underground duct banks. The standby duct bank shall be segregated from the normal power duct bank(s) by 2 ft minimum. All cables shall be 5 kV, 3 conductor, with ground wires, rubber or thermosetting insulation, 90°C, moisture and flame retardant, with overall moisture-resistant jacket.

Standby unit substations shall be provided within each building where standby power is required. The substation shall be located in a room segregated from the normal power substation rooms in hardened areas. Transformers shall be 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 shall be of the drawout type, air break, with solid-state, direct-acting tripping, electrically or manually operated.

Normal operation shall be 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 shall assume the full MRS Facility load after the isolation of the failed power source. All double-ended substation feeders can be transferred to the now-preferred normal power source. When it is determined that the failed service shall not return, the tie-breaker on the dead bus shall open.

Should there be a second power failure of the other normal power source, both tie-breakers and the feeder breakers shall open. The concurrent startup and synchronization of all diesel-generator units would be initiated, automatic transfer to the standby bus would take place, and standby power would be supplied to all connected substations.

When the standby generators are started, the voltage at the bus of the standby unit substations shall be zero. Automatic synchronizing of the standby generators shall be required only between generators. Manual synchronizing shall be provided to facilitate testing of the standby generators. Alarms shall be provided to annunciate loss of secondary voltage at all transformers.

A ground loop shall be provided around the perimeter of each building. Interconnections to adjacent buildings and to the main substation ground shall be provided. Each unit and standby substation shall be connected to the ground loop. All electrical equipment shall be grounded by means of ground wires contained within the power-distribution cables by ground wires in raceways, in accordance with the methods described in NEC Article 25.0. The ground wires shall be connected to the switchgear ground buses, which shall be connected to both the building ground loop and to the feeder-cable

ground wires. Building steel shall be 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 shall contain 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 shall be provided for all larger buildings and structures. The lightning conductors shall be connected to the building ground loop.

Uninterruptible power supply (UPS) systems shall be provided for each building where essential services require continuous power supply. The UPS systems shall operate from 480-volt, 3-phase input to the battery charger, with 480Y/277-volt, 3-phase output from the inverter. The battery shall be of the lead-calcium type, 125 volts (60 cells) for units rated up to 37.5 kVA, or 250 volts (120 cells) for larger units. Each system shall include a bypass and synchronizing supply for use in case of inverter failure.

19.10.2.B. Lighting

All lighting shall operate on 120, 277, or 480 volts, depending on the type, 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 shall serve all areas where loss of lighting could result in personnel hazards or equipment malfunction. Selected lighting fixtures in critical areas shall be connected to standby power.

Emergency lighting shall be 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 shall be battery-backup-type, automatic units, with a self-contained battery charger. Convenience receptacles shall be provided throughout the facility at 120 volts, 1 phase, 60 Hz from a 208Y/120-volt system. One or more receptacle transformers and panelboards shall be provided at each building. Transformers shall be dry type, distribution service, Delta-Wye, 480-208Y/120 volts, 3 phase.

Street lighting shall be provided throughout the MRS Facility. Luminaires shall be of the high-intensity discharge (HID) type, with photoelectric control. Average illumination level shall be 0.9 ft-c for major roads and intersections and 0.6 ft-c for secondary roadways.

19.10.2.C. Communications

1. Telephone System. An Electronic Private Automatic Branch Exchange (EPABX) shall be provided and located at the Site Services Building. Each building or facility shall be connected to the exchange by an underground cable network installed in conduit. The EPABX shall be connected to the nearest telephone utility via a private microwave system. Preliminary information indicates that a switch size of approximately 300 lines and 30 trunks, subject to verification during the final design phase, shall be

appropriate. In addition, provisions shall be included for a small number of telephone lines wired for direct ring-down (hot lines) for security and data transmissions to offsite locations.

2. Radio System and Radio Paging. A land-mobile UHF radio system, including handheld portable radios, shall be provided for intrafacility communications. Dedicated channels shall be provided for:

- Facility operation
- Facility security
- Maintenance
- Medical and emergency

Users shall have mobile and/or handheld radios capable of operation on one or more channels. A dedicated radio system (VHF-band) shall be provided to permit voice communication with locomotive engineers to control facility railroad operations.

A radio paging system (beepers) shall be installed, and pocket pagers shall be issued to key personnel.

3. Site Warning System. In addition to the building criticality warning systems, a site warning system shall be provided. The system shall consist of several sirens located throughout the MRS Facility and interconnected to the Security Building control center panel.

4. Instrumentation. Wiring for temperature monitoring of either drywell or concrete-cask storage facilities shall be provided. Wiring shall be installed underground in a concrete-encased, rigid conduit system, with junction-, pullboxes, and hand- or manholes, as required. Multiplexing equipment shall be installed in NEMA 4R enclosures, mounted on concrete pedestals above ground.

19.11 HVAC

Not applicable to this system.

19.12 FIRE PROTECTION

Not applicable to this system.

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SECTION 20

WATER DISTRIBUTION SYSTEM

20.1 INTRODUCTION

20.1.1 DESIGN CRITERIA

Water shall be provided by deep wells at the site or by a local supply of sufficient reliability and capacity. Water from the source shall be treated in an MRS Facility water treatment plant as necessary. After treatment, the water shall be pumped to a water storage tank sized to accommodate both the facility process use and maximum credible firewater demand. The water shall be distributed to all facilities via an underground system. The distribution system shall provide sanitary, process and fire-protection water for all facilities on the site. The distribution pressure shall be a minimum of 100 psi under normal operating conditions and shall meet the NFPA requirements for a fire-protection water source. The water system shall be looped and sectioned, with valves installed at appropriate locations to provide system reliability and flexibility.

20.1.2 BASIS FOR DESIGN

The water distribution system shall provide for all functions required by Section 20.1.1. A standby, diesel-engine-driven firewater pump and ground-level storage tank shall be provided to ensure an adequate supply of fire-protection water if a complete power failure occurs. Refer to Drawing No. H-3-56706, Site Utilities Distribution flow diagram in Section 1, which forms the basis for design for this system.

20.2 CIVIL AND SITE DEVELOPMENT

20.2.1 DESIGN CRITERIA

Refer to Section 20.1.1.

20.2.2 BASIS FOR DESIGN

In addition to the Basis for Design given in Section 20.1.2 and the criteria listed in Section 20.2.1, the following criteria shall be used.

20.2.2.A. General

(1) The water distribution system shall be designed in accordance with DOE Order 6430.1 and the following criteria.

(2) Water for the MRS Facility shall be provided by deep wells. If a local supply of sufficient reliability and capacity is available, a pipeline from the offsite source shall also be provided.

(3) Water from the wells shall be treated to various degrees for firewater, potable water, deionized water, soft water, demineralized water, cooling water, irrigation water, and process water. A single, closed-loop distribution system shall supply all water to the MRS Facility.

(4) Design velocity of flow in the system shall be 5 fps with a maximum allowable velocity of 10 fps.

(5) Lines shall be underground, with a minimum cover of 3 ft, or below the frost line, and designed to withstand the expected traffic loading.

(6) Pressure-reducing devices shall be provided on potable water lines. Backflow preventers shall be provided at process water connections to prevent the possibility of contamination of potable water in the combined-purpose water distribution system.

(7) The water supply and distribution system shall be adequately sized to serve the combined peak flow for all uses.

(8) The size of the water storage tank shall be based on the following:

- 4 hr of firewater flow below the standpipe opening.
- 100% of the daily domestic consumption for peaking above the standpipe.
- 4 hr process flow above the standpipe.

20.2.2.B. Water Treatment

(1) Chlorine residual shall be maintained in the potable water mains.

(2) Water treatment for deionized water, soft water, and demineralized water shall take place at the R&H Building, using potable water from the water distribution network.

20.2.2.C. Potable Water

A maximum daily population of 853 people shall be used as the design population. This number takes into account that some of the MRS facilities shall be operating on a 24-hr/day basis. The design flow shall be based on 35 gal per capita per day.

20.2.2.D. Fire-Protection Water

(1) Standby, diesel-engine-driven firewater pumps shall be included to ensure an adequate supply of fire-protection water if there is a complete power failure. Firewater pumps shall be designed in accordance with NFPA 20.

(2) Fire hydrants shall be strategically located around the facility, 50 ft from the buildings (+10 ft) alongside main plant roads. Hydrants must be within 15 ft of the shoulder of the road. If both requirements (distance from building and distance from road) cannot be met, the distance from the road shall govern. Maximum hydrant spacing shall be 300 ft.

(3) All branch lines to hydrants shall be provided with individual gate valves.

20.2.2.E. Irrigation Water

Irrigation water for landscaped areas shall be provided as necessary by service connections from the water distribution network. Backflow preventers and pressure-reducing valves shall be provided to prevent contamination of potable water and to reduce water waste resulting from high pressure.

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 DESIGN CRITERIA

No specific design criteria are cited.

20.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to permit safe and efficient operation of the system.

20.9 PIPING

20.9.1 DESIGN CRITERIA

No specific design criteria are cited.

20.9.2 BASIS FOR DESIGN

20.9.2.A. Plumbing

The plumbing system shall be designed in accordance with Section 1.9.2.

20.9.2.B. Piping

The piping system shall be designed in accordance with Section 1.9.2.

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.

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SECTION 21

SANITARY SEWER SYSTEM

21.1 INTRODUCTION

21.1.1 DESIGN CRITERIA

Sewage shall be treated and disposed of in compliance with applicable water pollution policies and laws.

21.1.2 BASIS FOR DESIGN

The sanitary sewer system shall be designed to meet the requirements listed in Section 21.1.1.

21.2 CIVIL AND SITE DEVELOPMENT

21.2.1 DESIGN CRITERIA

Sanitary sewer and process sewer grids shall connect the various plant sources with central treatment facilities. All liquid effluent streams from the R&H Building shall be monitored for radioactive content before release.

21.2.2 BASIS FOR DESIGN

Refer to Drawing No. H-3-56713, Sewer and Drain Systems Flow Diagram in Section 1, which forms the basis for design.

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

21.2.2.A. Collection System

(1) The sanitary sewer shall be provided for noncontaminated areas only. Sanitary sewage from the R&H Building shall be monitored for radioactive content before release. The sanitary lines shall be designed to carry domestic sanitary sewage only.

(2) Maximum flow rates shall be based on the fixture-unit method of calculation. The Manning formula shall be used to determine slope, pipe size, velocity, and flow. All main lines shall be sufficient to carry peak flow at a maximum depth of one-half the diameter.

(3) The minimum pipe size shall be 6 in. dia. Velocities for design shall be a minimum of 2 ft/sec, flowing at half depth, or 3 ft/sec when cleaning is difficult. Maximum velocity shall be 10 ft/sec.

(4) Sewer lines shall, in general, be located parallel to roads, but off the pavement, and they shall be in straight runs between manholes. Manhole spacing shall be at a change of pipe size, slope, or direction, every 300 ft. Cleanouts shall be used for changes in direction of minor sewer laterals and building connections.

(5) Sewer lines shall be placed below the frost line or have 3 ft minimum cover, and shall be designed to withstand maximum expected loads.

21.2.2.B. Sanitary Sewer Treatment

(1) The size of the sanitary waste treatment system shall be based on 25 gal/capita/day. A population of 853 employees per day shall be used as the design population.

(2) The sanitary waste system shall provide primary and secondary treatment by septic tank with a soil-adsorption system or an extended aeration process system.

(3) No effluent containing oil, acids, caustics, or the like shall discharge to the sanitary sewage treatment system.

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 DESIGN CRITERIA

No specific design criteria are cited.

21.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to permit safe and efficient operation of the system.

21.9 PIPING

21.9.1 DESIGN CRITERIA

No specific design criteria are cited.

21.9.2 BASIS FOR DESIGN

21.9.2.A. Plumbing

In addition to the criteria listed in Section 1.9.2, the following shall be used.

The sanitary sewer shall extend to an interface point 5 ft outside the buildings, where a connection shall be made between the exterior piping of the sanitary sewer system and the interior plumbing system of the buildings.

21.9.2.B. 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.

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SECTION 22

PROCESS SEWER SYSTEM

22.1 INTRODUCTION

22.1.1 DESIGN CRITERIA

Sewage shall be treated and disposed of in compliance with applicable water pollution policies and laws.

22.1.2 BASIS FOR DESIGN

The process sewer system shall be designed to meet the requirements listed in Section 22.1.1. Refer to Drawing No. H-3-56713, Sewer and Drain Systems Flow Diagram in Section 1, which forms the basis for design.

22.2 CIVIL AND SITE DEVELOPMENT

22.2.1 DESIGN CRITERIA

Sanitary sewer and process sewer grids shall connect the various plant sources with central treatment facilities. All liquid effluent streams from the R&H Building shall be monitored for radioactive content before release.

22.2.2 BASIS FOR DESIGN

In addition to the criteria listed in Section 1.2.2, the following criteria shall be used.

22.2.2.A. Collection System

(1) The process sewer shall be provided for noncontaminated areas only. The process sewage from the R&H Building shall be monitored for radioactive content before release.

(2) Maximum flow rates shall be as noted on the mechanical process utility flow diagrams. The Manning formula shall be used to determine the slope, pipe size, velocity, and flow. All main lines shall be sufficient to carry peak flow at a maximum depth of one-half the diameter.

(3) The minimum pipe size shall be 6 in. dia. Velocities for design shall be a minimum of 2 ft/sec flowing at half depth or 3 ft/sec when cleaning is difficult. Maximum velocity shall be 10 ft/sec.

(4) Sewer lines shall, in general, be located parallel to roads, but off the pavement, and they shall be in straight runs between manholes. Manhole spacing shall be at a change of line size, slope, direction, or a maximum of 300 ft. Cleanouts may be used for changes in direction of minor sewer laterals and building connections.

(5) Pipes shall be placed below the frost line, or have 3 ft minimum cover, and shall be designed to withstand maximum expected loads.

22.2.2.B. Process Sewage Treatment

(1) Treatment processes shall include neutralization, sedimentation, and filtration.

(2) The process sewage treatment system shall be sized for the average daily flow, as noted on the mechanical process utility flow diagrams.

(3) The process sewage treatment and sanitary sewage treatment shall be separate systems.

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

22.7.1 DESIGN CRITERIA

Refer to Section 22.2.1.

22.7.2 BASIS FOR DESIGN

Process waste treatment shall consist of floor and service drains that collect waste from areas that are "never contaminated" but that may contain chemicals harmful to the function of the sanitary sewer treatment system. Process drainage shall consist of boiler and cooling-tower blowdown, laboratory waste, and other chemical waste. The collected waste shall be drained to a process sewer lift sump, where it shall be monitored for pH and neutralized. Acid and caustic may be added as needed for neutralization. The waste shall then be pumped to the sewage treatment facility for disposal. Design shall be based on average summer capacity of 22,530 gpd.

22.8 INSTRUMENTATION AND CONTROL

22.8.1 DESIGN CRITERIA

No specific design criteria are cited.

22.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to permit safe and efficient operation of the system.

22.9 PIPING

22.9.1 DESIGN CRITERIA

No specific design criteria are cited.

22.9.2 BASIS FOR DESIGN

22.9.2.A. Plumbing

Not applicable to this system.

22.9.2.B. Piping

The piping system shall be designed in accordance with Section 1.9.2.

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.

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SECTION 23

FUEL DISTRIBUTION SYSTEMS

23.1 INTRODUCTION

23.1.1 DESIGN CRITERIA

Onsite storage for bulk quantities of fuel shall be provided at a central facility with a distribution system to the various use points.

Other utilities, such as natural gas, may be obtained from commercial suppliers, where cost effective and in conformance with national energy conservation policies.

23.1.2 BASIS FOR DESIGN

Drawing No. H-3-56712, Air, Gas and Fuel Oil Systems Flow Diagram in Section 1, forms the basis for design.

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 for these systems.

23.6 PROCESS (RADWASTE TREATMENT)

Not applicable for these systems.

23.7 MECHANICAL PROCESS

23.7.1 DESIGN CRITERIA

Refer to Section 23.1.1.

23.7.2 BASIS FOR DESIGN

23.7.2.A. Natural Gas

Natural gas shall be provided, if available, from the local utility company. The gas distribution system shall be installed in accordance with applicable requirements of NFPA, and shall supply the following equipment, as required:

(1) Hot water boilers
(2) Steam boilers
(3) Other support functions determined during design

23.7.2.B. Fuel Oil

Fuel oil shall be provided. The fuel-oil distribution system shall be installed in accordance with applicable requirements of NFPA, and shall supply the following equipment:

- Hot water and steam boilers
- Standby generators
- Other support functions determined during design

Fuel-oil storage shall be above ground, and capacity shall be equivalent to the supply needed for 45 calendar days of operation.

23.8 INSTRUMENTATION AND CONTROL

23.8.1 DESIGN CRITERIA

No specific design criteria are cited.

23.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to permit safe and efficient operation of the systems.

23.9 PIPING

23.9.1 DESIGN CRITERIA

No specific design criteria are cited.

23.9.2 BASIS FOR DESIGN

23.9.2.A. Plumbing

Not applicable to these systems.

23.9.2.B. Piping

In addition to the criteria listed in Section 1.9.2, the following criteria shall be used.

The fuel distribution system piping shall extend to an interface 5 ft outside the buildings, where a connection shall be made between the exterior piping of the distribution system and the interior fuel piping of the buildings.

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

Not applicable to these systems.

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SECTION 24

OILY SEWER SYSTEM

24.1 INTRODUCTION

24.1.1 DESIGN CRITERIA

No specific design criteria are cited.

24.1.2 BASIS FOR DESIGN

Oily sewer treatment shall consist of fuel-oil and lube-oil drains and underground collection tanks. Accumulated oil shall be periodically removed by vacuum truck for offsite 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

24.7.1 DESIGN CRITERIA

No specific design criteria are cited.

24.7.2 BASIS FOR DESIGN

The size of drains, piping, and collection tanks shall be based on the quantity of off-specification fuel oil that may have to be drained twice a year from the day tanks. The following buildings and drainage quantities shall be included in the basis for design:

Building	Quantity (gal/yr)
R&H Building	4,230
Administration	68
Security	20
Fire Station	40
Vehicle Maintenance	156
Site Services	156
Standby Generator	120
Cask Manufacturing	68
Water Treatment	30

24.8 INSTRUMENTATION AND CONTROL

24.8.1 DESIGN CRITERIA

No specific design criteria are cited.

24.8.2 BASIS FOR DESIGN

Instrumentation shall be provided to permit safe and efficient operation of the system.

24.9 PIPING

24.9.1 DESIGN CRITERIA

No specific design criteria are cited.

24.9.2 BASIS FOR DESIGN

The piping system shall be designed in accordance with Section 1.9.2.

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.

APPENDIX A

APPLICABLE REGULATORY GUIDES

Number	Title
1.13	Spent Fuel Storage Facility Design Basis
1.17	Protection of Nuclear Power Plants Against Industrial Sabotage
1.21	Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents From Light-Water-Cooled Nuclear Power Plants
1.23	Onsite Meteorological Programs
1.28	Quality Assurance Program Requirements (Design and Construction)
1.47	Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems
1.53	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems
1.60	Design Response Spectra for Seismic Design of Nuclear Power Plants
1.61	Damping Values for Seismic Design of Nuclear Power Plants
1.62	Manual Initiation of Protective Actions
1.68.3	Preoperational Testing of Instrument and Control Air Systems
1.74	Quality Assurance Terms and Definitions
1.76	Design Basis Tornado for Nuclear Power Plants
1.86	Termination of Operating Licenses for Nuclear Reactors
1.91	Evaluation of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants
1.92	Combining Modal Responses and Spatial Components in Seismic Response Analysis
1.93	Availability of Electric Power Sources
1.97	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident

Number	Title
1.105	Instrument Spans and Setpoints
1.106	Thermal Overload Protection for Electric Motors on Motor-Operated Valves
1.109	Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I
1.111	Methods for Estimating Atmospheric Transport and Disperson of Gaseous Effluents in Routine Releases From Light-Water-Cooled Reactors
1.112	Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents From Light-Water-Cooled Power Reactors
1.113	Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I
1.118	Periodic Testing of Electric Power and Protection Systems
1.122	Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components
1.128	Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants
1.129	Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants
1.132	Site Investigations for Foundations of Nuclear Power Plants
1.134	Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses
1.136	Material for Concrete Containments
1.137	Fuel-Oil Systems for Standby Diesel Generators
1.138	Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants
1.142	Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)
1.143	Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants

Number	Title
1.148	Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants
3.2	Efficiency Testing of Air-Cleaning Systems Containing Devices for Removal of Particles
3.4	Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors
3.6	Content of Technical Specifications for Fuel Reprocessing Plants
3.9	Concrete Radiation Shields
3.12	General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Fabrication Plants
3.14	Seismic Design Classification for Plutonium Processing and Fuel Fabrication Plants
3.16	General Fire Protection Guide for Plutonium Processing and Fuel Fabrication Plants
3.17	Earthquake Instrumentation for Fuel Reprocessing Plants
3.18	Confinement Barriers and Systems for Fuel Reprocessing Plants
3.22	Periodic Testing of Fuel Reprocessing Plant Protection System Actuation Functions
3.27	Nondestructive Examination of Welds in the Liners of Concrete Barriers in Fuel Reprocessing Plants
3.28	Welder Qualification for Welding in Areas of Limited Accessibility in Fuel Reprocessing Plants and in Plutonium Processing and Fuel Fabrication Plants
3.29	Preheat and Interpass Temperature Control for the Welding of Low-Alloy Steel for Use in Fuel Reprocessing Plants and in Plutonium Processing and Fuel Fabrication Plants
3.30	Selection, Application, and Inspection of Protective Coatings (Paints) for Fuel Reprocessing Plants
3.33	Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant
3.37	Guidance for Avoiding Intergranular Corrosion and Stress Corrosion in Austenitic Stainless Steel Components of Fuel Reprocessing Plants

Number	Title
3.40	Design Basis Floods for Fuel Reprocessing Plants and for Plutonium Processing and Fuel Fabrication Plants
3.41	Validation of Calculational Methods for Nuclear Criticality Safety
3.48	Standard Format and Content for the Safety Analysis Report for Independent Spent Fuel Storage Installation (Dry Storage)
3.49	Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)
3.50	Guidance on Preparing a License Application to Store Spent Fuel in an Independent Spent Fuel Storage Installation
3.53	Applicability of Existing Regulatory Guides to the Design and Operation of an Independent Spent Fuel Storage Installation
3.54	Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation
4.1	Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants
4.5	Measurements of Radionuclides in the Environment Sampling and Analysis of Plutonium in Soil
4.6	Measurements of Radionuclides in the Environment Strontium 89 and Strontium 90 Analyses
4.13	Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications
4.15	Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment
4.16	Measuring, Evaluating and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Airborne Effluents From Nuclear Fuel Processing and Fabrication Plants
5.7	Control of Personnel Access to Protected Areas, Vital Areas, and Material Access Areas
5.10	Selection and Use of Pressure-Sensitive Seals on Containers for Onsite Storage of Special Nuclear Material
5.12	General Use of Locks in the Protection and Control of Facilities and Special Nuclear Materials

Number	Title
5.13	Conduct of Nuclear Material Physical Inventories
5.26	Selection of Material Balance Areas and Item Control Areas
5.29	Nuclear Material Control Systems for Nuclear Power Plants
5.32	Communication With Transport Vehicles
5.44	Perimeter Intrusion Alarm Systems
5.55	Standard Format and Content of Safeguards Contingency Plans for Fuel Cycle Facilities
5.62	Reporting of Physical Security Events
7.1	Administrative Guide for Packaging and Transporting Radioactive Material
7.3	Procedures for Picking Up and Receiving Packages of Radioactive Material
7.4	Leakage Tests on Packages for Shipment of Radioactive Materials
7.7	Administrative Guide for Verifying Compliance With Packaging Requirements for Shipments of Radioactive Materials
8.1	Radiation Symbol
8.2	Guide for Administrative Practices in Radiation Monitoring
8.3	Film Badge Performance Criteria
8.4	Direct-Reading and Indirect-Reading Pocket Dosimeters
8.5	Immediate Evacuation Signal
8.6	Standard Test Procedure for Geiger-Muller Counters
8.7	Occupational Radiation Exposure Records Systems
8.8	Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as is Reasonably Achievable
8.9	Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program
8.10	Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as is Reasonably Achievable

Number	Title
8.11	Applications of Bioassay for Uranium
8.12	Criticality Accident Alarm Systems
8.13	Instruction Concerning Prenatal Radiation Exposure
8.14	Personnel Neutron Dosimeters
8.15	Acceptable Programs for Respiratory Protection
8.25	Calibration and Error Limits of Air Sampling Instruments for Total Volume of Air Sampled
8.26	Applications of Bioassay for Fission and Activation Products
8.28	Audible-Alarm Dosimeters

APPENDIX B

POTENTIALLY APPLICABLE REGULATORY GUIDES

1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors
1.6	Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems
1.9	Selection, Design, and Qualification of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants
1.30	Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment
1.32	Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants
1.38	Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants
1.39	Housekeeping Requirements for Water-Cooled Nuclear Power Plants
1.41	Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments
1.59	Design Basis Floods for Nuclear Power Plants
1.64	Quality Assurance Requirements for the Design of Nuclear Power Plants
1.78	Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release
1.94	Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants
1.108	Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants
1.110	Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors

1.116 Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems

1.117 Tornado Design Classification

1.123 Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants

1.144 Auditing of Quality Assurance Programs for Nuclear Power Plants

1.145 Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants

1.146 Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants

1.151 Instrument Sensing Lines

3.7 Monitoring of Combustible Gases and Vapors in Plutonium Processing and Fuel Fabrication Plants

3.10 Liquid Waste Treatment System Design Guide for Plutonium Processing and Fuel Fabrication Plants

3.19 Reporting of Operating Information for Fuel Reprocessing Plants

3.20 Process Offgas Systems for Fuel Reprocessing Plants

3.21 Quality Assurance Requirements for Protective Coatings Applied to Fuel Reprocessing and to Plutonium Processing and Fuel Fabrication Plants

3.31 Emergency Water Supply Systems for Fuel Reprocessing Plants

3.42 Emergency Planning for Fuel Cycle Facilities and Plants Licensed Under 10 CFR Part 50 and 70

4.2 Preparation of Environmental Reports for Nuclear Power Stations NUREG 0099

4.2.1 Additional Guidance Environmental Data

4.8 Environmental Technical Specifications for Nuclear Power Plants

5.1 Serial Numbering of Fuel Assemblies for Light-Water-Cooled Nuclear Power Reactors

5.3 Statistical Terminology and Notation for Special Nuclear Materials Control and Accountability

5.5 Standard Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Uranium Dioxide Powders and Pellets

5.6 Standard Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Plutonium Dioxide Powders and Pellets and Nuclear-Grade Mixed Oxides

5.9 Specifications for Ge(li) Spectroscopy Systems for Material Protection Measurements - Part I: Data Acquisition Systems

5.11 Nondestructive Assay of Special Nuclear Material Contained in Scrap and Waste

5.15 Security Seals for the Protection and Control of Special Nuclear Material

5.18 Limit of Error Concepts and Principles of Calculation in Nuclear Materials Control

5.27 Special Nuclear Material Doorway Monitors

5.33 Statistical Evaluation of Material Unaccounted For

5.34 Nondestructive Assay for Plutonium in Scrap Material by Spontaneous Fission Detection

5.36 Recommended Practice for Dealing with Outlying Observations

5.39 General Methods for the Analysis of Uranyl Nitrate Solutions for Assay, Isotopic Distribution, and Impurity Determinations

5.42 Design Considerations for Minimizing Residual Holdup of Special Nuclear Material in Equipment for Dry Process Operations

5.45 Standard Format and Content for the Special Nuclear Material Control and Accounting Section of a Special Nuclear Material License Application

5.49 Internal Transfers of Special Nuclear Material

5.51 Management Review of Nuclear Material Control and Accounting Systems

5.53 Qualification, Calibration, and Error Estimation Methods for Nondestructive Assay

5.58 Considerations for Establishing Traceability of Special Nuclear Material Accounting Measurements

8.19 Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants Design Stage Man-Rem Estimates

8.21 Health Physics Surveys for Byproduct Material at NRC-Licensed Processing and Manufacturing Plants

8.27 Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants

8.29 Instruction Concerning Risks From Occupational Radiation Exposure

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WAREHOUSE
- STORAGE OF BULK MATERIALS

WATER TREATMENT FACILITY
- POTABLE WATER TREATMENT
- WATER STORAGE AND PUMPING.

SITE SERVICES BUILDING
- MAINTENANCE OF ALL ON SITE UNCONTAMINATED EQUIPMENT
- PURCHASING OF ONSITE MATERIALS
- HOT CELL MOCKUP
- TRAINING OF OPERATIONS PERSONNEL

VEHICLE MAINTENANCE BUILDING
- MAINTENANCE AND SERVICING OF ALL ON-SITE VEHICLES △

ADMINISTRATION BUILDING
- ONSITE ADMINISTRATIVE FUNCTIONS
- STORAGE OF PERSONNEL, PURCHASING, ACCOUNTING AND MAINTENANCE RECORDS
- ACCESS TO WASTE INVENTORY RECORDS

FIRE STATION
- STORAGE AND DISPATCH OF FIRE FIGHTING EQUIPMENT AND PERSONNEL
- STORAGE & MAINTENANCE OF BREATHING AIR & FIRE EXTINGUISHERS
- EMERGENCY MEDICAL SERVICES

MAIN GATE / BADGEHOUSE
- INSPECTION OF ALL PERSONAL AND COMMERCIAL VEHICLES
- INSPECTION OF ALL PERSONAL △ AND HAND-CARRIED ITEMS
- VISITOR AND FORGOTTEN STAFF BADGING

EMPLOYEES & VISITORS
PERSONAL VEHICLES AND TRUCKS
PERSONNEL
TRUCK AND PERSONAL VEHICLES

SECURITY BUILDING
- ONSITE SECURITY FUNCTIONS
- SECONDARY SAFEGUARDS AND PLANT PROTECTION ALARM MONITORING
- PHYSICAL TRAINING

INSPECTION GATEHOUSE
- INSPECTION OF ALL INCOMING PAYLOAD VEHICLES FOR SAFEGUARDS & RADIATION
- EXCHANGE OF DRIVERS AND VEHICLES
- INSPECTION OF ALL OUTGOING VEHICLES VISUAL AND RADIATION

LOADED TRUCK & RAIL
RAIL & TRUCK

PROTECTED AREA GATEHOUSE
- INSPECTION OF ALL INCOMING AND OUTGOING SITE VEHICLES FOR SAFEGUARDS △
- INSPECTION OF ALL PERSONNEL AND HAND CARRIED ITEMS
- PRIMARY SAFEGUARDS AND PLANT PROTECTION ALARM MONITORING

RAIL & TRUCK
SITE VEHICLES

STANDBY GENERATOR BUILDING
- STANDBY POWER SOURCE FOR SAFETY RELATED SYSTEMS

OFF NORMAL SHIPMENT HOLDING AREA
- STORAGE OF OFF NORMAL INCOMING SHIPMENTS
- EVALUATE OFF NORMAL CONDITION
- DETERMINE HANDLING REQUIREMENTS

CHTRU WASTE STORAGE AREA
- RECEIVE AND STORE ON-SITE GENERATED SOLID RADWASTE CONTAINERS

SF, HLW, RHTRU STORAGE FACILITIES
- RECEIVE AND UNLOAD TRANSPORTER
- SECURE CASK
- MONITOR DESIGNATED STORAGE LOCATIONS
- RETRIEVE CASK OR CANISTER AND LOAD TRANSPORTER, AT ANY TIME, FOR EXAMINATION, REPAIR OR SHIPMENT OFFSITE

STORAGE FACILITY GATE STATION
- CONTROL ACCESS
- MONITOR PERSONNEL

TRANSPORTER AND SITE VEHICLES

TRANSPORTER AND TRUCKS

RECEIVING & HANDLING FACILITY
- RECEIVE OFFSITE SF, HLW AND RHTRU CASKS AND VEHICLES
- WASHDOWN CASKS AND VEHICLES
- UNLOAD VEHICLES AND SURVEY CASKS
- DELIVER METAL CASK TO STORAGE
- PREPARE CASK FOR UNLOADING
- UNLOAD CASK
- OVERPACK HLW OR RHTRU CANISTERS IF REQUIRED
- IDENTIFY, DISASSEMBLE, AND CONSOLIDATE SPENT FUEL
- PACKAGE HARDWARE AND FUEL RODS
- INVENTORY WASTE PACKAGE
- LOAD STORAGE CASK ON TRANSPORT VEHICLE
- UNLOAD TRANSPORTER, LOAD TRANSPORT CASK AND SHIP
- COLLECT, SHRED, ENCAPSULATE, PACKAGE AND SHIP TO CHTRU FACILITIES ON SITE GENERATED SOLID RADWASTE
- COLLECT, TREAT AND RECYCLE ON SITE GENERATED LIQUID RADWASTE

CONCRETE CASKS MANUFACTURING FACILITY
- FABRICATE CASKS
- CURE CASKS
- STORE CASKS

GATE
BULK SUPPLIES BY RAIL & TRUCK
GATE
CONCRETE CASKS

SEWAGE TREATMENT FACILITY
- TREATMENT & DISPOSAL OF PROCESS SEWER

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DOE/RW-CNTRCT	BY	3/1/85
	PDR	
Q.A.		2/14/85
APPD		2/14/85
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M R S FACILITY
SITE
PROJECT
FUNCTIONAL FLOW DIAGRAM
SEALED STORAGE CASK (CONCRETE CASK) CONCEPT

DWG NO 77A-100 | REV NO 7001
DWG NO H-3-55201 | SHEET NO 1 | NO OF SHTS 1

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
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	BDY 7/19/85	PNL		DLL 7/25/85	Bgk		DLL 7/25/85	PER CLIENT FINAL REVIEW COMMENT	△

REVISIONS

COMMENT PRT ISSUE NO	DATE	CHECK PRT ISSUE NO	DATE	LAST REV

DRAWING STATUS

04-1000-0001 (11-83)

☆ GPO 1983-781-872

1-162

IDENTIFICATION OF POTENTIAL HAZARDS

IDENTIFICATION OF CREDIBLE ACCIDENTS (FUEL HANDLING FUEL DAMAGE)
10 CFR 72.3W

FACILITY STRUCTURES SYSTEMS AND COMPONENTS

STRUCTURES SYSTEMS AND COMPONENTS IMPORTANT TO SAFETY

ENGINEERED MEASURES TO MITIGATE ACCIDENTS

REGULATORY LIMITS - NORMAL OPERATIONS (GENERAL PUBLIC)

- RADIATION EXPOSURE LIMIT
  10 CFR 72.67 25 MREM/YR
  DOE 5480.1A 500 MREM/YR
- EFFLUENT RELEASE LIMITS
  10 CFR 20 - APP. B TABLE 2
  5480.1A ATT. XI TABLE 2

POTENTIAL RISK TO THE PUBLIC
10 CFR 72.3W

REGULATORY LIMITS-DESIGN BASIS ACCIDENT *

- RADIATION EXPOSURE LIMIT
  10 CFR 72.68 5 REM AT SITE BOUNDARY
- EFFLUENT RELEASE LIMITS
  10 CFR 72.68 5 REM AT SITE BOUNDARY

RISK OF EXCEEDING REGULATORY LIMITS → CATEGORY I DESIGN

NO RISK OF EXCEEDING REGULATORY LIMITS → NON-CATEGORY I DESIGN

* DESIGN BASIS IS NORMAL OPERATION AND ANTICIPATED OCCURRENCES.

CONCEPTUAL DESIGN

JQP# NONE

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APPD		3/1/85
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SCALE	NONE	
CLASSIFIED BY	NOT REQD	DATE
CLASSIFICATION	NONE	

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M R S FACILITY
PROJECT
CLASSIFICATION (CRITERIA)
BLDG. NO 77A | TI-BASE NO 7001
DRWG NO H-3-55203 | SHEET NO. | No. OF SHTS 1 | 1

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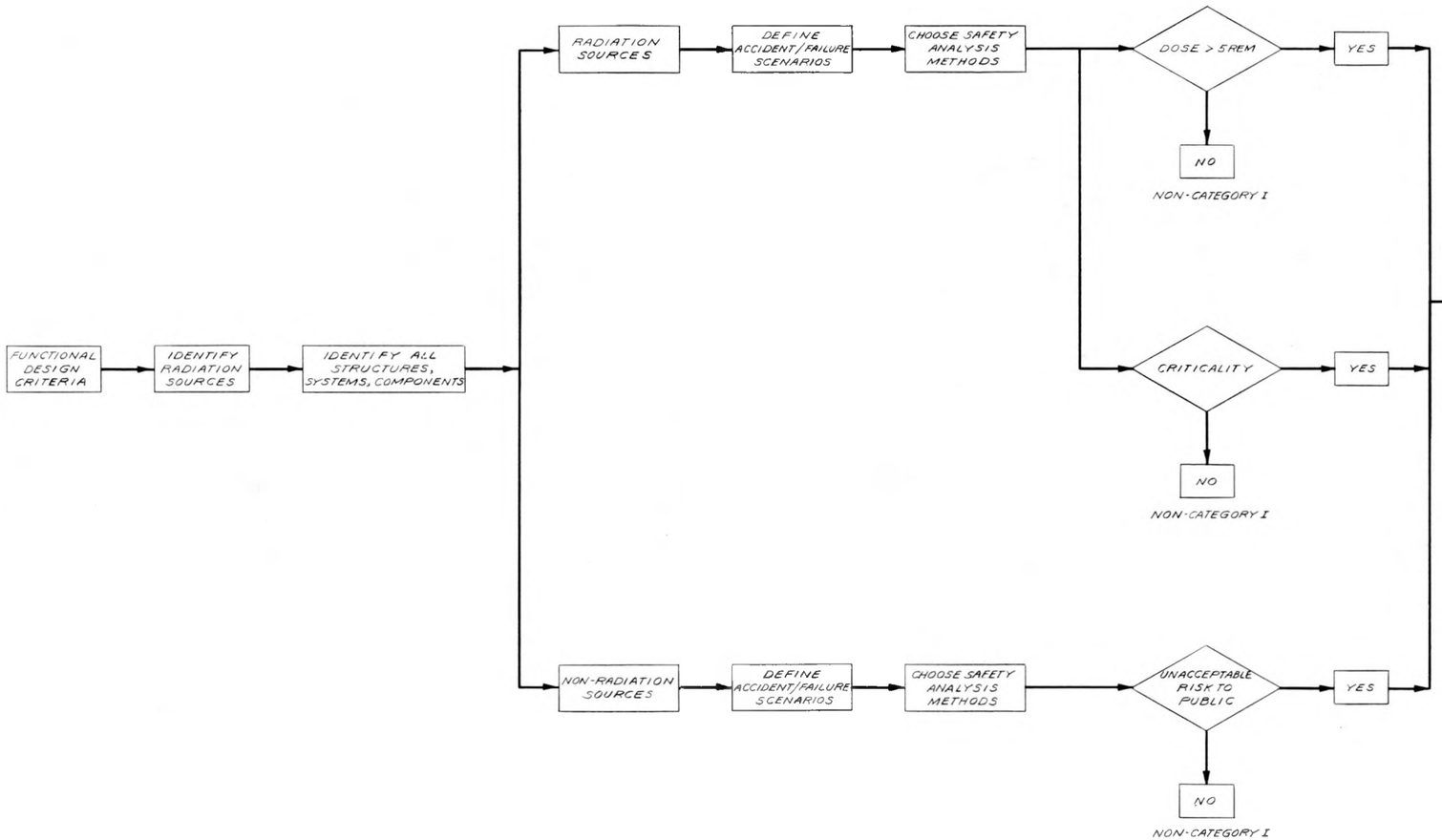

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JQP## NONE

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MRS FACILITY

PROJECT
CLASSIFICATION WORK PLAN

BLDG NO 77A | WBS NO 7001

DWG NO H-3-55204 | SHEET NO 1 | NO OF SHTS 1

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1-164

NOTES:
1. THIS DRAWING IS SPECIFIC FOR THE PRIMARY CONCEPT. THE ALTERNATE CONCEPT IS SIMILAR, BUT THE CASK MANUFACTURING FACILITY WOULD BE DELETED.

NATURAL GAS FROM OFF-SITE
WATER FROM OFF-SITE
CASK MANUFACTURING FACILITY
OILY SEWER COLLECTION DRUM (TYP. 4 PLACES)
POTABLE WATER
SANITARY SEWER
PROCESS SEWER
NATURAL GAS
FUEL OIL
FUEL STORAGE TANKS
FUEL OIL
STANDBY GENERATOR BUILDING
OFF-NORMAL STORAGE AREA
STORAGE AREA GATE STATION
TRANSPORTABLE METAL CASK STORAGE AREA
WATER TREATMENT FACILITY
INSTR. AIR
CHTRU FACILITY
WAREHOUSE
OILY SEWER
WATER STORAGE TANK
PLANT & INSTR. AIR
VEHICLE MAINTENANCE BUILDING
RECEIVING & HANDLING BUILDING
SF, HLW AND RHTRU STORAGE FACILITY
SITE SERVICES BUILDING
OILY SEWER
FIRE STATION
ADMINISTRATION BUILDING
OILY SEWER
PLANT & INSTR. AIR
SECURITY BUILDING
PROTECTED AREA GATEHOUSE
FUEL OIL
NATURAL GAS
PROCESS SEWER
SANITARY SEWER
POTABLE WATER
CWR
CWS
STEAM CONDENSATE
DI WATER
PLANT & INSTR. AIR
STEAM GENERATOR BUILDING
OILY SEWER
COOLING TOWER CHEMICAL BUILDING
COOLING TOWER
SECURITY FENCE (TYP.)
MAIN GATE/ BADGEHOUSE
SEWAGE TREATMENT FACILITY
OFF-SITE DISPOSAL
INSPECTION GATEHOUSE
SEPTIC TANK
SANITARY SEWER
DRAIN FIELD

CONCEPTUAL DESIGN

JQP# NONE

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Q A			7-24-85
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M R S FACILITY
UTILITIES
MECHANICAL PROCESS
SITE UTILITIES DISTRIBUTION
FLOW DIAGRAM

BLDG NO 77A-700 | INSTR NO 0104/0105
DWG NO H-3-56706 | SHEET NO 1 | TOTAL SHTS 1

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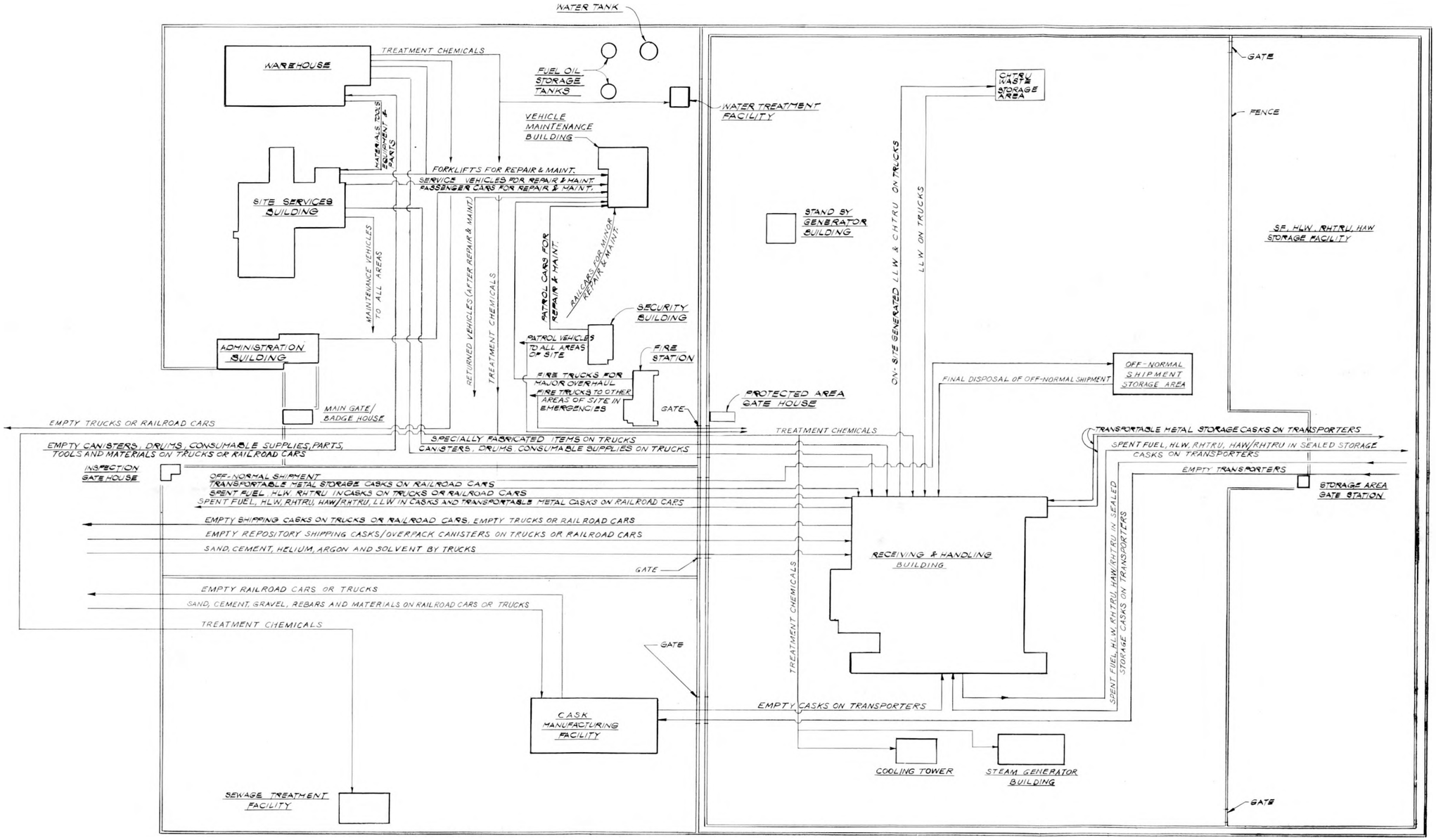
DRAWING STATUS				

7-19-85

1-165



CONCEPTUAL DESIGN

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DFT'S APPD		5-21-93	SITE
CHECKED		5/21/93	MECHANICAL SPECIALTIES
DRAWN	M.Baca	5/21/93	MATERIAL HANDLING FLOW DIAGRAM
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SIGNIFICANT	BY-DATE	PDR	BY-DATE	PDR	REV BY DATE	DESCRIPTION	REV NO
	APVD FOR CONFORMANCE WITH DESIGN CRIT		APPD			REVISIONS	
	COMMENT PRT ISSUE NO		DATE	CHECK PRT ISSUE NO		DATE	LAST REV
	DRAWING STATUS						

84-1905-040(11/93)
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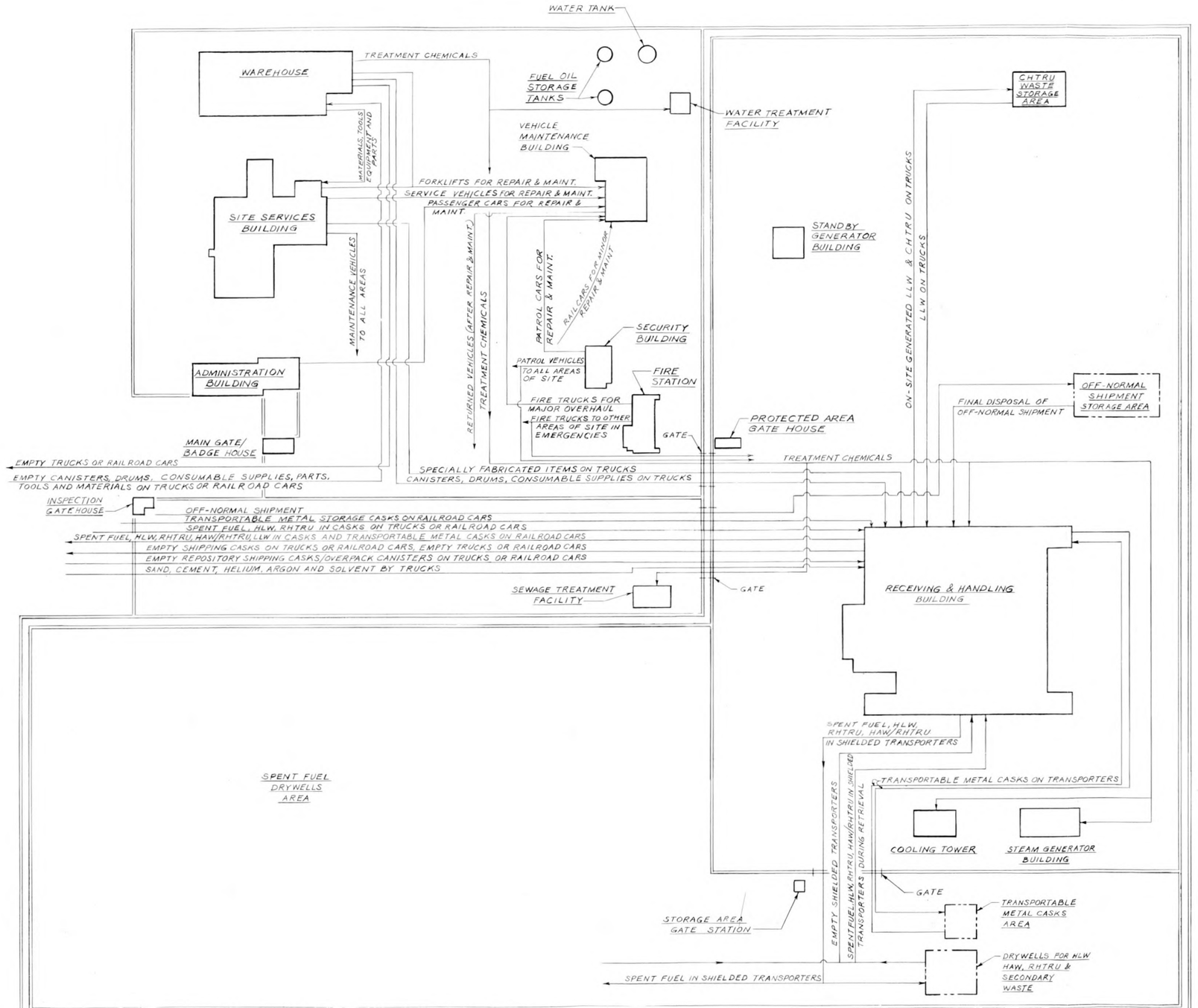

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA	BY		7/13/84
	FOR		
QA		N/A	
APPD			7/11/84
APPD			7/11/84
DPTS APPD			5-21-84
CHECKED			7/13/84
DRAWN			3/27/84
SCALE		NONE	
CLASSIFIED BY		NOT REQD	DATE
CLASSIFICATION		NONE	

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Westinghouse Electric Corp. Golder Associates
MRS FACILITY
SITE
MECHANICAL SPECIALTIES
MATERIAL HANDLING FLOW DIAGRAM
ALTERNATE CONCEPT

BLDG NO 77A-100 INDEX NO 0110
DWG NO H-3-56715 SHEET NO 2 NO OF SHTS 2

REFERENCE DRAWINGS
DWG NO | REV NO | DRAWING TITLE OR INDEX NO
NEXT USED ON

REVISIONS
MICRO FWD | BY-DATE | FOR | BY-DATE | FOR | REV BY DATE | DESCRIPTION | REV NO
APPD FOR CONFORM WITH DESIGN CRIT | APPD
COMMENT PRT ISSUE NO | DATE | CHECK PRT ISSUE NO | DATE | LAST REV
DRAWING STATUS

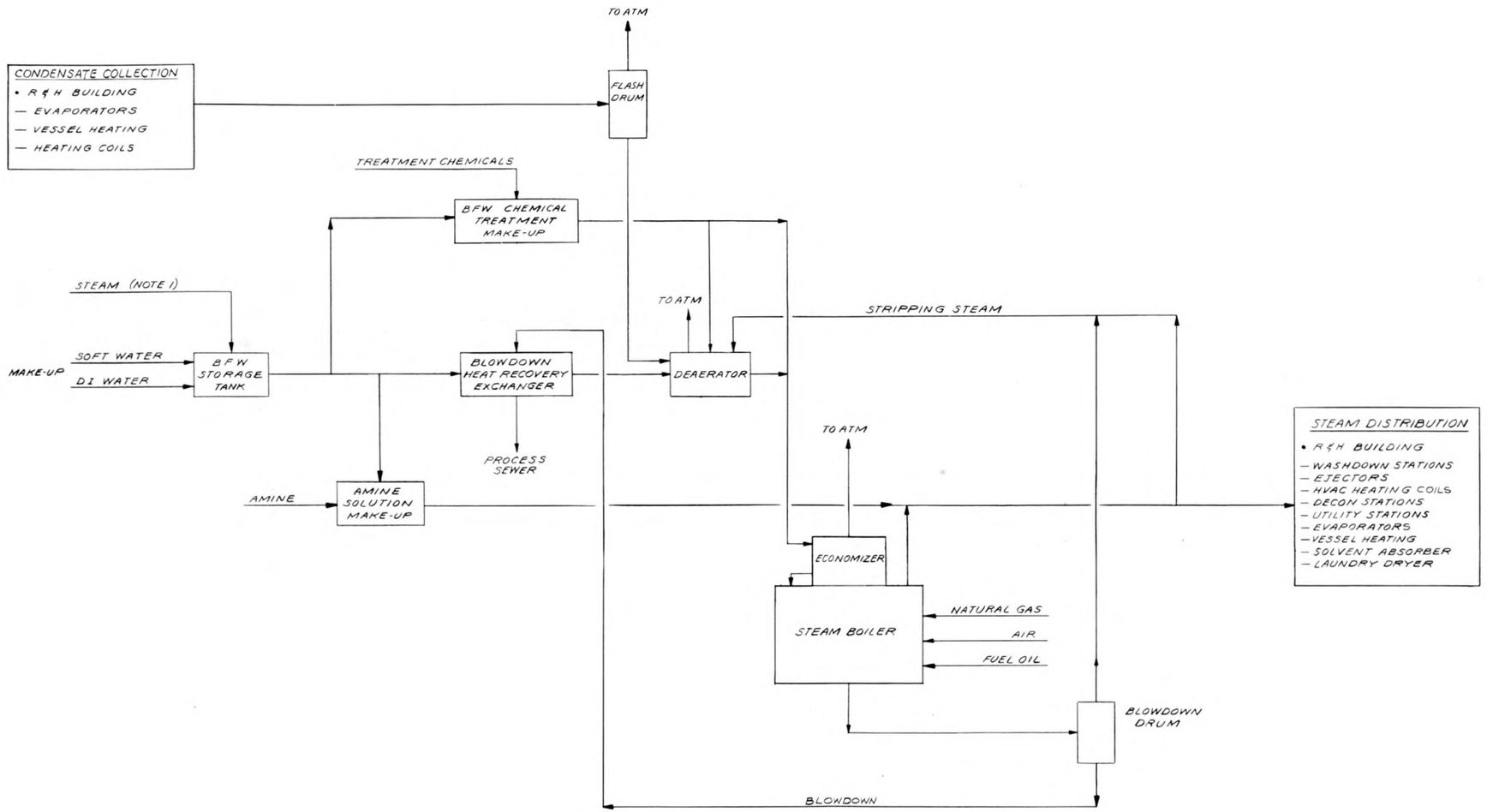
84-1980-046(11-83)

☆ GPO: 1984-794-407

NOTES:

1. INTERMITTENT FLOW FOR TEMPERATURE CONTROL.

1-167



CONCEPTUAL DESIGN

JQP # NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY / FOR	7/24/85
QA	7-24-85
APPD	7/24/85
DESIGN AGENT APPD	7/24/85
MFG APPD	7/24/85
CHECKED	7/24/85
DRAWN	7-15-85
SCALE	NONE
CLASSIFIED BY	NOT REQD
CLASSIFICATION	NONE

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MRS FACILITY
RECEIVING & HANDLING BUILDING

MECHANICAL PROCESS
STEAM / CONDENSATE SYSTEM
FLOW DIAGRAM

BLDG NO 77A-200 DRWG NO 7001

DRWG NO H-3-56711 REV 1

5-19-85

REFERENCE DRAWINGS
DWG NO | REV NO | DRAWING TITLE OR INDEX NO
NEXT USED ON

REVISIONS
MICRO F'W'S | BY-DATE | FOR | BY-DATE | FOR | REV BY DATE | DESCRIPTION | REV NO
APPD FOR CONFORM WITH DESIGN CRIT | APPD
COMMENT PRT ISSUE NO | DATE | CHECK PRT ISSUE NO | DATE | LAST REV
DRAWING STATUS

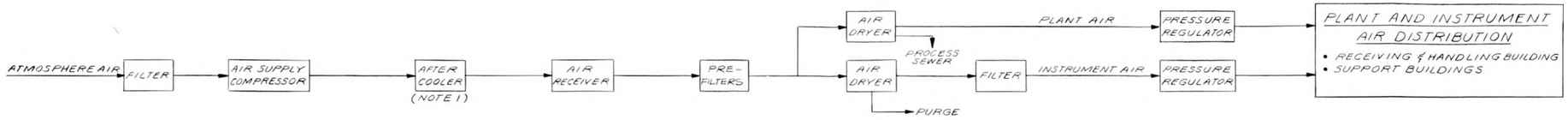
04-1980-048 (2/82)

U.S. GOVERNMENT PRINTING OFFICE: 1985 695-058

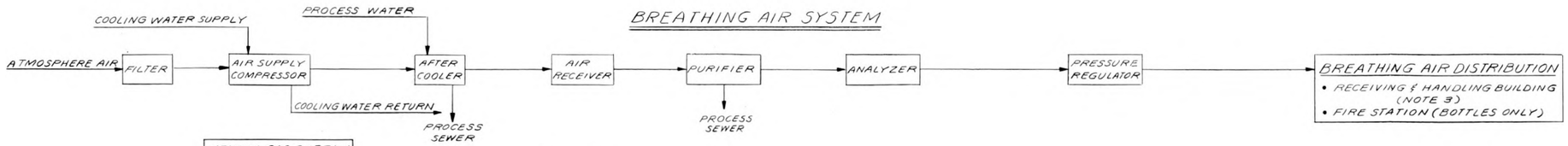
1-168

NOTES:
1. R & H BUILDING AFTERCOOLER IS WATER COOLED, ALL OTHERS ARE AIR COOLED.
2. NATURAL GAS MAY BE USED IF AVAILABLE LOCALLY.
3. SEPARATE COMPRESSOR PROVIDED FOR AIR-PACK BOTTLE FILLING EQUIPMENT.

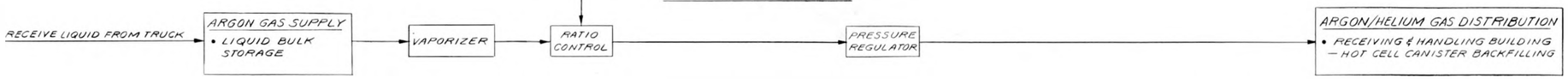
PLANT AND INSTRUMENT AIR SYSTEM



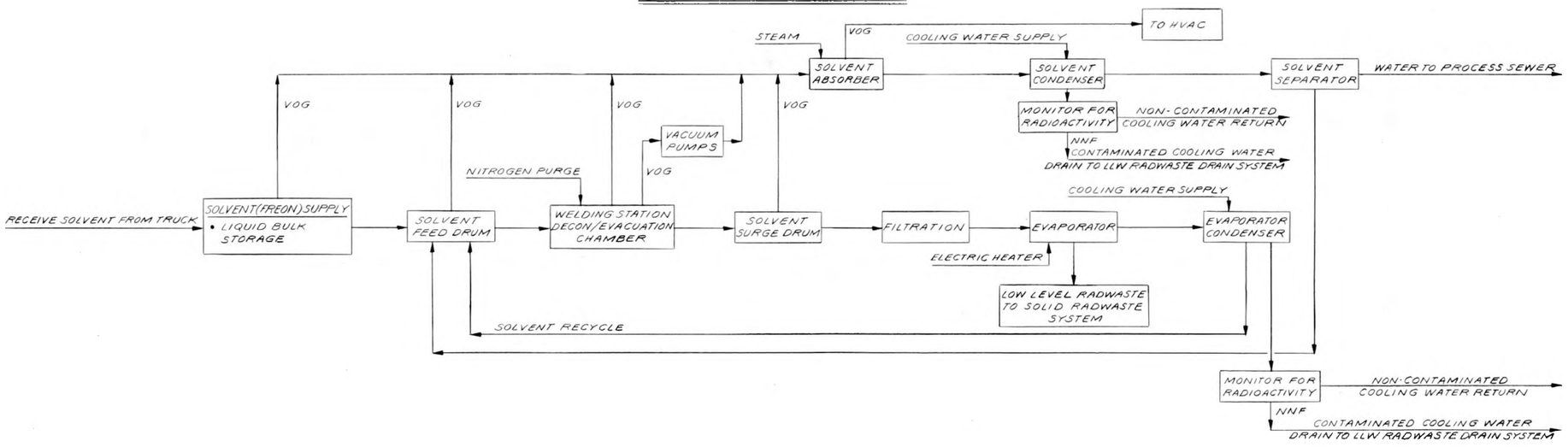
BREATHING AIR SYSTEM



INERT GAS SYSTEM



SOLVENT ($C_2 Cl_3 F_3$) SYSTEM



NATURAL GAS SYSTEM
(NOTE 2)

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA		7/31/85
BY		
FOR		
Q A		7/24/85
APPD		7/30/85
Design Engr		7/24/85
DEPT APPD		7/24/85
CHECKED		7/24/85
DRAWN		7/9/85
SCALE	NONE	
CLASSIFIED BY	NOT REQD	DATE
CLASSIFICATION	NONE	

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MECHANICAL PROCESS
AIR, GAS AND SOLVENT SYSTEMS FLOW DIAGRAM

BLDG NO 77A-200 | TABBS NO 7001
DWG NO H-3-56712 | SHEET NO 1 | TOTAL SHTS IN DWG 1

REFERENCE DRAWINGS
NEXT USED ON

DRAWING STATUS

7-16-85

RADWASTE DRAIN SYSTEMS

HIGH ACTIVITY RADWASTE COLLECTION

FLOOR SUMPS FROM:
- RECEIVING & HANDLING BUILDING
  - HIGH ACTIVITY EQUIPMENT DECON
  - PROCESS CELL DECON
  - CRANE MAINTENANCE DECON
  - MAINTENANCE CELL DECON
  - OTHER MISCELLANEOUS DRAINS

→ COLLECTION HEADER → HIGH ACTIVITY LIQUID RADWASTE TREATMENT SYSTEM

LOW LEVEL RADWASTE COLLECTION

FLOOR SUMPS FROM:
- RECEIVING & HANDLING BUILDING
  - HEALTH PHYSICS PERSONNEL DECON DRAINS
  - CASK HANDLING DECON
  - LOW LEVEL LIQUID RADWASTE EQUIPMENT DRAINS
  - LOW LEVEL LIQUID RADWASTE AREA DECON
  - LOW LEVEL SOLID RADWASTE DRUM DECON
  - SAFETY SHOWER DRAINS
  - LOADOUT/DECON DRAIN
  - LAUNDRY ROOM DECON
  - OTHER MISCELLANEOUS DRAINS
- FINAL HEPA FILTER FIREWATER SPRAY
- ANALYTICAL LAB RADWASTE

→ COLLECTION HEADER → LOW LEVEL LIQUID RADWASTE TREATMENT SYSTEM

OILY SEWER SYSTEM

OILY SEWER COLLECTION
- STEAM GENERATOR BUILDING
  - BOILER FUEL DRAINS
- VEHICLE MAINTENANCE BUILDING
  - BOILER FUEL DRAINS
  - VEHICLE OIL DRAINS
- OTHER SUPPORT BUILDINGS
  - BOILER FUEL DRAINS

→ COLLECTION HEADER → COLLECTION TANKS → VACUUM TRUCK REMOVAL/ DISPOSAL

PROCESS SEWER SYSTEM

PROCESS SEWER COLLECTION

SEE NOTE 2
DRAINS FROM:
- RECEIVING & HANDLING BUILDING
  - VEHICLE WASHDOWN SUMPS
  - DECON MAKE-UP ROOM
  - SOLVENT SEPARATOR
  - HOT WATER HEATER
  - OTHER MISCELLANEOUS DRAINS
- SUPPORT BUILDINGS
  - HOT WATER BOILER BLOWDOWN
  - CHEMICAL DRAINS
- STEAM GENERATOR BUILDING
  - STEAM BOILER BLOWDOWN
- COOLING TOWER BLOWDOWN
- SEWAGE TREATMENT FACILITY
  - FILTER BACKWASH

→ COLLECTION HEADER
- MONITOR FOR RADIOACTIVITY (R&H BLDG. ONLY)

NON-CONTAMINATED → PROCESS SEWER LIFT SUMP
- MONITOR pH
- NEUTRALIZE

ACID ↓ / CAUSTIC ↑

→ SEWAGE TREATMENT FACILITY
- FLOCCULATE
- CLARIFY
- FILTER

→ OFF-SITE DISPOSAL

NNF → CONTAMINATED DRAIN TO LLW RADWASTE DRAIN SYSTEM

CHTRU STORAGE FACILITY DRAIN SYSTEM

CHTRU STORAGE FACILITY RADWASTE DRAIN COLLECTION

SUMPS FROM 24 CELLS

→ COLLECTION HEADER → CHTRU STORAGE FACILITY COLLECTION SUMPS
- MONITOR FOR RADIOACTIVITY
- MONITOR LIQUID LEVEL

NON-CONTAMINATED → VACUUM TRUCK REMOVAL/ DISPOSAL

NNF → CONTAMINATED → RECEIVING & HANDLING BUILDING
- TRANSFER BY VACUUM TRUCK TO LOW LEVEL LIQUID RADWASTE SYSTEM

SANITARY SEWER SYSTEM

SANITARY WASTE COLLECTION

SEE NOTE 1
DRAINS FROM:
- RECEIVING & HANDLING BUILDING
- SUPPORT BUILDINGS

→ UNDERGROUND SANITARY SEWER COLLECTION HEADER
- MONITOR FOR RADIOACTIVITY (R&H BUILDING ONLY)

NON-CONTAMINATED → SEWAGE TREATMENT FACILITY
- AERATE
- CLARIFY
- FILTER
- CHLORINATE

→ OFF-SITE DISPOSAL

NNF → CONTAMINATED DRAIN TO LLW RADWASTE DRAIN SYSTEM

NOTES:
1. SANITARY SEWAGE SYSTEM INCLUDES RESTROOMS, LUNCH ROOMS, JANITOR'S SINKS, CHANGE ROOMS, WATER COOLERS AND OTHER SANITARY AREAS.
2. PROCESS SEWER SYSTEM SERVES UNRESTRICTED ACCESS ZONES THAT HAVE NO POTENTIAL FOR RADIOACTIVE CONTAMINATION BUT MAY CONTAIN CHEMICALS HARMFUL TO THE FUNCTION OF THE SANITARY SEWER SYSTEM.

1-169

CONCEPTUAL DESIGN

JQP # NONE

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MECHANICAL PROCESS
SEWER & DRAIN SYSTEMS
FLOW DIAGRAM

SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
W.O. NO 77A-200
LICENSE NO 7001
DRAWING NO H-3-56713
SHEET NO 1 OF 1

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY 7/30/85
PDR 7/30/85
Q A 7-16-85
ENGR 7/24/85
DEPTD APPD 7/24/85
CHECKED 7/24/85
DRAWN D. Larson 7/15/85

REFERENCE DRAWINGS
NEXT USED ON

REVISIONS
DESCRIPTION
COMMENT PRT ISSUE NO | DATE | CHECK PRT ISSUE NO | DATE
DRAWING STATUS

7-16-85

DOE GOVERNMENT PRINTING OFFICE: 1984-488

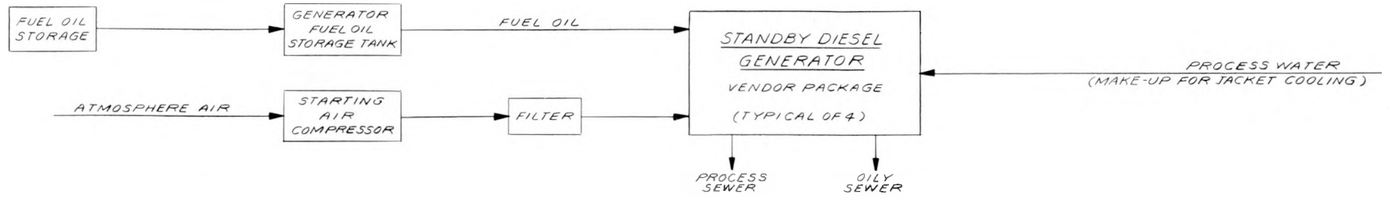
84-1850-040 (3/82)

1-170

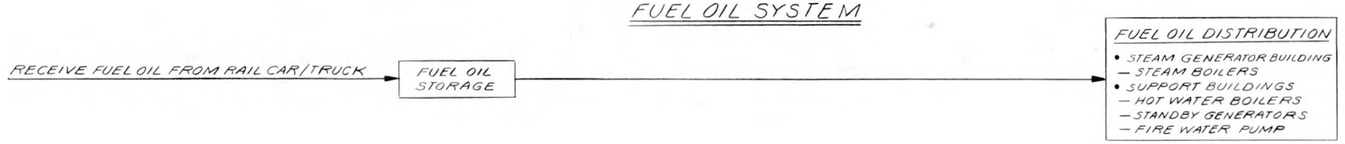
NOTES:

1. HOT WATER BOILERS REQUIRED IN THE FOLLOWING SUPPORT BUILDINGS: ADMINISTRATION, SECURITY, SITE SERVICES, FIRE STATION, VEHICLE MAINTENANCE, AND CASK MANUFACTURING FACILITY.
2. BACK-UP FUEL IF AVAILABLE.

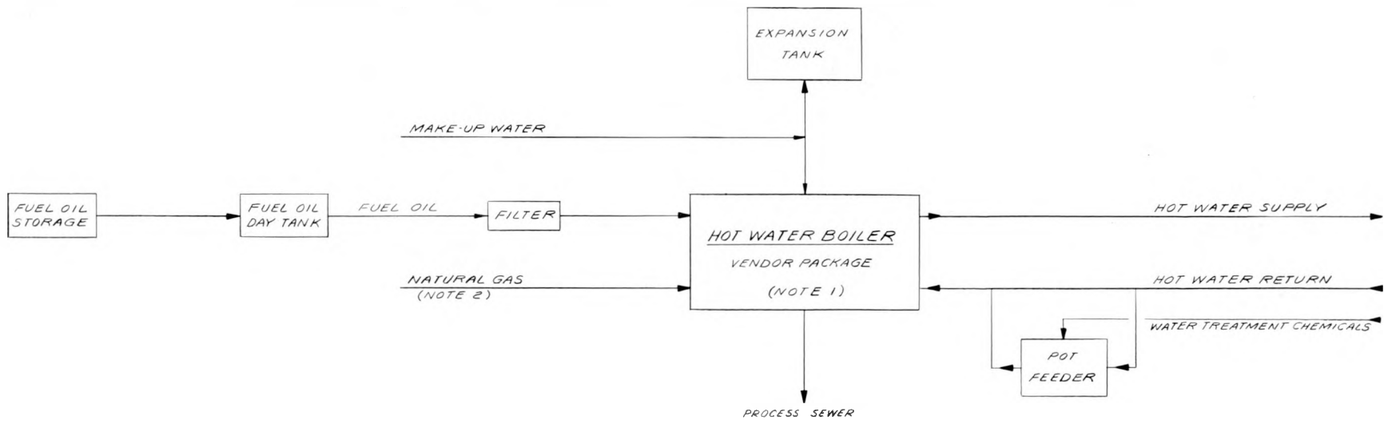
STANDBY GENERATOR SYSTEM



FUEL OIL SYSTEM



HOT WATER BOILER SYSTEM



CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY	7/19/84	U. S. Department Of Energy Richland Operations Office
PDE		PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
QA	7/19/84	THE RALPH M. PARSONS COMPANY of DELAWARE
APPD	7/19/84	Westinghouse Electric Corp. — Golder Associates
MFG APPD	7/19/84	MRS FACILITY STANDBY GENERATOR BUILDING
CHECKED	7/19/84	MECHANICAL PROCESS
DRAWN D. Langen	5-13-85	HOT WATER BOILER, STANDBY GENERATOR AND FUEL OIL SYSTEMS FLOW DIAGRAM
SCALE NONE		
CLASSIFIED BY NOT REQD	DATE	BLDG NO 77A-810 — TITLE NO 7001
CLASSIFICATION NONE		DWG NO H-3-56714 — SHEET NO 1 — NO OF SHTS 1

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

MICRO FWD	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH DESIGN CRIT		APPD				

REVISIONS

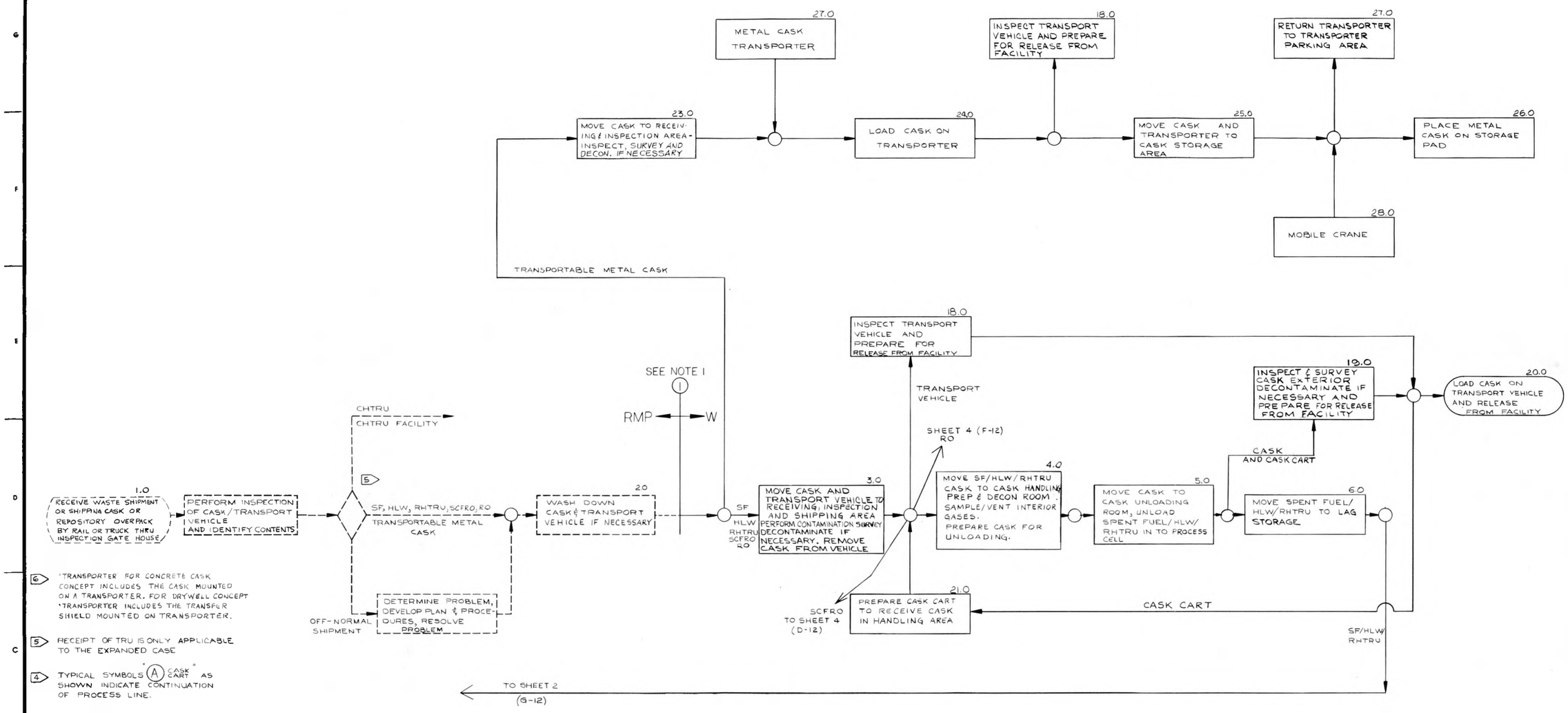
COMMENT PRT ISSUE NO	DATE	CHECK PRT ISSUE NO	DATE	LAST REV

DRAWING STATUS

5-13-85

DOPO 1983/793-078

2-114



6 "TRANSPORTER" FOR CONCRETE CASK CONCEPT INCLUDES THE CASK MOUNTED ON A TRANSPORTER. FOR DRYWELL CONCEPT "TRANSPORTER" INCLUDES THE TRANSFER SHIELD MOUNTED ON TRANSPORTER.

5 RECEIPT OF TRU IS ONLY APPLICABLE TO THE EXPANDED CASE

4 TYPICAL SYMBOLS "A CASK CART" AS SHOWN INDICATE CONTINUATION OF PROCESS LINE.

3 NUMERICAL IDENTIFICATION OF LEVEL I FUNCTION BLOCK ARE KEYED TO FUNCTION BLOCK IDENTIFICATION NUMBERS OF LEVEL II FLOW DIAGRAM.

NOTE 2
ABBREVIATIONS:

CHTRU	CONTACT HANDLED TRANSURANIC WASTE.
RHTRU	REMOTE HANDLED TRANSURANIC WASTE.
HLW	HIGH LEVEL WASTE.
SF	SPENT FUEL.
R&H	RECEIVING & HANDLING.
SCFRO	SHIPPING CASK FOR REPOSITORY OVERPACK
RO	REPOSITORY OVERPACK

HAW/RHTRU HIGH SPECIFIC ACTIVITY MATERIAL GENERATED ON SITE, THAT MAY EXCEED CLASS C SPECS FOR LOW LEVEL WASTE AND MAY OR MAY NOT CONTAIN SOME QUANTITY OF TRANSURANIC MATERIAL.

NOTE 1
INTERFACE SYMBOL (1) DENOTES DIVISION OF RESPONSIBILITY BETWEEN RALPH M. PARSONS CO. AND WESTINGHOUSE.

CONCEPTUAL DESIGN

JQP# NONE

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MRS FACILITY	RECEIVING & HANDLING BUILDING
MATERIAL HANDLING	LEVEL I MATERIAL FLOW DIAGRAM
SCALE NONE	DWG NO 77A-200
CLASSIFICATION NOT REQD / NONE	SHT NO H-3-56703

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY 7/1/85; PDD; Q A; 7/1/85; 7/1/85; DESIGNED 6/6/85; DRAWN 7/1/85; CHECKED 7/1/85

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

WHERE F'D	BY-DATE	PDR	BY-DATE	PDR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH DESIGN CRIT		APPD			REVISIONS	

COMMENT PRT ISSUE NO 86 DATE; CHECK PRT ISSUE NO DATE; LAST REV

DRAWING STATUS 7-8-85

2-115

FROM SHEET 1 (C-10)

17.0 TRANSPORTER → 6

HLW/RHTRU

7.0 INSPECT WASTE PACKAGE AND OVERPACK AS NECESSARY

13.0 DECONTAMINATE WASTE PACKAGE AS NECESSARY

15.0 LOAD WASTE PACKAGE INTO TRANSPORTER

16.0 EXIT TO STORAGE

ROUTE WASTE

INTACT SPENT FUEL ASSEMBLIES

CONSOLIDATE?

YES

8.0 DISASSEMBLE FUEL RODS AND CONSOLIDATE

HAW/RHTRU

11.0 REDUCE VOLUME OF NON-FUEL COMPONENTS

22.0 STORAGE DRUMS FOR NON FUEL COMPONENTS

11.0 LOAD VOLUME REDUCED NON-FUEL COMPONENTS INTO & SEAL DRUMS

43.0 DRUM DISCHARGE CART

44.0 LOAD DRUMS ONTO DRUM DISCHARGE CART

45.0 MOVE DRUMS TO CANYON CELL

70.0 MOVE DRUM CAGE INTO CANYON CELL

71.0 TRANSFER DRUMS FROM DRUMS DISCHARGE CART TO CAGE

SHIP OFF-SITE ?

YES → TO ZONE B-12 SHEET 4

NO → TO STEP 2.0 DWG H-3-56704 SH 1 (ZONE D-7) FOR CONCRETE CASK STORAGE OR DWG H-3-56705 SH 1 (ZONE D-6) FOR DRYWELL STORAGE

NO

9.0 LOAD FUEL ASSEMBLY INTO CANISTER

22.0 STORAGE CANISTER

22.0 STORAGE CANISTER

8.0 LOAD CONSOLIDATED FUEL RODS INTO CANISTER

12.0 WELD CANISTER LID TO CANISTER

13.0 CLEAN/DECONTAMINATE CANISTER

14.0 INSPECT WELD AND LEAK TEST CANISTER

PRECONSOLIDATED FUEL RODS

IS OVERPACKING REQUIRED ?

YES

NO

10.0 LOAD CONSOLIDATED FUEL RODS INTO OVERPACK CANISTER

22.0 OVERPACK CANISTER

12.0 WELD LID TO OVERPACK CANISTER

13.0 DECONTAMINATE CANISTER

14.0 CANISTER WELD INSPECTION

87.0 INTER-CELL TRANSPORTER

15.0 LOAD CANISTER INTO INTER-CELL TRANSPORTER

TO IN BUILDING LAG STORAGE ?

NO → SHIP OFF-SITE ? NO → TO STEP 2.0 DWG H-3-56704 SH 1 (ZONE D-7) FOR CONCRETE CASK STORAGE OR DWG H-3-56705 SH 1 (ZONE D-6) FOR DRYWELL STORAGE

SHIP OFF-SITE ? YES → TO ZONE G-9 SHEET 4

YES → 90.0 IN-BUILDING LAG STORAGE → 100.0 RETRIEVE → SHIP OFF-SITE ? YES → TO ZONE G-9 SHEET 4

NO → TO STEP 2.0 DWG H-3-56704 SH 1 (ZONE D-7) FOR CONCRETE CASK STORAGE OR DWG H-3-56705 SH 1 (ZONE D-6) FOR DRYWELL STORAGE

CONCEPTUAL DESIGN

JOP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA — BY — FOR — QA — APPD — DATE 7/3/85

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MATERIAL HANDLING
LEVEL 1 MATERIAL FLOW DIAGRAM

SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
BLDG NO 77A-200
INDEX NO 7001
DWG NO H-3-56703
SHEET NO 2 OF 10

DWG NO | REV NO | DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS
NEXT USED ON

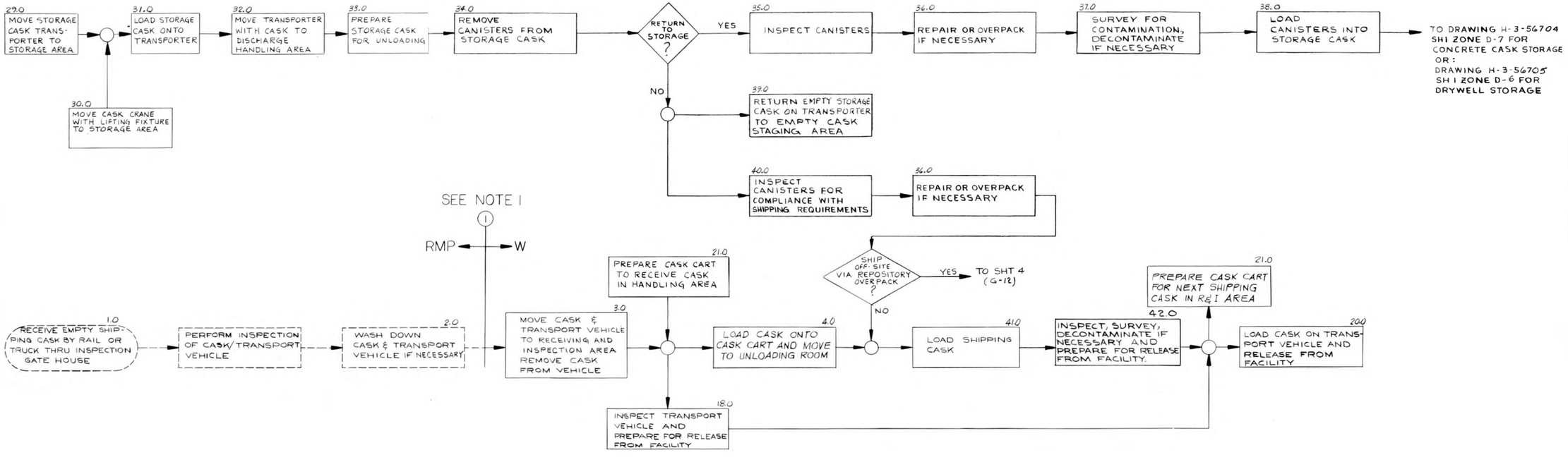
REVISIONS

MICRO FM'D	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH DESIGN CRIT		APPD				

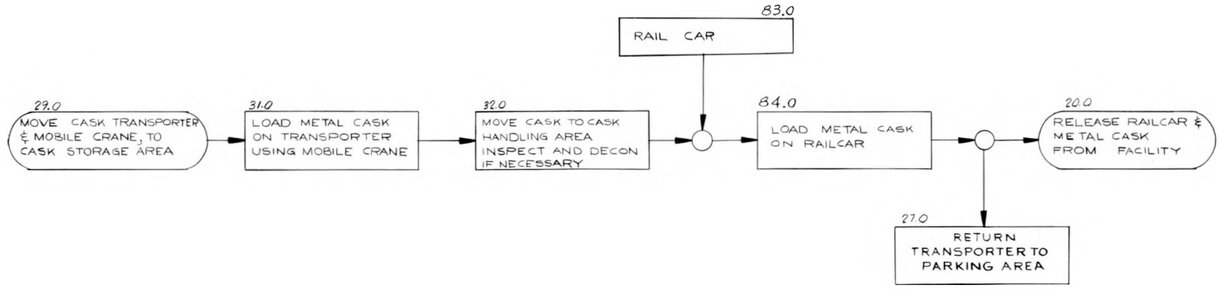
COMMENT PRT ISSUE NO 6 — DATE — CHECK PRT ISSUE NO — DATE — LAST REV

DRAWING STATUS 7-9-85

2-116



STORAGE PACKAGE RETRIEVAL



TRANSPORTABLE METAL CASK RETRIEVAL

CONCEPTUAL DESIGN

JQP# NONE

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MATERIAL HANDLING
LEVEL I MATERIAL FLOW DIAGRAM

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY — PDR — QA — APPD — DRWN — SCHEDULE — DPSS MGR — DRWN — SCALE NONE — CLASSIFIED BY NOT REQD — CLASSIFICATION NONE

BLDG NO 77A-200 — INSTR NO 7001 — DWG NO H-3-56703 — SHEET NO 3 — REV NO 10

REFERENCE DRAWINGS — DWG NO — REV NO — DRAWING TITLE OR INDEX NO — NEXT USED ON

REVISIONS — BY-DATE — PDR — APPD FOR CONFORM WITH DESIGN CRIT — APPD — DESCRIPTION — REV NO — COMMENT PRT ISSUE NO 5 — CHECK PRT ISSUE NO — DRAWING STATUS 7-8-85

2-117

FROM SHEET 2 (C-1)

51.0 CANISTERS FROM PROCESSING

FROM SHEET 3 (E-5)

51.0 CANISTERS FROM STORAGE

51.0 LOAD CANISTERS INTO REPOSITORY OVERPACK

52.0 WELD REPOSITORY OVERPACK

53.0 DECON REPOS. O.P.

53.0 SWIPE

SWIPE OK ? — NO

YES

RAILCAR

FROM SHEET 1 (D-6) RO

46.0 LOAD REPOSITORY OVERPACK ONTO CASK CART

48.0 MOVE CASK CART INTO SHIPPING LOAD-OUT ROOM

50.0 LIFT REPOSITORY OVERPACK INTO CELL AND PLACE INTO WELD PIT

50.0 MOVE CASK CART TO RECEIVING AND INSPECTION AREA AND PREPARE FOR SCFRO

88.0 BRIDGE CRANE WITH OVERPACK LIFTING YOKE

54.0 PLACE REPOSITORY OVERPACK INTO SCFRO

55.0 MOVE CASK CART WITH CASK AND OVERPACK INTO CASK HANDLING & DECON. ROOM

62.0 INSPECT RAIL CAR AND PREPARE FOR RELEASE FROM FACILITY

62.0 MOVE RAIL CAR TO RAIL CAR PARKING AREA

TO D-1

56.0 SEAL CASK AND DECONTAMINATE FOR SHIPMENT

56.0 SWIPE

SWIPE OK ? — NO

YES

57.0 MOVE CASK CART INTO RECEIVING AND INSPECTION AREA

RAILCAR

63.0 MOVE SCFRO MOUNTED ON RAIL CAR INTO RECEIVING AND INSPECTION AREA

64.0 LOAD SCFRO ONTO CASK CART

65.0 MOVE CASK CART INTO SHIPPING LOADOUT ROOM

SCFRO SHEET 1 (C-7)

SPENT FUEL & HIGH LEVEL WASTE

YES

RAIL CAR NEEDED FOR OUTGOING SHIPMENT ?

FROM E-10

NO

58.0 TRANSFER SCFRO TO RAIL CAR

59.0 INSPECT CASK AND PREPARE FOR RELEASE FROM FACILITY

60.0 RELEASE FROM FACILITY

SEE NOTE 1

W

RMP

91.0 RELEASE FULL SHIPPING CASK WITH REPOSITORY OVERPACK OR DRUMS THRU INSPECTION GATEHOUSE

61.0 BRIDGE CRANE WITH SHIPPING CASK LIFTING YOKE

75.0 LOAD DRUMS INTO SHIPPING CASK

76.0 MOVE CASK CART WITH DRUMS INTO CASK HANDLING & DECONTAMINATION ROOM

77.0 SEAL CASK AND DECONTAMINATE FOR SHIPMENT

78.0 CONTAMINATION SURVEY

SURVEY RESULTS SATISFACTORY ? — NO

YES

79.0 MOVE CASK AND CART TO RECEIVING & INSPECTION AREA

80.0 TRANSFER CASK TO TRANSPORT VEHICLE

CASK CART

81.0 INSPECT CASK AND PREPARE FOR RELEASE FROM FACILITY

FROM SHEET 2 (D-4)

71.0 DRUMS FROM HAW/ RHTRU PROCESSING

72.0 MOVE SHIPPING CASK INTO RECEIVING & INSPECTION AREA.

73.0 LOAD SHIPPING CASK ONTO CASK CART

74.0 MOVE CASK CART INTO CANYON CELL SHIPPING LOADOUT ROOM

HAW & RHTRU

CONCEPTUAL DESIGN

FACILITY DISCHARGE PROCESSING

REFERENCE DRAWINGS

NEXT USED ON

REVISIONS

DRAWING STATUS 7-9-85

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
MATERIAL HANDLING

LEVEL I MATERIAL FLOW DIAGRAM

SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
BLDG NO 77A-200
DWG NO H-3-56703
SHEET NO 4
REV NO 10

2-118

(5) TRANSPORTABLE METAL CASK SF/HLW/RHTRU CASKS, CHTRU, RHTRU CONTAINERS, SCFRO ENTER THRU INSPECTION GATE HOUSE BY RAIL OR TRUCK 1.1

(B) MOVE CASK/CONTAINER AND TRANSPORT VEHICLE TO PROTECTED AREA GATEHOUSE FOR CURSORY INSP 1.2

REVIEW BILL OF LADING TO DETERMINE CONTENTS OF CASKS/CONTAINERS 1.3

METAL CASK SPENT FUEL/HLW/RHTRU, SCFRO AND VEHICLE

SURVEY CASK AND TRANSPORT VEHICLE FOR RADIATION AND CONTAMINATION INSPECT FOR DAMAGE 1.4

1.6 DETERMINE PROBLEM DEVELOP PLAN & PROCEDURES, RESOLVE PROBLEM

ARE INSPECTION RESULTS & CASK CONTENTS ACCEPTABLE ?

NO → 1.5 MOVE CASK/CONTAINER AND VEHICLE TO OFF-NORMAL SHIPMENT STORAGE AREA FOR SPECIAL HANDLING

OUTSIDE R&H FACILITY

YES

MOVE CASK, SCFRO, AND APPROPRIATE VEHICLES TO INCOMING AIR CONTROL VESTIBULE 2.1

REMOVE ROAD DIRT FROM OVERPACKS CASKS & VEHICLES IF NECESSARY 2.2

SEE NOTE 1 (I) RMP ↕ W

SF/HLW/RHTRU/ TRANSPORTABLE METAL CASK, SCFRO

SF/HLW/RHTRU/SCFRO

MOVE CASK & VEHICLE TO RECEIVING, INSPECTION AND SHIPPING AREA 3.1

TRANSPORTABLE METAL STORAGE CASK (G) (SEE DWG H-3-56703 SH. 9 ZONE E-13)

REMOVE PERSONNEL BARRIERS FROM VEHICLE 3.2

REMOVE IMPACT LIMITERS AND CASK SHIPPING RESTRAINTS 3.3

PERFORM CONTAMINATION AND RADIATION SURVEY OF CASK EXTERIOR 3.4

3.4.1 DETERMINE PROBLEM DEVELOP PLAN & PROCEDURES RESOLVE PROBLEM

NO ← ARE CONTAMINATION SURVEY RESULTS OF CASK ACCEPTABLE ?

YES

REMOVE CASK FROM TRANSPORT VEHICLE 3.5

SF/HLW/RHTRU

(E-13 SHEET 8) (J) SCFRO

(D) (F-2 THIS SHT) TRANSPORT VEHICLE

(4) CASK CART (A) (B-6, THIS SHEET) (B-4, SHEET 7) (D-2, SHEET 8)

PLACE CASK ON CASK CART AND INSTALL RESTRAINTS 3.6

MOVE TO CASK HANDLING AND DECON ROOM 4.1

REMOVE OUTER CASK LID (IF NECESSARY) 4.2

OBTAIN GAS SAMPLE FROM CASK INTERIOR - CHECK CASK INTERNAL PRESSURE - VENT AND PURGE IF REQ'D. TO CONTROLLED VENT SYS 4.3

LOOSEN FASTENERS ON INNER CASK COVER INSTALL CASK CONTAMINATION BARRIER ADAPTER 4.4

POSITION CASK FOR REMOVAL OF SPENT FUEL HLW/RHTRU IN CASK UNLOADING ROOM 5.1

ENGAGE CASK CONTAMINATION BARRIER 5.2

REMOVE SHIELD PLUGS FROM PROCESS CELL ENTRY PORT 5.3

REMOVE CASK INNER COVER 5.4

CONFIRM CASK CONTENTS 5.5

REMOVE CONTENTS OF CASK 5.6

CASK (B) ← SF/HLW/RHTRU (F-4 THIS SHT)

ROUTE WASTE FORM

HLW/RHTRU → 6.1 MOVE HLW/RHTRU TO IN-PROCESS LAG STORAGE → 7.0 MOVE TO INSPECTION STATION → (F) (SEE DWG H-3-56703 SH 6 ZONE C-13)

SF

IS SPENT FUEL PRECONSOLIDATED ?

NO → CONSOLIDATE ? → YES

YES → MOVE PRECONSOLIDATED FUEL ROD CANISTER TO IN-PROCESS LAG STORAGE 6.2

NO → 9.1 PLACE FUEL ASSEMBLY ON TRANSFER UPENDER

(A-7) (C)

9.2 LOAD FUEL ASSEMBLY INTO STORAGE CANISTER

IS OVERPACK REQUIRED ?

YES → OVERPACK (A-7) (C) → 10.1 PLACE CONSOLIDATED FUEL ROD CANISTER ON TRANSFER UPENDER → 10.2 LOAD CONSOLIDATED FUEL ROD CANISTER IN OVERPACK CANISTER

NO → (I) (SEE DWG H-3-56703 SHT 6, ZONE G-13)

(E) (SEE DWG H-3-56703 SHT 6 ZONE F-13)

IS DISASSEMBLY STATION AVAILABLE ?

NO → 6.3 MOVE SPENT FUEL TO IN-PROCESS LAG STORAGE

YES → MOVE SPENT FUEL ASSEMBLIES TO DISASSEMBLY STATION 8.1

REMOVE FUEL ASSEMBLY NOZZLES 8.2

REMOVE FUEL RODS 8.3

HAW/RTHRU (H) (SEE DWG H-3-56703, SHT 6 ZONE B-8)

CONSOLIDATE FUEL RODS 8.4

(C) (A-7) STORAGE CANISTERS

LOAD CONSOLIDATED FUEL RODS INTO STORAGE CANISTER 8.5

(THIS SHT A-11) (SHT 6 B-12) (SH 7 E-12) (SH 8 E-12)

CASK CART (A)

21.1 PREPARE CASK CART TO RECEIVE CASK

INSTALL IMPACT LIMITERS & CASK SHIPPING RESTRAINTS 20.2

INSTALL PERSONNEL BARRIERS ON TRANSPORT VEHICLE 20.3

MOVE CASK AND TRANSPORT VEHICLE TO DISPATCH AREA 20.4

(W) (I) RMP SEE NOTE 1

EMPTY CASK/TRANSPORT VEHICLE EXIT THROUGH SECURITY GATE 20.5

(G-8) (B) CASK

INSPECT CASK INTERIOR TO ASSURE THAT ALL WASTE HAS BEEN REMOVED 19.1

REPLACE INNER CASK COVER (LID) 19.2

REPLACE SHIELD ON PROCESS CELL ENTRY PORT 19.3

DISENGAGE CONTAMINATION BARRIER 19.4

MOVE CASK TO HANDLING PREP AND DECON ROOM 19.5

REMOVE CASK CONTAMINATION BARRIER ADAPTER, REPLACE OUTER CASK COVER, IF REQ'D 19.6

SURVEY CASK FOR EXTERNAL CONTAMINATION 19.7

19.7.1 DECONTAMINATE CASK OUTER SURFACE ← NO ← ARE SURVEY RESULTS ACCEPTABLE ?

YES

MOVE CASK TO CASK RECEIVING, INSPECTION AND SHIPPING AREA 19.8

REMOVE CASK FROM CART AND LOAD ON TRANSPORT VEHICLE 20.1

(L) (SHT 8 C-4)

(D-10, SHEET 8) (B-9, SHEET 9) (E-10 SHEET 7) (A-10, THIS SHEET)

(D) TRANSPORT VEHICLE

18.1 PERFORM CONTAMINATION SURVEY OF TRANSPORTATION VEHICLE

ARE SURVEY RESULTS ACCEPTABLE ?

NO → 18.1.1 DECONTAMINATE VEHICLE

YES

18.2 INSPECT VEHICLE FOR DAMAGE

18.2.2 MOVE REPLACEMENT TRANSPORT VEHICLE TO INSPECTION AREA

IS VEHICLE SATISFACTORY FOR SERVICE ?

NO → REMOVE TRANSPORT VEHICLE FOR REPAIR OR REPLACEMENT (BY OTHERS) 18.2.1

YES

IS VEHICLE NEEDED FOR OUT-GOING SHIPMENT ?

NO → (W) (1) SEE NOTE 1 RMP → 20.6 VEHICLE EXIT THROUGH SECURITY GATE

YES

CONCEPTUAL DESIGN

22.1 RECEIVE STORAGE CANISTERS, OVERPACKS, DRUMS, LIDS, REPOSITORY OVERPACK

RECEIVING, INSPECTION AND SHIPPING

REJECT → 22.1.1 REWORK STORAGE CANISTERS OR OVERPACKS

ACCEPT → STORE CANISTERS, OVERPACKS, REPOSITORY OVER PACKS, CASES AND DRUMS IN WAREHOUSE 22.2

REJECT ← REWORK INSPECTION → ACCEPT

SCRAP 22.1.2

SEE NOTE 1 (I) RMP ↕ W

TRANSFER STORAGE CANISTERS, CAGES, OVERPACKS OR REPOSITORY OVERPACK TO PROCESS CELLS 22.3

REPOSITORY OVERPACK WITH TRANSPORTER (SHT 7, E-13) (K)

DRUMS, CAGES STORAGE CANISTERS OR OVERPACKS (E-7, D-5, OR D-7 THIS SHT, A-8, C-8, C-9, D-6 SHT 6) (C)

JQP # NONE

APPD FOR CONFORMANCE WITH 5000-108 CRITERIA			
BY			7/1/85
QA			
			7/1/85
			7/1/85
			7/1/85
			7/1/85
			7/1/85

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MATERIAL HANDLING
LEVEL II MATERIAL FLOW DIAGRAM

SCALE	NONE	BLDG NO	77A-200
CLASSIFIED BY	NOT REQD	ISSUED NO	700 T
CLASSIFICATION	NONE	DRWG NO	H-3-56703
		SHEET NO	5
		TOTAL SHTS INCL ADDL	10

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

RECORD PWA	BY-DATE	PDR	BY-DATE	PDR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH 5000-108 CRIT		APPD				

REVISIONS
COMMENT PRT ISSUE NO 7 DATE CHECK PRT ISSUE NO DATE LAST REV
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84-1990-048 (5/83)

U.S. GOVERNMENT PRINTING OFFICE: 1983 546-016

2119

SH5 ZONE (C-8) (I)

10.1 PLACE CONSOLIDATED FUEL ROD CANISTER ON TRANSFER UPENDER

13.1 DECONTAMINATE CANISTER

13.3 PERFORM CONTAMINATION SURVEY OF CANISTER

ARE SURVEY RESULTS ACCEPTABLE ? — NO / YES

THIS SHEET (D5 & D8) (SEE DRAWING H-3-56703 SH5 ZONE C-7) (E)

12.0 MOVE CANISTER TO WELD STATION

12.1 EVACUATE CANISTER

12.2 BACK FILL CANISTER WITH INERT GAS

12.3 WELD COVER TO SF CANISTER

13.1 DECONTAMINATE CANISTER

13.2 LEAK TEST CANISTER

ARE INSPECTION RESULTS ACCEPTABLE ? — NO / YES

13.3 PERFORM DECONTAMINATION SURVEY OF CANISTER

13.3.1 DECONTAMINATE CANISTER

ARE SURVEY RESULTS ACCEPTABLE ? — NO / YES

13.4 PERFORM ULTRASONIC WELD INSPECTION

ARE INSPECTION RESULTS ACCEPTABLE ? — NO / YES

13.5 REMOVE DEFECTIVE WELD — YES

ARE DEFECTS REPAIRABLE ? — NO

(E) (F-13 THIS SHT)

13.6 PLACE DEFECTIVE CANISTER IN OVERPACK

(C) OVERPACK (SEE DWG. H-3-56703 SHT 5 ZONE A-7)

(E) (F-13 THIS SHT)

MOVE TO IN-BUILDING LAG STORAGE ? — YES / NO

(F) (SEE DWG. H-3-56703 SHT5, ZONE G-5)

7.1 VISUAL INSPECTION FOR PHYSICAL DAMAGE

ARE INSPECTION RESULTS ACCEPTABLE ? — NO / YES

7.3 PLACE DEFECTIVE HLW/RHTRU CANISTER IN OVERPACK

7.4 MOVE OVERPACK TO WELD STATION

7.5 WELD HLW/RHTRU OVERPACK

7.6 INSPECT OVERPACK WELD

7.5.1 REPAIR OVERPACK WELD — NO

IS WELD ACCEPTABLE ? — YES

(C) OVERPACK (SEE DWG. H-3-56703 SHT 5 ZONE A-7)

13.7 PERFORM CONTAMINATION SURVEY

ARE SURVEY RESULTS ACCEPTABLE ? — YES / NO

13.7.1 DECON

TO STEP 2.0 DWG H-3-56704 SH.2 FOR CONCRETE CASK STORAGE OR DWG. H-3-56705 SH. 2 FOR DRYWELL STORAGE

MOVE TO IN-BUILDING LAG STORAGE ? — NO / YES

90.1 TO IN-BUILDING LAG STORAGE VIA CELL CRANE

DRUM SHEET 5 (A-7) (C)

SHEET 5 (D-5) (H)

11.1 TRANSFER NON-FUEL COMPONENTS TO VOLUME REDUCTION STATION

11.2 LOAD VOLUME REDUCED NON-FUEL INTO STORAGE DRUM & SECURE LID ON DRUM.

11.3 TRANSFER STORAGE DRUM TO DECONTAMINATION CELL

11.4 DECONTAMINATE DRUM

11.5 PERFORM CONTAMINATION SURVEY

ARE SURVEY RESULTS SATISFACTORY? — YES / NO

7.0.1 MOVE DRUM PALLET INTO DECONTAMINATION CELL

7.0.2 PLACE DRUM ON DRUM PALLET

IS PALLET FULL? — NO / YES

7.1.1 MOVE PALLET WITH 5 DRUMS TO CANYON CELL

7.1.3 TRANSFER DRUMS FROM PALLET TO CAGE AND BOLT CAGE SHUT

PALLET

DRUM CAGE (C) SHEET 5 (A-7)

SHIP CAGE OFF SITE ? — YES / NO

7.5.1 PLACE CAGE INTO SHIPPING CASK

7.9.1 REPLACE SHIPPING CASK INNER COVER & INSTALL BOLTS

(SH.8 D-12) (M)

7.2.1 MOVE EMPTY SHIPPING CASK TO DISCHARGE PORT LOADING AREA

(A) SHEET 5 (B-6) SHEET 7 (B-4) SHEET 8 (D-2)

7.3.1 PLACE CASK ON CART

7.4.1 MOVE CASK INTO CASK HANDLING AREA

7.4.2 OPEN CANYON CELL DISCHARGE PORT & REMOVE CASK INNER COVER

CONCEPTUAL DESIGN

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
MATERIAL HANDLING
LEVEL II MATERIAL FLOW DIAGRAM

SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
W.O. NO 77A-200
DRAWING NO H-3-56703
REV 6
SHEET NO 10

REFERENCE DRAWINGS
NEXT USED ON

REVISIONS
COMMENT PRT ISSUE NO 6 DATE CHECK PRT ISSUE NO DATE
DRAWING STATUS 7-10-85

APPD FOR CONFORMANCE WITH DESIGN CRITERIA 7/9/85
APPD FOR CONFORM WITH DESIGN CRIT 7/9/85
APPD 7/9/85
CHECKED 7/9/85
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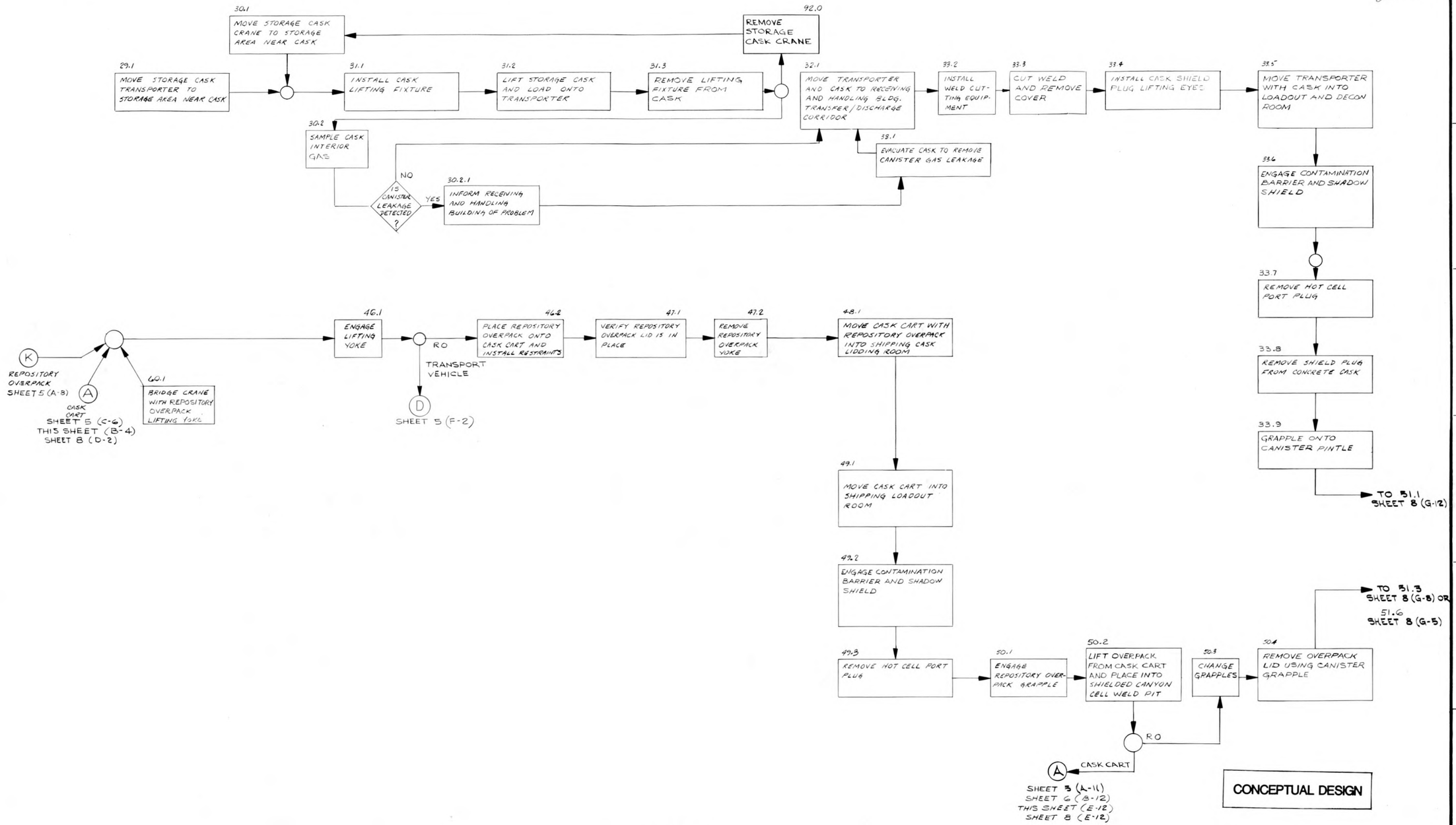
2-120



LEVEL II

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY PNL	7/31/85	U. S. Department Of Energy, Richland Operations Office
PNL Q A		PACIFIC NORTHWEST LABORATORY, OPERATED BY BATTELLE MEMORIAL INSTITUTE
APPD	7/31/85	THE RALPH M. PARSONS COMPANY of DELAWARE
DESIGN	7/31/85	Westinghouse Electric Corp. — Golder Associates
CHECKED	6/6/85	MRS FACILITY, RECEIVING & HANDLING BUILDING
DRAWN	7/31/85	MATERIAL HANDLING
SCALE	NONE	LEVEL II MATERIAL FLOW DIAGRAM
CLASSIFIED BY	NOT REQD	BLDG NO 77A-200 — INDEX NO 7001
CLASSIFICATION	NONE	DWG NO H-3-56703 — SHEET NO 7 — TOTAL SHEETS 10

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

MICRO FICHE	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH DESIGN CRIT		APPD			REVISIONS	
	COMMENT PRT ISSUE NO 6		DATE	CHECK PRT ISSUE NO		DATE	LAST REV
	DRAWING STATUS 7-8-85						

84-1980-048(11-83)

2-121

FROM 33.9 (SHEET 7 D-1)

51.1 LIFT CANISTER OUT OF STORAGE CASK

51.2 SWIPE CANISTER UPON REMOVAL

ARE RESULTS ACCEPTABLE — YES / NO

51.3 DECONTAMINATE CANISTERS

57.4 POSITION CANISTER OVER REPOSITORY OVERPACK

FROM 50.4 (SHEET 7 C-1)

51.5 SET CANISTER INTO REPOSITORY OVERPACK

IS REPOSITORY OVERPACK FULL — NO / YES

51.8 SET CANISTER INTO REPOSITORY OVERPACK

51.7 POSITION CANISTER OVER REPOSITORY OVERPACK.

FROM 50.4 (SHEET 7 C-1)

51.6 LIFT CANISTER OUT OF IN-BUILDING LAG STORAGE

IS REPOSITORY OVERPACK FULL — NO / YES

52.1 SET UP WELDING EQUIPMENT

52.2 REPLACE OVERPACK LID

52.3 WELD LID IN PLACE

52.4 INSPECT WELD

IS WELD ACCEPTABLE? — NO / YES

52.4.1 REPAIR WELD

53.1 DECON REPOSITORY OVERPACK

53.2 SWIPE RO — SWIPE OK — NO / YES

54.1 ENGAGE OVERPACK GRAPPLE

54.2 TRANSFER OVERPACK FROM WELD PIT INTO SCFRO

54.3 DISCONNECT AND RETRACT OVERPACK GRAPPLE

54.4 SCFRO INNER COVER AND COVER BOLTS

(N) (THIS SHEET C-11)

SHEET 5 (A-10) (J) SCFRO

(A) CASK CART

SHEET 5 (B-6)
SHEET 7 (B-4)
SHEET 8 (D-2)

62.0 BRIDGE CRANE WITH SCFRO LIFTING YOKE

63.0 ENGAGE LIFTING YOKE

64.0 PLACE SCFRO ONTO CASK CART AND INSTALL RESTRAINTS

SCFRO

TRANSPORT VEHICLE

(D) SHEET 5 (F-2)

64.1 VERIFY THAT SCFRO LID(S) IS IN PLACE

64.2 REMOVE LIFTING YOKE

65.0 MOVE CASK CART WITH SCFRO INTO CASK HANDLING ROOM

65.1 INSTALL CONTAMINATION BARRIER ADAPTER

65.2 MOVE CASK CART WITH SCFRO INTO LOADOUT & DECON ROOM

65.3 ENGAGE CONTAMINATION BARRIER SHADOW SHIELD

66.0 OPEN HOT CELL PORT

67.0 SET SCFRO COVER(S) ON FLOOR OF HOT CELL

SCFRO

68.0 HOT CELL POWER MAST

68.0 HOT CELL POWER MAST

(M) (SHEET 6 A-13)

(N) (THIS SHEET E-2)

55.0 REPLACE SHIELDED CANYON CELL PORT PLUG

55.1 OPEN SHIPPING LOADOUT ROOM DOOR

55.2 DISENGAGE CONTAMINATION BARRIER

55.3 MOVE CASK CART TO CASK HANDLING AREA, FOR REMOVAL OF CONTAMINATION BARRIER ADAPTER AND PREPARATION FOR SHIPMENT

56.0 SURVEY CASK FOR CONTAMINATION

ARE SURVEY RESULTS ACCEPTABLE? — YES / NO

56.1 DECONTAMINATE CASK OUTER SURFACE

57.0 MOVE CASK CART WITH REPOSITORY SHIPPING CASK TO RECEIVING, INSPECTION AND SHIPPING AREA

FROM B-2 SHEET 5 RAIL CAR

(L)

60.1 BRIDGE CRANE WITH SHIPPING CASK LIFTING YOKE

58.1 REMOVE SHIPPING CASK FROM CASK CART AND LOAD ONTO TRANSPORT VEHICLE

(A) CASK CART
SHEET 5 (A-11)
SHEET 6 (B-12)
SHEET 7 (E-12)
SHEET 8 (E-12)

58.2 INSTALL IMPACT LIMITERS & CASK SHIPPING RESTRAINTS

58.3 INSTALL PERSONNEL BARRIERS ON RAIL CAR

59.0 MOVE SHIPPING CASK MOUNTED ON RAIL CAR TO DISPATCH AREA THRU OUTGOING AIR CONTROL VESTIBULE

91.0 REVIEW DISCH&GE PAPERS AND TRANSFER SHIPPING CASK THROUGH SECURITY GATE

W RMP

(I) SEE NOTE 1

LEVEL II

CONCEPTUAL DESIGN

DWG NO	REV NO	DRAWING TITLE OR INDEX NO	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
			MICRO FICHE	APPD FOR CONFORM WITH DESIGN CRIT		APPD	REVISIONS		

REFERENCE DRAWINGS — COMMENT PRT ISSUE NO 7 — DATE — CHECK PRT ISSUE NO — DATE — LAST REV

NEXT USED ON — DRAWING STATUS 7-9-85

APPD FOR CONFORMANCE WITH DESIGN CRITERIA — BY — DATE 7/31/85 — FOR PNL

Q A

APPD — DATE 7/31/85

DRAWN — DATE 7/31/85

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SCALE NONE

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U. S. Department Of Energy
Richland Operations Office
PACIFIC NORTHWEST LABORATORY
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Westinghouse Electric Corp. — Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING
MATERIAL HANDLING
LEVEL II MATERIAL FLOW DIAGRAM

BLDG NO 77A-200 — ISSUE NO 7001

DWG NO H-3-56703 — SHEET NO 8 — TOTAL SHEETS 10

2

2-122

(SEE DWG H-3-56703 SH-5 ZONE C-13)

G TRANSPORTABLE METAL CASK

23.1 MOVE CASK TO RECEIVING, INSPECTION AND SHIPPING AREA

23.2 REMOVE SHIPPING CASK HOLDDOWNS

23.2 PERFORM CONTAMINATION SURVEY

ARE RESULTS ACCEPTABLE ?

YES

NO

23.2.1 DECONTAMINATE CASK

23.3 PREPARE FOR TRANSFER TO TRANSPORTER

P (D-3 THIS SHEET)

27.1 MOVE CASK TRANSPORTER TO RECEIVING, INSPECTION AND SHIPPING AREA

82.0 BRIDGE CRANE WITH TRANSPORTABLE METAL STORAGE CASK LIFTING YOKE

24.1 ENGAGE LIFTING YOKE

24.2 LOAD CASK ONTO TRANSPORTER

24.3 DISENGAGE LIFTING YOKE

24.4 ENGAGE CASK HOLD DOWN

27.2 RETURN TRANSPORTER TO TRANSPORTER PARKING AREA

P (F-3 THIS SHEET)

25.1 MOVE CASK TO CASK STORAGE AREA

26.1 RELEASE CASK HOLD-DOWN AND PREPARE FOR TRANSFER TO STORAGE PAD

26.2 LIFT CASK FROM TRANSPORTER AND PLACE ON STORAGE PAD

26.3 COMPLETE STORAGE PREPARATION

28.1 MOVE MOBILE CRANE TO CASK STORAGE PAD

28.2 PARK, MOBILE CRANE

D F-2 SHEET 5

CONCEPTUAL DESIGN

JQP # NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA	7/21/85
BY	
PQA	
QA	
	7/21/85
	7/21/85
	7/21/85
	7/21/85
	7/21/85

U. S. Department Of Energy
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PACIFIC NORTHWEST LABORATORY
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Westinghouse Electric Corp. Golder Associates

MRS FACILITY
RECEIVING & HANDLING BUILDING
MATERIAL HANDLING
LEVEL II MATERIAL FLOW DIAGRAM

SCALE	NONE
DESIGNED BY	NOT REQD
CLASSIFICATION	NONE
SYSTEM NO	77A-200
DRAWING NO	H-3-56703
SHEET NO	9
REV NO	10

REFERENCE DRAWINGS
NEXT USED ON

REVISIONS
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96-1960-046 (3/83)

U.S. GOVERNMENT PRINTING OFFICE: 1983 656-610

2-123

RECEIVING 1.0

RHTRU, CHTRU CONTAINERS

SF, HLW, RHTRU CASKS, SCFRO RO

OFF-NORMAL SHIPMENTS

SHIPPING 60.0

FULL SCFRO AND VEHICLE

PERFORM INSPECTION OF CASK/TRANSPORT VEHICLE AND WASHDOWN 81.0 82.0 2.0 3

CASK AND TRANSPORT VEHICLE

FULL SCFRO AND VEHICLE

RMP ◄► W

1

CASK RECEIVING, INSPECTION AND SHIPPING AREA 57.0, 58.0, 59.0, 61.0 62.0, 64.0, 80.0, 23.0, 3.0, 19.0

MAJOR EQUIPMENT REQUIREMENTS
- 150 TON CASK CRANE
- DEDICATED CASK LIFTING FIXTURES
- MOBILE CRANE TO LIFT CASK SHIPPING GEAR
- RAIL CAR/TRAILER PULLER

CASK/OR SCFRO&RO

CASK CART

SHIPPING CASK TRANSFER CART 47.0, 46.0, 27.0, 21.0

MAJOR EQUIPMENT REQUIREMENTS
- DEDICATED SHIPPING CASK TRANSFER CART WITH SELF CONTAINED MOTIVE POWER SYSTEM
- CASK CART REMOTE CONTROL SYSTEM
- CASK ADAPTERS
- CONTAMINATION BARRIER ADAPTERS

CASK TRANSPORT VEHICLE INSPECTION AND REPAIR 61.0, 18.0

MAJOR EQUIPMENT REQUIREMENTS
- STANDARD RAIL CAR/TRAILER MAINTENANCE EQUIPMENT
- CLEANING AND DECONTAMINATION EQUIPMENT
- RAIL CAR/TRAILER POWER TOW

TRANSPORT VEHICLE

CASK OR SCFRO&RO/CASK CART

CASK CART W/EMPTY CASK OR CASK CART W/FULL SCFRO

EMPTY CASK

EMPTY CASK AND TRANSPORT VEHICLE EXIT 20.0

CASK HANDLING & DECON ROOM OR SHIPPING CASK LIDDING ROOM 78, 77, 76.0, 55.0, 65.0, 41.0, 4.0, 19.0

MAJOR EQUIPMENT REQUIREMENTS
- MISCELLANEOUS TOOLS
- CASK GAS SAMPLING AND VENTING SYSTEM
- MONORAIL PLATFORM
- MONORAIL
- CASK DECONTAMINATION EQUIPMENT
- CASK OUTER COVER REMOVAL EQUIPMENT

CASK OR SCFRO&RO/CASK CART

CASK CART W/EMPTY CASK OR CASK CART W/SHIPPING CASK & FULL REPOSITORY OVERPACK

CASK UNLOADING ROOM OR SHIPPING LOADOUT ROOM 75.0, 55.0, 49.0, 5.0

MAJOR EQUIPMENT REQUIREMENTS
- CASK CART POSITIONING AND LOCKING DEVICES
- CASK SEISMIC RESTRAINT SYSTEM
- CONTAMINATION BARRIERS
- REMOTE VIEWING SYSTEM

SPENT FUEL, HLW, RHTRU, SCFRO AND RO

SCFRO WITH FULL RO'S

PROCESS CELL OR CANYON CELL

6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 33.0, 50.0, 51.0, 52.0, 53.0, 54.0 70.0, 71.0, 72.0, 73.0, 74.0, 90.0, 100.0

SPENT FUEL PROCESSING

MAJOR EQUIPMENT REQUIREMENTS
- 20 TON LIFTING DEVICE WITH DEDICATED MANIPULATOR
- FUEL ASSEMBLY UPENDER
- FUEL DISASSEMBLY EQUIPMENT
- FUEL ROD CONSOLIDATION EQUIPMENT
- NON-FUEL HARDWARE VOLUME REDUCTION EQUIPMENT
- PORT PLUGS
- CONTAMINATION CONTROL EQUIPMENT
- EQUIPMENT HATCHES
- CASK UNLOADING PORT COVERS

CELL 1, 2, 3 AND 4

HIGH LEVEL WASTE REMOTE HANDLED TRANSURANIC PROCESSING REPOSITORY OVERPACK PROCESSING

MAJOR EQUIPMENT REQUIREMENTS
- 35 TON LIFTING DEVICE WITH DEDICATED MANIPULATOR (2 REQUIRED PER CELL)
- EMPTY OVERPACK CONTAINER TRANSFER AND STORAGE SYSTEM
- REPOSITORY OVERPACK WELDING STATION WITH WELD-PIT AND WELDING HEAD (2 REQ'D)

CELL 5 AND 6

CANISTER LOADING

MAJOR EQUIPMENT REQUIREMENTS
- EMPTY CANISTER TRANSFER EQUIPMENT
- LIFTING DEVICES WITH DEDICATED MANIPULATOR

CELL 1, 2, 3 AND 4

CANISTER WELDING, CUTTING & LEAK TESTING

MAJOR EQUIPMENT REQUIREMENTS

A WELDING & CUTTING
- WELDING CHAMBER WITH REMOVABLE LID
- CUTTING CHAMBER WITH REMOVABLE LID
- VACUUM SYSTEM
- AUTOMATIC, REMOTELY CONTROLLED WELDING EQUIPMENT
- AUTOMATIC, REMOTELY CONTROLLED CANISTER CUTTING EQUIPMENT
- TRACE GAS SUPPLY SYSTEM
- WELDING COVER GAS SYSTEM
- CONTROLLED VOLUME CHAMBER WITH REMOVABLE LID

B INSPECTION
- TRACE GAS SAMPLING AND TESTING SYSTEM
- ULTRASONIC WELD INSPECTION EQUIPMENT

CELL 5 & 6

CLEANING/DECONTAMINATION

MAJOR EQUIPMENT REQUIREMENTS
- CONTROLLED VOLUME CHAMBER WITH LID
- SWIPE TRANSFER EQUIPMENT
- SOURCE OF CLEANING FLUIDS
- VACUUM DRYING SYSTEM
- MASTER/SLAVE MANIPULATORS

CELL 1, 2, 3, 4, 5 & 6

CANISTER OUTLOADING

MAJOR EQUIPMENT REQUIREMENTS
- SHIELD PLUG (MAINTENANCE & PORT)
- CONTAMINATION CONTROL SYSTEM
- LIFTING DEVICE FOR SHIELD PLUGS & CANISTERS

CELL 5 & 6

STORAGE CANISTERS, OVERPACKS, DRUMS & REPOSITORY OVERPACKS 22.0

MAJOR EQUIPMENT REQUIREMENTS
- LIFTING AND TRANSPORT EQUIPMENT
- TRANSFER AND LOADING SYSTEM
- SHIPPING CASK FOR REPOSITORY OVERPACK TRANSPORT VEHICLE

CONCRETE CASK, TRANSFER SHIELDS 17.0

TRANSPORTER 17.0

EXIT TO WASTE STORAGE 16.0

CONCEPTUAL DESIGN

JQP # NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA		7/31/85	U. S. Department Of Energy, Richland Operations Office
BY			PACIFIC NORTHWEST LABORATORY, OPERATED BY BATTELLE MEMORIAL INSTITUTE
FOR			THE RALPH M. PARSONS COMPANY of DELAWARE
QA			Westinghouse Electric Corp. / Golder Associates
APPD		7/31/85	MRS FACILITY, RECEIVING & HANDLING BUILDING
APPD		7/31/85	MATERIAL HANDLING
CHECKED		7/31/85	LEVEL III EQUIPMENT FLOW DIAGRAM
APPROVED		7/31/85	SCALE NONE
			CLASSIFIED BY NOT REQD
			CLASSIFICATION NONE
			BECHTEL JOB NO 77A-200
			DRAWING NO H-3-56703
			SHEET NO 10
			NO OF SHEETS 10

REFERENCE DRAWINGS

NEXT USED ON

REVISIONS

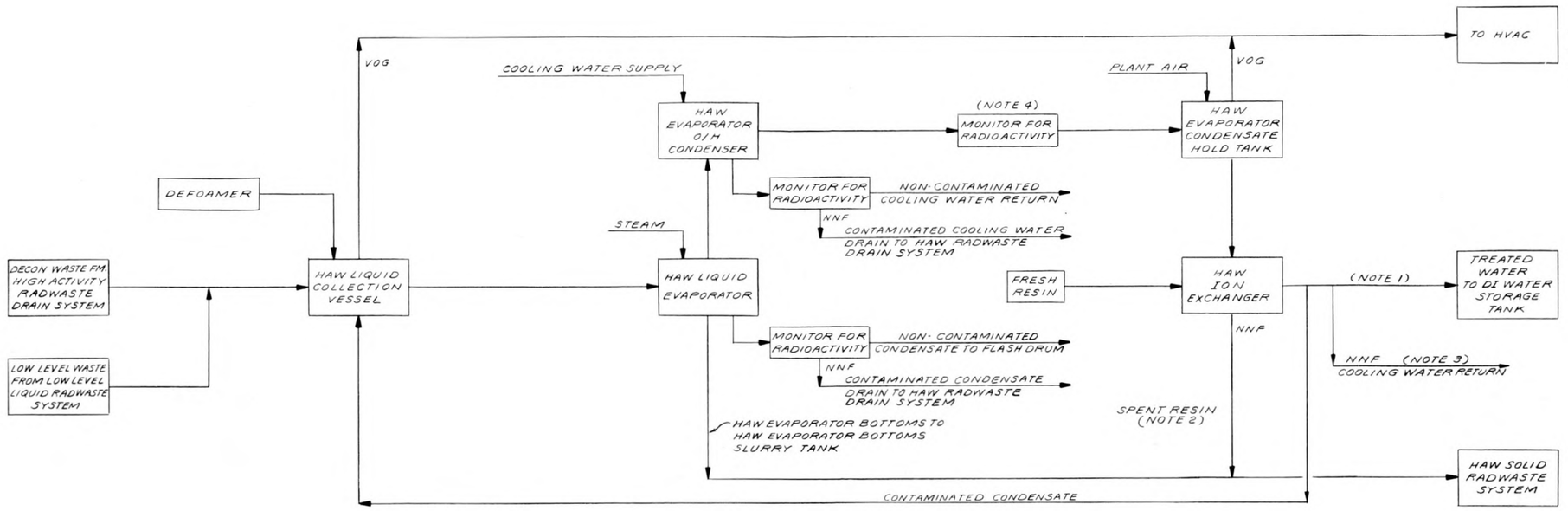
DRAWING STATUS 7-9-85

86-1090-048 (3/83)

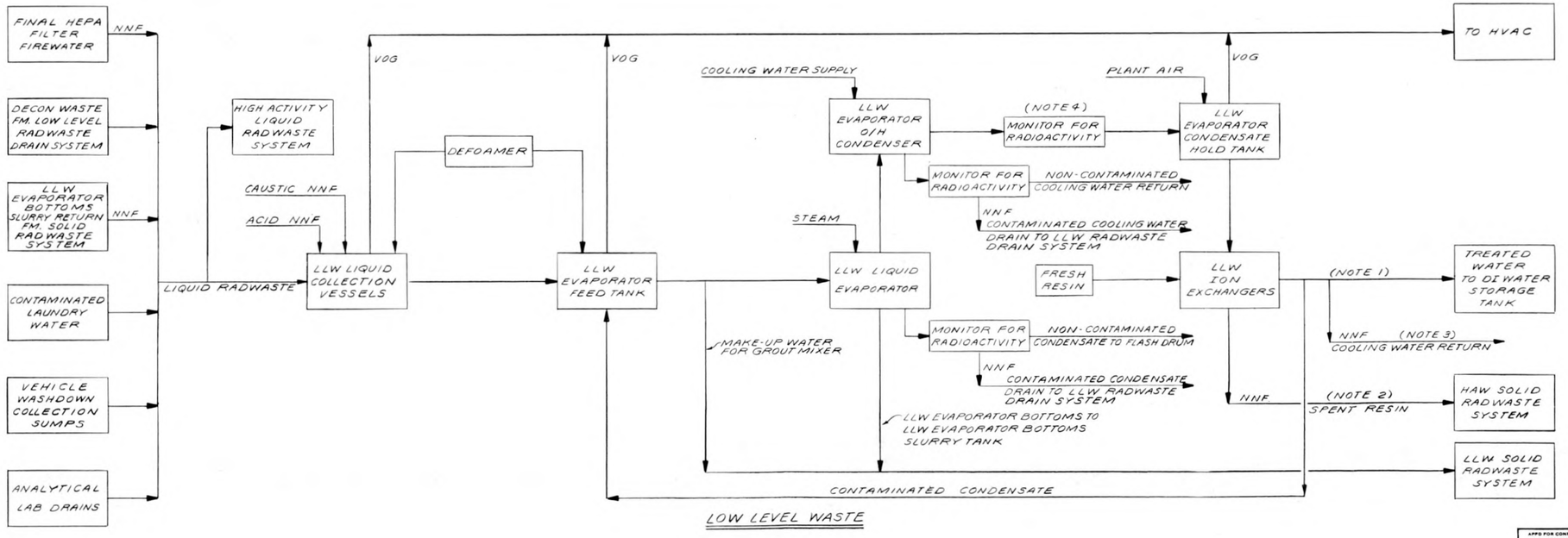
U.S. GOVERNMENT PRINTING OFFICE: 1983 651-816

2-124

NOTES:
1. CHECK FOR CONTAMINATION AND CONDUCTIVITY.
2. INTERMITTENT SPENT RESIN REMOVAL.
3. DIVERT IF LEAK IN O/H CONDENSER.
4. RADIOACTIVITY READING INDICATES PROBLEM WITH EVAPORATOR, SYSTEM SHOULD BE SHUTDOWN.



HIGH ACTIVITY WASTE



LOW LEVEL WASTE

ABBREVIATIONS

VOG — VESSEL OFF-GAS
NNF — NORMALLY NO FLOW
O/H — OVERHEAD
DI — DEIONIZED WATER
LLW — LOW LEVEL WASTE
HAW — HIGH SPECIFIC ACTIVITY WASTE THAT MAY OR MAY NOT CONTAIN SOME QUANTITY OF TRANSURANIC MATERIAL.
HVAC — HEATING, VENTILATION AND AIR CONDITIONING

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY		7/30/85	U. S. Department Of Energy, Richland Operations Office
FOR			PACIFIC NORTHWEST LABORATORY, OPERATED BY BATTELLE MEMORIAL INSTITUTE
Q A		7/30/85	THE RALPH M. PARSONS COMPANY of DELAWARE
APPD		7/30/85	Westinghouse Electric Corp. / Golder Associates
ENGR		7/30/85	MRS FACILITY, RECEIVING & HANDLING BUILDING
DPTE APPD		7/30/85	MECHANICAL PROCESS
CHECKED		7/29/85	LIQUID RADWASTE SYSTEM, HIGH ACTIVITY & LOW LEVEL, FLOW DIAGRAM
DRAWN		5-4-85	
SCALE	NONE		
CLASSIFIED BY	NOT REQD	DATE	BLDG NO 77A-200 / TASK OR WBS NO 7000
CLASSIFICATION	NONE		DWG NO H-3-56707 / SHEET NO 1 / REV NO 1

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

MICRO FW'S	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
	APPD FOR CONFORM WITH DESIGN CRIT		APPD			REVISIONS	

COMMENT PRT ISSUE NO	DATE	CHECK PRT ISSUE NO	DATE	LAST REV
DRAWING STATUS				

1-3-85

84-1980-046(11-83)
© DPO-1984-784-407

NOTES:

1. CHECK FOR EXTERIOR CONTAMINATION.

2-125

LLW/CHRTU COMBUSTIBLE WASTE
- FM, R & H BUILDING

COMBUSTIBLE WASTE COLLECTION STORAGE

DRUM FILL (CAGE)

VIBRATOR / SCISSOR LIFT

CONTAMINATED SLUDGE
- FREON DRY CLEANING
- VEHICLE WASHDOWN AREA
- SOLVENT EVAPORATOR

CEMENT

DRUM FILL

DRUM TUMBLER

LLW LIQUID RADWASTE SYSTEM

MAKE-UP LIQUID

EVAPORATOR BOTTOMS

LLW EVAPORATOR BOTTOMS SLURRY TANK

OFF-GAS TO HVAC

CEMENT
SAND

GROUT MIXER

LLW/CHTRU NON-COMBUSTIBLE WASTE
- FM, R & H BUILDING (EXCEPT HOT CELL)

NON-COMBUSTIBLE WASTE COLLECTION STORAGE

LLW/CHTRU FILTERS
- FM, R & H BUILDING

LLW/CHTRU HEPA AND PREFILTER STORAGE

OFF-GAS TO HVAC

FILTER COMPACTOR/ PACKAGING UNIT

LLW/CHTRU CONTAMINATED FILTERS
- FROM LAUNDRY SYSTEM

LLW/CHTRU INSPECTION STATION "A"

(NOTE 1)

NON-CONTAMINATED

DI WATER

LOW LEVEL SOLID WASTE DRUM DECON STATION

CONTAMINATED

DRAIN TO LLW RADWASTE DRAIN SYSTEM

NON-CONTAMINATED

LLW/CHTRU CURING STATION

LLW/CHTRU DRUM FILL

INSPECTION STATION "B"

DRUM INTERROGATOR

LOW LEVEL WASTE TO OFF-SITE DISPOSAL

CHTRU TO ON-SITE CHTRU STORAGE

REJECTS

OVERPACKING STATION

LLW SPENT RESIN

HAW LIQUID RADWASTE SYSTEM

HAW SPENT RESIN

COOLING WATER SUPPLY

HAW EVAPORATOR BOTTOMS SLURRY

SPENT RESIN SLURRY TANK

OFF-GAS TO HVAC

COOLING JACKET

OFF-GAS TO HVAC

HAW EVAPORATOR BOTTOMS SLURRY TANK

CEMENT

HAW DRUM FILL

HAW DRUMMING STATION TUMBLER

HAW INSPECTION STATION "C" (NOTE 1)

DI WATER

CONTAMINATED

HAW DRUM DECON STATION

NON-CONTAMINATED

DRAIN TO HAW RADWASTE DRAIN SYSTEM

HAW CURING STATION

DRUM STORAGE CAGE

TO ON-SITE STORAGE

LLW/CHTRU

MONITOR FOR RADIOACTIVITY

NON-CONTAMINATED COOLING WATER RETURN

NNF

CONTAMINATED COOLING WATER DRAIN TO HAW RADWASTE DRAIN SYSTEM

HAW NON-COMBUSTIBLE WASTE
- FROM HOT CELLS

DI WATER

EQUIPMENT DECON ROOM

HAW RADWASTE DRAIN

EQUIPMENT ROOM INSPECTION STATION

HAW

DI WATER

CONTAMINATED

HAW FILTER DRUM DECON STATION

DRAIN TO HAW RADWASTE DRAIN SYSTEM

HAW FILTERS FROM RECEIVING & HANDLING BUILDING

CONTAMINATED HAW HEPA FILTER COLLECTION STORAGE

OFF-GAS TO HVAC

HAW HEPA FILTER CUTTER / COMPACTOR

FILTER MEDIA

HAW DRUM FILL

HAW INSPECTION STATION "D" (NOTE 1)

NON-CONTAMINATED

FILTER FRAMES

ALLIGATOR SHEAR MACHINE

LINE LEGEND

- LLW EVAPORATOR BOTTOMS, MAKE-UP LIQUID, AND CONTAMINATED SLUDGE
- CONTAMINATED LLW/CHTRU HEPA FILTERS & PREFILTERS
- LLW/CHTRU NON-COMBUSTIBLE WASTE
- LLW/CHTRU COMBUSTIBLE WASTE
- FILTERS FROM LAUNDRY
- HAW EVAPORATOR BOTTOMS SLURRY AND SPENT RESINS FROM LLW/HAW LIQUID RADWASTE
- HAW NON-COMBUSTIBLES
- CONTAMINATED HAW FILTERS
- CONTAMINATED SLUDGE

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY / FOR	7/30/85	U. S. Department Of Energy, Richland Operations Office
Q A	7/30/85	PACIFIC NORTHWEST LABORATORY, OPERATED BY BATTELLE MEMORIAL INSTITUTE
APPD	7/30/85	THE RALPH M. PARSONS COMPANY of DELAWARE
DRAWN	7/30/85	Westinghouse Electric Corp. / Golder Associates
DPTE APPD	7/29/85	MRS FACILITY, RECEIVING & HANDLING BUILDING
CHECKED	7/29/85	MECHANICAL PROCESS
DRAWN	7/25/85	SOLID RADWASTE SYSTEM, HIGH ACTIVITY & LOW LEVEL, FLOW DIAGRAM
SCALE	NONE	
CLASSIFIED BY	NOT REQD	BLDG NO 77A-200; SERIES NO 7000
CLASSIFICATION	NONE	DWG NO H-3-56708; SHEET NO 1; TOTAL SHTS 1

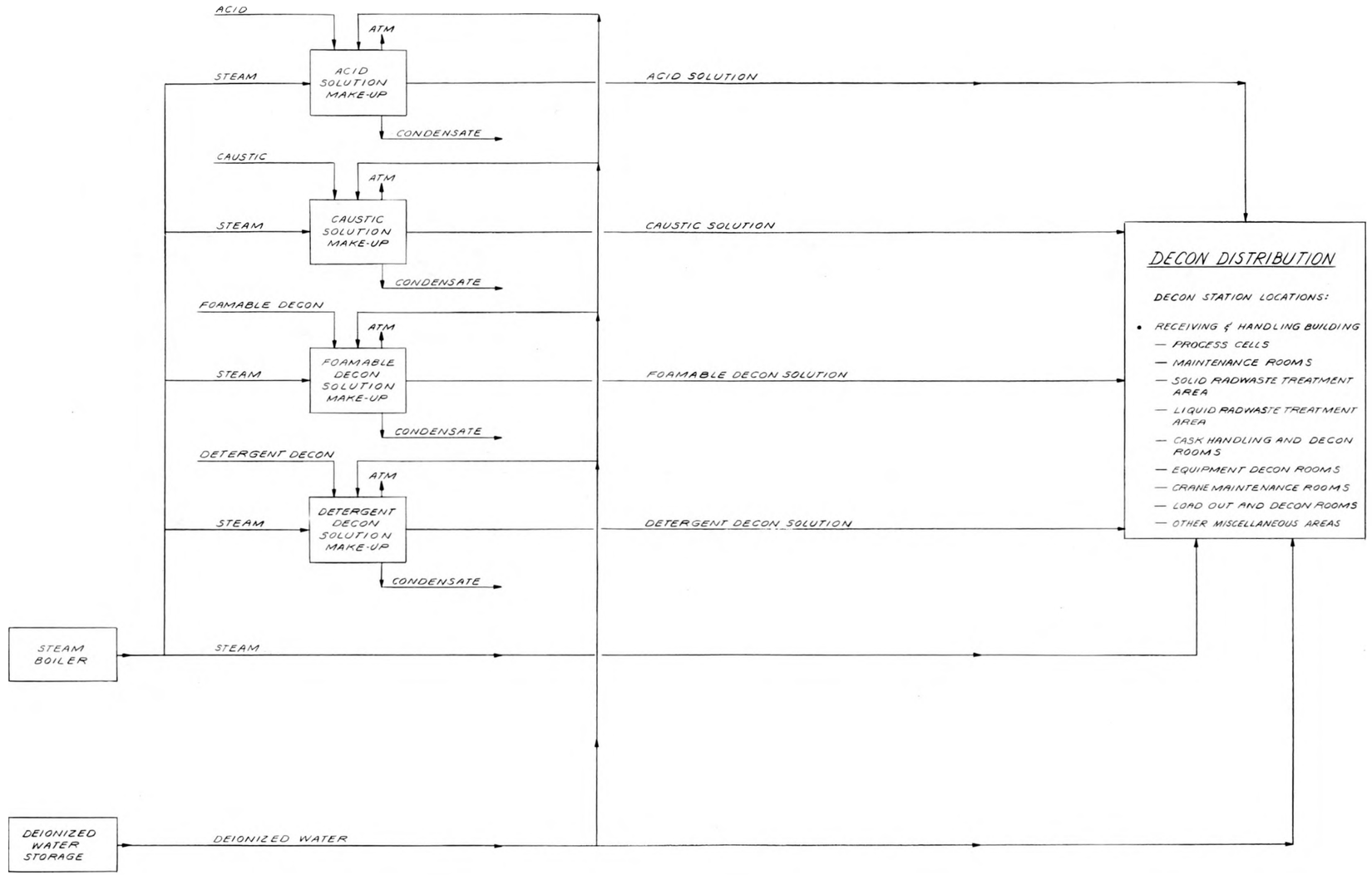
DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

MICRO F'M'S	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
APPD FOR CONFORM WITH DESIGN CRIT			APPD			REVISIONS	

COMMENT PRT ISSUE NO	DATE	CHECK PRT ISSUE NO	DATE	LAST REV
DRAWING STATUS				

7-16-85

2-126



CONCEPTUAL DESIGN

JQP # NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY / FOR	7/24/85
QA	7-30-85
APPD	7/29/85
DESIGN	7/29/85
DEPTS APPD	7/29/85
CHECKED	7/29/85
DRAWN	7-25-85
SCALE	NONE
CLASSIFIED BY	NOT REQD
CLASSIFICATION	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
MECHANICAL PROCESS
DECON SOLUTION MAKE-UP SYSTEM
FLOW DIAGRAM

BLDG NO 77A-200 | WBS NO 7000
DWG NO H-3-56709 | SHEET NO 1 | REV NO 1

5.21.85

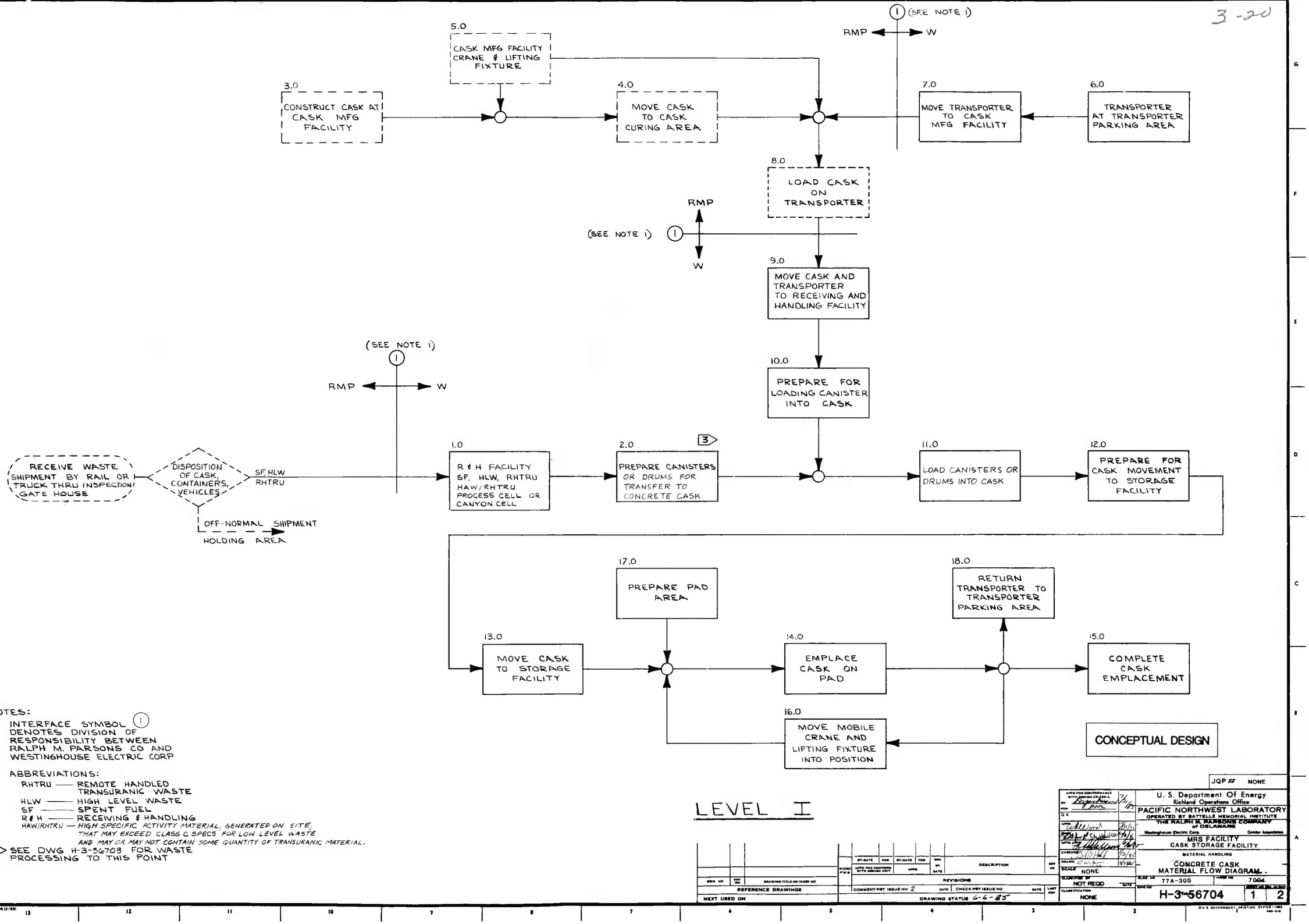
REFERENCE DRAWINGS
DWG NO | REV NO | DRAWING TITLE OR INDEX NO
NEXT USED ON

REVISIONS
BY-DATE | FOR | BY-DATE | FOR | REV BY DATE | DESCRIPTION | REV NO
MICRO FWD | APPD FOR COMPLIANCE WITH DESIGN CRIT | APPD

DRAWING STATUS
COMMENT PRT ISSUE NO | DATE | CHECK PRT ISSUE NO | DATE | LAST REV

84-1960-048 (5/83)

U.S. GOVERNMENT PRINTING OFFICE: 1983 0-461-035



NOTES:

1. INTERFACE SYMBOL (1) DENOTES DIVISION OF RESPONSIBILITY BETWEEN RALPH M. PARSONS CO AND WESTINGHOUSE ELECTRIC CORP

2. ABBREVIATIONS:
   - RHTRU — REMOTE HANDLED TRANSURANIC WASTE
   - HLW — HIGH LEVEL WASTE
   - SF — SPENT FUEL
   - R & H — RECEIVING & HANDLING
   - HAW/RHTRU — HIGH SPECIFIC ACTIVITY MATERIAL, GENERATED ON SITE, THAT MAY EXCEED CLASS C SPECS FOR LOW LEVEL WASTE AND MAY OR MAY NOT CONTAIN SOME QUANTITY OF TRANSURANIC MATERIAL.

(3) SEE DWG H-3-56703 FOR WASTE PROCESSING TO THIS POINT

LEVEL I

CONCEPTUAL DESIGN

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
CASK STORAGE FACILITY
MATERIAL HANDLING
CONCRETE CASK MATERIAL FLOW DIAGRAM

APPS FOR CONFORMANCE WITH DESIGN CRITERIA — APPD — DATE
BY Director of PNL — 7/1/85
Q A
APPD — 7/1/85
APPD — 7/1/85
CHECKED — 7/1/85
DRAWN — 7/1/85
SCALE NONE
EXAMINED BY NOT REQD
CLASSIFICATION NONE
SIZE 77A-300 — DWG NO 7004
H-3-56704 — SHEET NO 1 — REV NO 2

REFERENCE DRAWINGS — NEXT USED ON

REVISIONS — COMMENT PRT ISSUE NO 2 — CHECK PRT ISSUE NO — DRAWING STATUS 6-6-85

DESCRIPTION — BY-DATE — PQR — APPD

APPD FOR CONFORM WITH DESIGN CRIT — MICRO FILM #

DRAWING TITLE OR HOOD NO — DWG NO — REV NO

84 1960-046 (3/83)

U.S. GOVERNMENT PRINTING OFFICE: 1983 656-910

5.0 CASK MFG FACILITY CRANE AND LIFTING FIXTURE

3.0 CONSTRUCT CONCRETE CASK AT CASK MFG. FACILITY

4.0 INSTALL CASK LIFTING FIXTURE ON CASK

4.1 MOVE CONCRETE CASK TO CASK CURING AREA

4.2 REMOVE LIFTING FIXTURE FROM CASK

(1) (SEE NOTE 1) RMP ↔ W

7.0 MOVE TRANSPORTER TO CASK MFG FACILITY

6.0 CASK TRANSPORTER AT TRANSPORTER PARKING AREA

8.0 INSTALL CASK LIFTING FIXTURE ON CASK

8.1 LIFT CONCRETE CASK AND LOAD ONTO TRANSPORTER

8.2 REMOVE LIFTING FIXTURE FROM CONCRETE CASK

(1) (SEE NOTE 1) RMP / W

9.0 MOVE TRANSPORTER & CASK TO R&H FACILITY TRANSFER/DISCHARGE CORRIDOR ACV

10.0 REMOVE CASK TEMP COVER & INSTALL SHIELD PLUG LIFTING EYES

10.1 RETURN TEMP. COVER TO CASK MFG FACILITY

10.2 OPEN DOOR & MOVE TRANSPORTER & CASK INTO LOADOUT AND DECON ROOM

10.3 INSTALL CONTAMINATION BARRIERS BETWEEN CASK & HOT CELL PORT ROTATE SHIELD INTO PLACE & CLOSE DOOR

(1) (SEE NOTE 1) RMP ↔ W

RECEIVE WASTE SHIPMENT BY RAIL OR TRUCK THRU INSPECTION GATE HOUSE

DISPOSITION OF CASK, CONTAINERS, VEHICLES

OFF-NORMAL SHIPMENT HOLDING AREA

1.0 R&H FACILITY SF, HLW, RHTRU, HAW/RHTRU PROCESS CELL OR CANYON CELL

2.0 PREPARE CANISTERS OR DRUMS FOR TRANSFER TO CONCRETE CASK

3

11.0 REMOVE HOT CELL PORT PLUG

11.1 REMOVE SHIELD PLUG FROM CONCRETE CASK

11.2 TRANSFER WASTE CANISTERS OR DRUMS TO CONCRETE CASK

11.3 REPLACE CONCRETE CASK SHIELD PLUG

11.4 REPLACE HOT CELL PORT PLUG

12.0 OPEN LOADOUT AND DECON ROOM DOOR

12.1 REMOVE CONTAMINATION BARRIER AND ROTATE SHIELD

12.2 MOVE CASK AND TRANSPORTER TO TRANSFER/DISCHARGE CORRIDOR, CLOSE DOOR

12.3 PERFORM RADIATION SCAN ON CASK AND CONTAMINATION SURVEY ON CASK TOP

12.4 ARE SURVEY RESULTS ACCEPTABLE ? YES / NO

12.4.1 DECONTAMINATE CASK TOP SURFACE

12.5 PREPARE CASK COVER FOR WELDING

12.6 REMOVE SHIELD PLUG LIFTING EYES, INSTALL COVER ON CASK AND WELD

12.7 INSPECT WELD

12.8 IS WELD ACCEPTABLE ? YES / NO

12.8.1 REPAIR WELD

13.0 MOVE CASK AND TRANSPORTER OUT OF R&H FACILITY FOR DELIVERY TO STORAGE FACILITY

17.0 PREPARE STORAGE PAD AREA

14.0 EMPLACE CONCRETE CASK ON STORAGE PAD, USING CASK LIFTING FIXTURE

18.0 RETURN TRANSPORTER TO TRANSPORTER PARKING AREA

15.0 COMPLETE CASK INSTRUMENTATION HOOKUP

16.0 MOVE MOBILE CRANE & LIFTING FIXTURE TO NEXT STORAGE PAD LOCATION

LEVEL II

CONCEPTUAL DESIGN

JQP # NONE

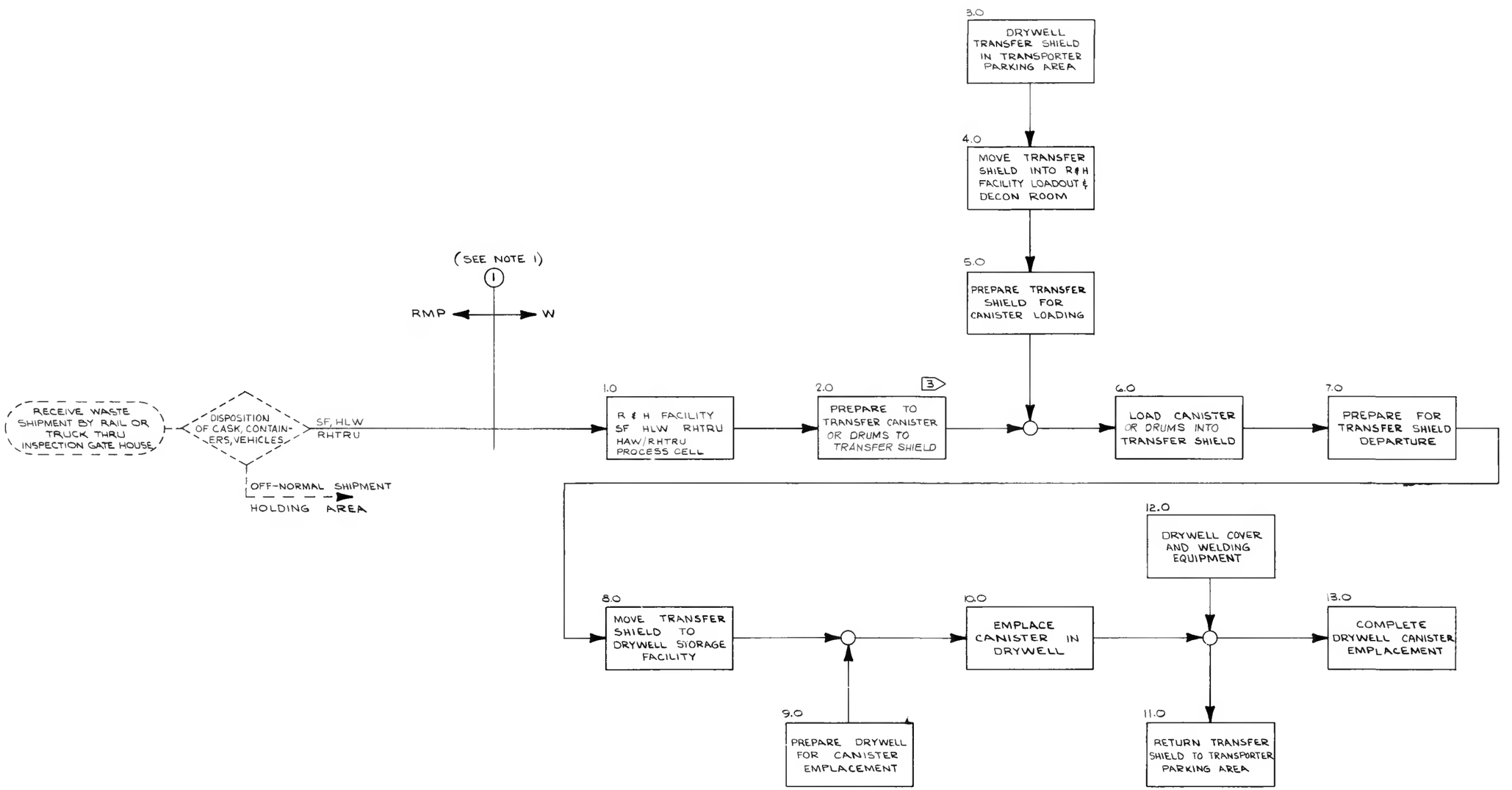
U. S. Department Of Energy
Richland Operations Office
PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE
THE MACHATTIE MANSCHE COMPANY of DELAWARE
Westinghouse Electric Corp. Golder Associates
MRS FACILITY
CASK STORAGE FACILITY
MATERIAL HANDLING
CONCRETE CASK MATERIAL FLOW DIAGRAM
SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE
BLDG NO 77A-300
DRWG NO H-3-56704
SHEET NO 2 OF 2

REFERENCE DRAWINGS
NEXT USED ON

REVISIONS
COMMENT PRT ISSUE NO 2 DATE CHECK PRT ISSUE NO DATE
DRAWING STATUS 6-6-85

64-1800-040 (5/83)

3-22



NOTES:

1. INTERFACE SYMBOL (1) DENOTES DIVISION OF RESPONSIBILITY BETWEEN RALPH M. PARSONS CO AND WESTINGHOUSE ELECTRIC CORP

2. ABBREVIATIONS:

RHTRU	REMOTE HANDLED TRANSURANIC WASTE
HLW	HIGH LEVEL WASTE
SF	SPENT FUEL
R & H	RECEIVING & HANDLING
HAW/RHTRU	HIGH SPECIFIC ACTIVITY MATERIAL GENERATED ON SITE, THAT MAY EXCEED CLASS C SPECS FOR LOW LEVEL WASTE AND MAY OR MAY NOT CONTAIN SOME QUANTITY OF TRANSURANIC MATERIAL.
3	SEE DWG H-3-56703 FOR WASTE PROCESSING TO THIS POINT.

LEVEL I

CONCEPTUAL DESIGN

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
DRYWELL STORAGE FACILITY
MATERIAL HANDLING
DRYWELL
MATERIAL FLOW DIAGRAM

SCALE NONE
CLASSIFIED BY NOT REQD
CLASSIFICATION NONE

BLDG. NO. 77A-400 SYSTEM NO. 7001
DRAWING NO. H-3-56705 SHEET NO. 1 REV NO. 2

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY [signature] 7/21/85
PDR
QA
APPD [signature] 7/19/85
APPD [signature] 7/19/85
APPD [signature] 7/19/85
CHECKED [signature] 7/19/85
DRAWN [signature] 7/19/85

REVISIONS

BY-DATE	PDR	BY-DATE	PDR	REV BY DATE	DESCRIPTION	REV NO
APPD FOR CONFORM WITH DESIGN CRIT		APPD				

COMMENT PRT ISSUE NO. 2 DATE CHECK PRT ISSUE NO. DATE LAST REV

DRAWING STATUS 6-6-85

DWG NO	REV NO	DRAWING TITLE OR INDEX NO	MICRO F'M'S
REFERENCE DRAWINGS			
NEXT USED ON			

86-1980-046 (3/83)

U.S. GOVERNMENT PRINTING OFFICE: 1983 555-918

3-23

RECEIVE WASTE SHIPMENT BY RAIL OR TRUCK THRU INSPECTION GATE HOUSE

DISPOSITION OF CASK, CONTAINERS, VEHICLES

OFF-NORMAL SHIPMENT HOLDING AREA

SF, HLW, RHTRU

RMP

SEE NOTE 1

W

1.0 R&H FACILITY SF, HLW, RHTRU, HAW/RHTRU PROCESS CELL

2.0 PREPARE TO TRANSFER CANISTER OR DRUMS TO TRANSFER SHIELD

3

5.2 OPEN TRANSFER SHIELD UPPER GATE

5.1 CLOSE LOADOUT AND DECON ROOM DOOR, RAISE TRANSFER SHIELD INTO EXIT PORT

5.0 ALIGN TRANSFER SHIELD WITH HOT CELL EXIT PORT

4.0 MOVE TRANSFER SHIELD INTO R & H FACILITY LOADOUT AND DECON ROOM

3.1 INSTALL DRYWELL SHIELD PLUG INTO TRANSFER SHIELD

3.0 DRYWELL TRANSFER SHIELD IN TRANSPORTER PARKING AREA

6.0 REMOVE EXIT PORT PLUG

6.1 LOWER CANISTER OR DRUMS INTO TRANSFER SHIELD

6.2 REPLACE EXIT PORT PLUG

7.0 CLOSE TRANSFER SHIELD UPPER GATE

7.1 USING TRANSFER SHIELD GRAPPLE, GRAPPLE ONTO CANISTER OR DRUM CAGE PINTLE

7.2 LOWER TRANSFER SHIELD TO TRAVEL POSITION

7.3 OPEN LOADOUT AND DECON ROOM DOOR

7.4 PERFORM CONTAMINATION SURVEY INSPECTION

7.5 ARE RESULTS ACCEPTABLE ? YES / NO

7.6 DECONTAMINATE SHIELD

8.0 MOVE TRANSFER SHIELD TO DRYWELL STORAGE FACILITY

9.0 REMOVE TEMPORARY WEATHER COVER FROM DRYWELL FOR CANISTER OR DRUMS EMPLACEMENT

9.1 INSPECT INSIDE OF DRYWELL FOR DEBRIS AND WATER

9.2 IS DRYWELL ACCEPTABLE ? YES / NO

9.3 CLEAN DRYWELL

10.0 ALIGN TRANSFER SHIELD WITH DRYWELL TO EMPLACE CANISTER OR DRUMS

10.1 OPEN TRANSFER SHIELD LOWER GATE

10.2 LOWER CANISTER OR DRUMS INTO DRYWELL

10.3 LOWER PLUG INTO DRYWELL

12.0 BRING DRYWELL COVER AND WELDING EQUIPMENT FROM HOLDING AREA

11.0 RETURN TRANSFER SHIELD TO TRANSPORTER PARKING AREA

13.0 SEAT DRYWELL COVER ON DRYWELL AND SEAL WELD IN PLACE

13.1 INSPECT WELD

13.2 IS WELD ACCEPTABLE ? NO / YES

13.3 REPAIR WELD

13.4 APPLY CORROSION RESISTANT COATING ON WELD AREA

LEVEL II

CONCEPTUAL DESIGN

JQP # NONE

APPD FOR CONFORMANCE WITH DESIGN CRITERIA BY		7/31/85
FOR		
Q A		
APPD		7/31/85
APPD		7/31/85
CHECKED		7/31/85
DRAWN		7/31/85
SCALE	NONE	
CLASSIFIED BY	NOT REQD	DATE
CLASSIFICATION	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
DRYWELL STORAGE FACILITY
MATERIAL HANDLING
DRYWELL
MATERIAL FLOW DIAGRAM

BLDG NO 77A-400 | TASK NO 7001
DWG NO H-3-56705 | SHEET NO 2 | REV NO 2

REFERENCE DRAWINGS
DWG NO | REV NO | DRAWING TITLE OR INDEX NO
NEXT USED ON

REVISIONS
MICRO P'W'S | APPD FOR CONFORM WITH DESIGN CRIT BY-DATE FOR | APPD BY-DATE FOR | REV BY DATE | DESCRIPTION | REV NO
COMMENT PRT ISSUE NO 2 DATE | CHECK PRT ISSUE NO DATE | LAST REV
DRAWING STATUS 6-6-85

86-1960-048 (3/83)

GPO 888-588

17-9

OFF-SITE WATER SUPPLY

WATER TREATMENT (IF REQUIRED)

POTABLE WATER STORAGE TANK

POTABLE/FIREWATER PUMPS

POTABLE/FIREWATER DISTRIBUTION
- SUPPORT BUILDINGS USED FOR:
  - FIREWATER
  - DRINKING WATER
  - WASHROOMS/TOILETS
  - LUNCH ROOMS
  - SAFETY SHOWERS
  - EYE WASH STATIONS
  - HOT WATER BOILERS
  - STANDBY GEN. JACKET WATER MAKE-UP

BRINE

RINSE

WATER SOFTENER

TO PROCESS SEWER

DI WATER

BFW STORAGE TANK

- STEAM BOILERS
- BFW CHEMICAL TREATMENT

BLOWDOWN TO PROCESS SEWER

BACKFLOW PREVENTER

STEAM GENERATOR BUILDING

BACKFLOW PREVENTER

HOT WATER HEATER

STEAM

VEHICLE WASHDOWN

CARBON FILTER

REGENERATION CHEMICALS (ACID, CAUSTIC)

BACK WASH

DEIONIZER

TO PROCESS SEWER

TREATED WATER FROM LLW & HAW LIQUID RADWASTE SYSTEMS

DEIONIZED WATER STORAGE TANK

STEAM

CONDENSATE

SUMPS
- MONITOR FOR RADIOACTIVITY

NON-CONTAMINATED WATER TO PROCESS SEWER

CONTAMINATED WATER TO LOW LEVEL LIQUID RADWASTE SYSTEM

- DECON SOLUTION MAKE-UP
- DECON STATIONS
- FINAL HEPA SPRAY SYSTEM
- BFW STORAGE TANK

STEAM

AIR

HOT WATER VESSEL

CONDENSATE

DETERGENT

RESPIRATOR WASHER

CHEMICAL ADDITIVES

VOG

WASHER/ EXTRACTOR

LAUNDRY

STEAM

LAUNDRY DRYER

CONDENSATE

VOG

FREON MAKE-UP

FREON DRY CLEANING UNIT

VOG

VOG

TO HVAC

VOG

EFFLUENT COLLECTION TANK

FILTER

AIR

FILTERED EFFLUENT VESSEL

NON-CONTAMINATED TO PROCESS SEWER

CONTAMINATED TO LOW LEVEL LIQUID RADWASTE SYSTEM

FREON SLUDGE

CONTAMINATED FILTERS

SOLID RADWASTE SYSTEM

- OTHER USERS
- FIRE WATER
- DRINKING
- WASHROOMS/TOILETS
- LUNCH ROOMS
- SAFETY SHOWERS
- EYE WASH STATIONS

RECEIVING & HANDLING BUILDING

TREATMENT CHEMICALS

COOLING TOWER MAKE-UP

COOLING WATER SUPPLY

COOLING WATER RETURN

TO PROCESS SEWER

CONCEPTUAL DESIGN

JQP# NONE

APPD FOR CONFORMANCE WITH DBB-QA CRITERIA	BY	7/30/85
	FOR DOE	
QA		7/30/85
APPD		7/30/85
APPD		7/31/85
DPTM APPD		7/31/85
CHECKED		7/31/85
DRAWN		7/15/85
SCALE	NONE	
CLASSIFIED BY	NOT REQD	DATE
CLASSIFICATION	NONE	

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MRS FACILITY
RECEIVING & HANDLING BUILDING
MECHANICAL PROCESS
WATER TREATMENT SYSTEM
FLOW DIAGRAM

BLDG NO 77A-200 | U-DOE NO 7000
DWG NO H-3-56710 | SHEET NO THIS SHEET 1 | SHEETS 1

DWG NO	REV NO	DRAWING TITLE OR INDEX NO
REFERENCE DRAWINGS		
NEXT USED ON		

MICRO F'M'S	APPD FOR CONFORM WITH DBB-QA CRIT	BY-DATE	FOR	BY-DATE	FOR	REV BY DATE	DESCRIPTION	REV NO
		APPD					REVISIONS	

COMMENT PRT ISSUE NO	DATE	CHECK PRT ISSUE NO	DATE	LAST REV
DRAWING STATUS				

7-3-85

84-1980-048(11-83)

GPO:1983-793-673