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QA: QA

Civilian Radioactive Waste Management System
Management & Operating Contractor

Engineering Files for Site Recommendation

TDR-WHS-MD-000001 REV 00

May 2000

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Civilian Radioactive Waste Management System
Management & Operating Contractor

Engineering Files for Site Recommendation

TDR-WHS-MD-000001 REV 00

May 2000

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CHANGE HISTORY

Revision Number	Interim Change No.	Effective Date	Description of Change
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ACRONYMS AND ABBREVIATIONS

AC	alternating current
AHU	air handling unit
ALARA	as low as is reasonably achievable
AMTAS	Alarm Monitoring and Threat Assessment System
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ATS	Assembly Transfer System
avg	average
B&PV	boiler and pressure vessel
B&W	Babcock and Wilcox
BOP	Balance of Plant
BWR	boiling water reactor
CAS	central alarm system
CCC	central control center
CCCC	Central Command and Control Center
CCHS	Carrier/Cask Handling System
CCTS	Carrier/Cask Transport System
CCTV	closed-circuit television
CE	Combustion Engineering
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGA	Compressed Gas Association
CHW	chilled water
cm	centimeter
CPB	Carrier Preparation Building
CQ	conventional quality
CRWMS	Civilian Radioactive Waste Management System
CSNF	commercial spent nuclear fuel
CTS	Canister Transfer System
CWA	Clean Water Act
DBE	design basis event
DC	direct current
DC	disposal container
DCHS	Disposal Container Handling System
DHLW	defense high-level waste
DOE	U.S. Department of Energy

DPC	dual-purpose canister
DR	dose rate
DSNF	DOE spent nuclear fuel
EDE	effective dose equivalent
EDS	Emergency Dispatch System
EFSR	Engineering Files for Site Recommendation
e-mail	electronic mail
EOC	Emergency Operations Center
ERCS	Emergency Response Center System
ERS	Emergency Response System
ESF	Exploratory Studies Facility
fpm	feet per minute
ft	feet
g	gram
gal	gallon
GPa	gigapascal
gpd	gallons per day
gpm	gallons per minute
GROA	Geologic Repository Operation Area
HEPA	high-efficiency particulate air
HFE	Human Factors Engineering
HHT	heavy-haul transport
HIC	high-integrity container
HLW	high-level waste
HPT	health physics technician
hr	hour
HSS	Health Safety System
HVAC	heating, ventilation, and air-conditioning
HW	heating water
Hz	hertz
I&C	Instrumentation and Control
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers, Inc.
in.	inch
INEEL	Idaho National Engineering and Environmental Laboratory
IP	immobilized plutonium
ITS	important to safety
kg	kilogram
kip	kilopound
ksf	kips per square feet

kv	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
LA	License Application
LAN	local area network
lb	pound
LCC	local control consoles
LIMS	Laboratory Information Management System
LLW	low-level waste
LSA	low specific activity
LWT	legal-weight truck
m	meter
max.	maximum
MCC	motor control center
MGDS	Mined Geological Disposal System (now MGR)
MGR	Monitored Geologic Repository
ml	milliliter
mm	millimeter
MPC	multi-purpose canister
MPa	megapascal
MPFL	maximum possible fire loss
mrem	millirem
MTBF	mean-time-between-failures
MTTR	mean-time-to-repair
MTU	metric tons uranium
Mva	mega-volt ampere
NAC	Nuclear Assurance Corporation International, Inc.
NDE	non-destructive examination
NFC	non-fuel component
NFPA	National Fire Protection Association
NPSF	North Portal Surface Facility
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
NUHOMS®	NUtech HOrizontal Modular Storage
OA/FA	oil immersed self-cooled/oil immersed forced air cooled
OCRWM	Office of Civilian Radioactive Waste Management
OPM	Offsite Prime Mover
OSHA	Occupational Safety and Health Association
PA	public address
pcf	pounds per cubic foot
pci	pounds per cubic inch

ACRONYMS AND ABBREVIATIONS (Continued)

PMF	probable maximum flood
PSB	Pool Storage Building
psf	pounds per square foot
psi	pounds per square inch
psig	pounds per square inch (gage)
PVC	Polyvinyl Chloride
PWR	Pressurized Water Reactor
QA	Quality Assurance
QARD	*Quality Assurance Requirements and Description*
QL	Quality Level
q_s	surcharge load
RCA	Radiologically Controlled Area
RDRD	Repository Design Requirements Document
rem	roentgen equivalent, man
RSDD	Repository Surface Design Department
S&S	Safeguards and Security
SCFM	standard cubic feet per minute
SDD	System Description Document
SEMS	Surface Environmental Monitoring System
SFA	spent fuel assembly
SNF	spent nuclear fuel
SOS	Site Operations System
SPM	Site Prime Mover
sq ft	square feet
SR	Site Recommendation
SRM	Site Radiological Monitoring System
SRS	Savannah River Site
SSC	structures, systems, and component
SSF	Subsurface Facility
TBD	to be determined
TBV	to be verified
TD	total dose
TMB	Transporter Maintenance Building
TSC	Technical Support Center
UBC	Uniform Building Code
UCF	uncanistered fuel
UL	Underwriters' Laboratory
UMS™	Universal MPC System™
UPC	Uniform Plumbing Code
UPS	uninterruptible power supply
USC	United States Code

UT	Ultrasonic Tests
UTC	Universal Time Coordinated
VA	Viability Assessment
VT	Visual Test
WHB	Waste Handling Building
WE	Westinghouse Electric
WP	waste package
WPRS	Waste Package Remediation System
WTB	Waste Treatment Building
WVDP	West Valley Demonstration Project

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1. PURPOSE

The purpose of the *Engineering Files for Site Recommendation* (EFSR) is to provide a centralized file of referenceable, discrete, and identifiable functions, processes, features, services and equipment used for defining functional areas and functional relationships for the Waste Handling Building (WHB) systems, Waste Treatment Building (WTB) systems, site-layout, balance-of-plant (BOP), etc. The EFSR is a compilation of the functional requirements, applicable codes and standards, general system information, design criteria, and acceptance criteria for surface facilities.

The information compiled in the EFSR:

- Will conform to the applicable System Description Documents (SDDs)
- Will support the inputs to the applicable sections of the Site Recommendation (SR)
- Will include supporting figures (see Attachment I).

2. QUALITY ASSURANCE

The work presented in this document has been prepared in accordance with Office of Civilian Radioactive Waste Management (OCRWM) approved program document AP-3.11Q, *Technical Reports,* and with the *Development Plan for Engineering Files for Site Recommendation* (CRWMS M&O 2000i) developed under AP-2.13Q, *Technical Product Development Planning.* An Activity Evaluation, *Developing Engineering Files to Support SR (Work Package 24012123M1)* (CRWMS M&O 1999m) has been performed in accordance with QAP-2-0, *Conduct of Activities.* This Activity Evaluation determined that this document is subject to the requirements of the *Quality Assurance Requirements and Description* (QARD) (DOE 2000). In addition, this report is quality affecting because the results will support the inputs to the applicable sections of the SR.

Structures, systems, and components (SSCs) are assigned quality levels (QLs) within classification analyses performed in accordance with QAP-2-3, *Classification of Permanent Items.* The WHB Structure is a QL-1 SSC based on the *Classification of the MGR Waste Handling Building System* (CRWMS M&O 1999k, Table 1). The WTB Structure is a QL-2 SSC based on the *Classification of the MGR Waste Treatment Building System* (CRWMS M&O 1999l, Table 1). Classification of additional systems are as designated in appropriate sections of Attachment II of this document.

As required by AP-SV.1Q, *Control of the Electronic Management of Data*, the methods used to control the electronic management of data were accomplished in accordance with the controls specified in the development plan for this document.

Use of any data from this report for input into documents supporting procurement, fabrication, or construction is required to be controlled as to be verified (TBV) in accordance with AP-3.15Q, *Managing Technical Product Inputs*: "This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The

status of the input information quality may be confirmed by review of the Document Input Reference System database."

This document contains the current state of knowledge of the proposed surface facility systems. This document does not provide analysis, models, or conclusions that affect any system's critical characteristics, scientific results, or provide data that can be directly relied upon to address waste isolation issues. There will be no effect on the safety classification of any surface structure, system, or component (SSC).

3. METHOD

The EFSR is a compilation of the design criteria and acceptance criteria for all surface facilities. No analysis is done. The EFSR has no conclusions or results.

4. DESIGN REQUIREMENTS

The following requirements are design inputs and criteria taken primarily from SDDs. These design requirements will be used and met in future designs of the surface facilities. The system descriptions presented in Attachment II are the conceptual designs of the various systems using the design requirements. The descriptions are not considered complete and do not yet include all design requirements.

The use of unqualified and unverified inputs throughout this document is considered appropriate for the intended purpose of this report (Site Recommendation and the total-system life cycle cost). The results of this report will not impact safety or waste isolation. This data are also not intended to be used for procurement, fabrication, or construction.

WASTE HANDLING BUILDING

4.1 ASSEMBLY TRANSFER SYSTEM

4.1.1 System Functions

The following functions for the Assembly Transfer System (ATS) are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.1):

4.1.1.1 The system receives transportation casks from the Carrier/Cask Handling System (CCHS).

4.1.1.2 The system samples, vents, and cools transportation casks containing spent nuclear fuel (SNF).

4.1.1.3 The system samples and vents transportation casks containing dual-purpose canisters (DPCs).

4.1.1.4 The system penetrates, samples, vents, and cools DPCs containing SNF.

4.1.1.5 The system transfers transportation casks into the pool.

4.1.1.6 The system opens transportation casks and DPCs for unloading.

4.1.1.7 The system unloads SNF assemblies and single-element canisters from transportation casks and DPCs.

4.1.1.8 The system stores SNF assemblies and single element canisters in the pool.

4.1.1.9 The system decontaminates transportation casks and DPCs.

4.1.1.10 The system returns empty casks and DPCs to the CCHS.

4.1.1.11 The system dries SNF assemblies and single element canisters prior to disposal container (DC) loading.

4.1.1.12 The system receives empty DCs configured for loading from the Disposal Container Handling System (DCHS).

4.1.1.13 The system loads SNF assemblies and single element canisters into the DC.

4.1.1.14 The system seals, evacuates oxidizing gases, and backfills the DC with inert gas.

4.1.1.15 The system decontaminates the DC external surfaces.

4.1.1.16 The system transfers the DC to the DCHS.

4.1.1.17 The system supports the collection of material control and accounting data.

4.1.1.18 The system operates in the environmental conditions established for the WHB System.

4.1.1.19 The system provides remote handling and control features to minimize radiation exposure to workers.

4.1.1.20 The system provides features and equipment for reducing the risk of, responding to, and recovering from, off-normal events and credible design basis events (DBEs).

4.1.1.21 The system ensures criticality control is maintained during all waste handling operations.

4.1.1.22 The system provides features for the inspection, testing, calibration, and maintenance of system equipment.

4.1.1.23 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.1.1.24 The system provides for the monitoring and control of its operation by either local or remote means.

4.1.1.25 The system provides safety features to protect personnel and equipment during normal and off-normal conditions.

4.1.2 System Design Criteria

The system design criteria for the ATS system are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2).

4.1.2.1 System Performance Criteria

The system performance criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.1).

4.1.2.2 Safety Criteria

The safety criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.2).

4.1.2.3 System Environment Criteria

The system environment criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.3).

4.1.2.4 System Interfacing Criteria

The system interfacing criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.4).

4.1.2.5 Operational Criteria

The operational criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.5).

4.1.2.6 Codes and Standards Criteria

The codes and standards criteria for the ATS are as identified in the *Assembly Transfer System Description Document* (CRWMS M&O 2000a, Section 1.2.6).

4.2 CANISTER TRANSFER SYSTEM

4.2.1 System Functions

The following functions for the Canister Transfer System (CTS) are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.1):

4.2.1.1 The system receives and transports loaded casks containing waste in disposable canisters from the CCHS for processing.

4.2.1.2 The system samples and vents transportation casks containing canister waste.

4.2.1.3 The system opens transportation casks for unloading.

4.2.1.4 The system unloads canisters from the transportation casks.

4.2.1.5 The system provides features to stage canister waste to support DC loading.

4.2.1.6 The system decontaminates transportation casks and off-normal canisters.

4.2.1.7 The system returns empty casks to the CCHS.

4.2.1.8 The system receives empty DCs configured for loading from the DCHS.

4.2.1.9 The system loads canister waste into DCs.

4.2.1.10 The system delivers loaded DCs to the DCHS.

4.2.1.11 The system supports the collection of material control and accounting data.

4.2.1.12 The system operates within the environmental conditions within the WHB System.

4.2.1.13 The system provides remote handling and control features to minimize radiation exposure to workers.

4.2.1.14 The system provides features and equipment for reducing the risk of, responding to, and recovering from, off-normal events and credible DBEs.

4.2.1.15 The system ensures criticality control is maintained during all waste handling operations.

4.2.1.16 The system provides features for the inspection, testing, calibration, and maintenance of system equipment.

4.2.1.17 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.2.1.18 The system provides for the monitoring and control of its operation by either local or remote means.

4.2.1.19 The system provides safety features to protect personnel and equipment during normal and off-normal conditions.

4.2.2 System Design Criteria

The system design criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2).

4.2.2.1 System Performance Criteria

The system performance criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.1).

4.2.2.2 Safety Criteria

The safety criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.2).

4.2.2.3 System Environment Criteria

The system environment criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.3).

4.2.2.4 System Interfacing Criteria

The system interfacing criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.4).

4.2.2.5 Operational Criteria

The operational criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.5).

4.2.2.6 Codes and Standards Criteria

The codes and standards criteria for the CTS are as identified in the *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2.6).

4.3 CARRIER/CASK HANDLING SYSTEM

4.3.1 System Functions

The following functions for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.1):

4.3.1.1 The system accommodates carriers with empty or loaded casks or overpacks from the Carrier/Cask Transport System.

4.3.1.2 The system transfers casks between the cask carrier and the ATS and CTS.

4.3.1.3 The system transfers overpacks between the overpack carrier and the ATS.

4.3.1.4 The system supports the collection of material control and accounting data.

4.3.1.5 The system operates within the environmental conditions of the WHB.

4.3.1.6 The system provides features to minimize radiation exposure to workers.

4.3.1.7 The system provides features and equipment for reducing the risk of, responding to, and recovering from off-normal events and credible DBEs.

4.3.1.8 The system provides features for the inspection, testing, and maintenance of system equipment.

4.3.1.9 The system facilitates decontamination and decommissioning at repository closure.

4.3.2 System Design Criteria

The system design criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2).

4.3.2.1 System Performance Criteria

The system performance criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.1).

4.3.2.2 Safety Criteria

The safety criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.2).

4.3.2.3 System Environment Criteria

The system environment criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.3).

4.3.2.4 System Interfacing Criteria

The system interfacing criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.4).

4.3.2.5 Operational Criteria

The operational criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.5).

4.3.2.6 Codes and Standards Criteria

The codes and standards criteria for the CCHS are as identified in the *Carrier/Cask Handling System Description Document* (CRWMS M&O 2000f, Section 1.2.6).

4.4 WASTE PACKAGE REMEDIATION SYSTEM

4.4.1 System Functions

The following functions for the Waste Package Remediation System (WPRS) are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.1):

4.4.1.1 The system receives, transports, and returns DCs/waste packages (WPs) containing uncanistered SNF and canistered waste to and from the DCHA for remediation.

4.4.1.2 The system unseals normal, defective, and/or partially welded DCs/WPs.

4.4.1.3 The system prepares rejected, but repairable, closure welds for re-welding.

4.4.1.4 The system provides a temporary lid for opened DCs/WPs.

4.4.1.5 The system collects process remediation operation fines and waste.

4.4.1.6 The system supports the collection of material control and accounting data.

4.4.1.7 The system operates within the environmental conditions within the WHB System.

4.4.1.8 The system provides features to minimize radiation exposure to workers.

4.4.1.9 The system provides features and equipment for reducing the risk of, responding to, and recovering from abnormal events and credible accidents.

4.4.1.10 The system decontaminates DCs/WPs prior to transport to the DCHS System.

4.4.1.11 The system limits the spread of radioactive contamination from the system.

4.4.1.12 The system provides features for the inspection, testing, and maintenance of system equipment.

4.4.1.13 The system provides features to stage removed DC/WP lids to support system operations.

4.4.1.14 The system provides features to transfer DC/WP lids for disposal.

4.4.1.15 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.4.2 System Design Criteria

The system design criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2).

4.4.2.1 System Performance Criteria

The system performance criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.1).

4.4.2.2 Safety Criteria

The safety criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.2).

4.4.2.3 System Environment Criteria

The system environment criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.3).

4.4.2.4 System Interfacing Criteria

The system interfacing criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.4).

4.4.2.5 Operational Criteria

The operational criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.5).

4.4.2.6 Codes and Standards Criteria

The codes and standards criteria for the WPRS are as identified in the *Waste Package Remediation System Description Document* (CRWMS M&O 2000z, Section 1.2.6).

4.5 DISPOSAL CONTAINER HANDLING SYSTEM

4.5.1 System Functions

The following functions for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.1):

4.5.1.1 The system receives, prepares for loading, stages, and transfers empty DCs to the ATS and CTS.

4.5.1.2 The system receives loaded DCs from the ATS and CTS.

4.5.1.3 The system stages, positions, and welds the DC closure lids.

4.5.1.4 The system evacuates the DC internal gases and backfills the container with inert gas.

4.5.1.5 The system performs non-destructive examinations of DC weld integrity.

4.5.1.6 The system transfers DC/WPs to/from the WPRS.

4.5.1.7 The system decontaminates the WP external surfaces prior to delivery to the Waste Emplacement System.

4.5.1.8 The system provides lag storage for loaded DCs and WPs.

4.5.1.9 The system loads WPs onto the Waste Emplacement/Retrieval System emplacement pallet and bedplate of the WP transporter.

4.5.1.10 The system receives recovered WPs from the Waste Emplacement/Retrieval System.

4.5.1.11 The system reads DC/WP unique identifiers and provides inventory data for material control and accounting.

4.5.2 System Design Criteria

The system design criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2).

4.5.2.1 System Performance Criteria

The system performance criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.1).

4.5.2.2 Safety Criteria

The safety criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.2).

4.5.2.3 System Environment Criteria

The system environment criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.3).

4.5.2.4 System Interfacing Criteria

The system interfacing criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.4).

4.5.2.5 Operational Criteria

The operational criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.5).

4.5.2.6 Codes and Standards

The codes and standards criteria for the DCHS are as identified in the *Disposal Container Handling System Description Document* (CRWMS M&O 2000j, Section 1.2.6).

4.6 WASTE HANDLING BUILDING SYSTEM

4.6.1 System Functions

The following functions for the WHB are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.1):

4.6.1.1 The system provides the required space, layout, and structures to support and optimize the waste handling operations for expected waste throughputs.

4.6.1.2 The system protects the WHB SSCs from the external environments.

4.6.1.3 The system helps maintain worker and public radiation doses as low as is reasonably achievable (ALARA).

4.6.1.4 The system helps limit the spread of contamination within the facility.

4.6.1.5 The system provides safe work areas with a suitable environment for personnel and equipment to support operations, maintenance, and other activities.

4.6.1.6 The system provides the required space and layout in support of emergency plans.

4.6.1.7 The system provides the required space and layout in support of access control requirements.

4.6.1.8 The system provides the required space and layout for equipment storage.

4.6.1.9 The system limits the probability and consequences of off-normal conditions and DBEs.

4.6.1.10 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.6.1.11 The system provides space and layout to support inspection, testing, calibration, and maintenance activities.

4.6.1.12 The system provides chilled water (CHW), hot water, potable water, industrial air, and instrument air as required to support waste handling operations.

4.6.1.13 The system interfaces with the Monitored Geologic Repository (MGR) systems as required to support all waste handling and related operations.

4.6.1.14 The system facilitates decommissioning of the WHB.

4.6.2 System Design Criteria

4.6.2.1 System Performance Criteria

The system performance criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.1).

4.6.2.2 Safety Criteria

The safety criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.2).

4.6.2.3 System Environment Criteria

The system environment criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.3).

4.6.2.4 System Interfacing Criteria

The system interfacing criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.4).

4.6.2.5 Operational Criteria

The operational criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.5).

4.6.2.6 Codes and Standards Criteria

The codes and standards criteria for the WHB structure and foundation are as identified in the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.6).

4.7 WASTE HANDLING BUILDING VENTILATION SYSTEM

4.7.1 System Functions

The following functions for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.1):

4.7.1.1 The system provides the proper environment for personnel comfort and equipment operation in the contaminated, potentially contaminated, and uncontaminated areas of the WHB to support the waste handling operations.

4.7.1.2 The system limits the spread of airborne contamination within the WHB.

4.7.1.3 The system limits the release of airborne radioactive contaminants to the accessible environment to maintain public and worker radiation exposures ALARA.

4.7.1.4 The system provides status of system parameters and ventilation equipment operation.

4.7.1.5 In conjunction with other MGR systems, the WHB Ventilation System operates to mitigate the consequences of DBEs.

4.7.1.6 The system provides active and passive features for the safety of personnel and for maintaining radiation doses ALARA during normal and off-normal conditions in the WHB.

4.7.1.7 The system permits periodic inspection, testing, and maintenance of system components.

4.7.1.8 The system performs its confinement and filtration functions following credible DBEs.

4.7.2 System Design Criteria

4.7.2.1 System Performance Criteria

The system performance criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.1).

4.7.2.2 Safety Criteria

The safety criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.2).

4.7.2.3 System Environment Criteria

The system environment criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.3).

4.7.2.4 System Interfacing Criteria

The system interfacing criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.4).

4.7.2.5 Operational Criteria

The operational criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.5).

4.7.2.6 Codes and Standards Criteria

The codes and standards criteria for the WHB Ventilation System are as identified in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.6).

4.8 POOL WATER TREATMENT AND COOLING SYSTEM

4.8.1 System Functions

The following functions for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.1):

4.8.1.1 The system controls pool water temperature to support safe waste handling operations.

4.8.1.2 The system suppresses the growth of micro-organisms in the pool.

4.8.1.3 The system maintains water clarity in the pool.

4.8.1.4 The system treats the pool water to control radiological exposure to personnel and equipment.

4.8.1.5 The system controls pool water chemistry.

4.8.1.6 The system detects leaks through the pool liner.

4.8.1.7 The system provides the means for cleaning and removing debris from the pool surface.

4.8.1.8 The system monitors and controls the pool water level.

4.8.1.9 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.8.1.10 The system helps control the spread of radioactive particles in the pool during waste handling operations.

4.8.1.11 The system provides the required equipment to support pool liner cleaning.

4.8.1.12 The system provides indications and alarms of system parameters.

4.8.1.13 The system mitigates the consequences of equipment failures and off-normal conditions.

4.8.1.14 The system maintains occupational radiological exposures ALARA.

4.8.2 System Design Criteria

4.8.2.1 System Performance Criteria

The system performance criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.1).

4.8.2.2 Safety Criteria

The safety criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.2).

4.8.2.3 System Environment Criteria

The system environment criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.3).

4.8.2.4 System Interfacing Criteria

The system interfacing criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.4).

4.8.2.5 Operational Criteria

The operational criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.5).

4.8.2.6 Codes and Standards Criteria

The codes and standards criteria for the Pool Water Treatment and Cooling System are as identified in the *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p, Section 1.2.6).

4.9 WASTE HANDLING BUILDING FIRE PROTECTION SYSTEM

4.9.1 System Functions

The following functions for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.1):

4.9.1.1 The system distributes and delivers fire suppressants (includes water and other agents) within the WHB.

4.9.1.2 The system provides the means to control the propagation, and extinguish WHB fires.

4.9.1.3 The system provides the means for prompt detection and annunciation of WHB fires.

4.9.1.4 Reserved

4.9.1.5 The system provides the means to detect, control, and suppress credible WHB explosion hazards.

4.9.1.6 The system provides occupant notification of WHB fire emergency/evacuation conditions.

4.9.1.7 The system provides fire protection signals.

4.9.1.8 The system completes fire barriers where penetrations exist.

4.9.2 System Design Criteria

4.9.2.1 System Performance Criteria

The system performance criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.1).

4.9.2.2 Safety Criteria

The safety criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.2).

4.9.2.3 System Environment Criteria

The system environment criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.3).

4.9.2.4 System Interfacing Criteria

The system interfacing criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.4).

4.9.2.5 Operational Criteria

The operational criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.5).

4.9.2.6 Codes and Standards Criteria

The codes and standards criteria for the WHB Fire Protection System are as identified in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.6).

4.10 WASTE HANDLING BUILDING ELECTRICAL SYSTEM

4.10.1 System Functions

The following functions for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.1):

4.10.1.1 The system distributes electrical power.

4.10.1.2 The system receives normal electrical power from the Site Electrical Power System.

4.10.1.3 The system transfers loads between normal and emergency power.

4.10.1.4 The system monitors its own operating parameters.

4.10.1.5 The system provides for both local and remote monitoring and control of its operations.

4.10.1.6 The system transforms power for electrical loads.

4.10.1.7 The system performs the Quality Level (QL)-2 functions of emergency power generation and distribution.

4.10.1.8 The system provides lighting, grounding, and lightning protection.

4.10.1.9 The system operates within expected environmental conditions.

4.10.2 System Design Criteria

4.10.2.1 System Performance Criteria

The system performance criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.1).

4.10.2.2 Safety Criteria

The safety criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.2).

4.10.2.3 System Environment Criteria

The system environment criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.3).

4.10.2.4 System Interfacing Criteria

The system interfacing criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.4).

4.10.2.5 Operational Criteria

The operational criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.5).

4.10.2.6 Codes and Standards Criteria

The codes and standards criteria for the WHB Electrical System are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000u, Section 1.2.6).

4.11 WASTE HANDLING BUILDING INSTRUMENTATION AND CONTROL SYSTEM

4.11.1 System Functions

The following functions for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.1):

4.11.1.1 The system monitors and controls facility operating systems.

4.11.1.2 The system provides supervisory control.

4.11.1.3 The system monitors access to both controlled and protected areas.

4.11.1.4 The system manages seismic data.

4.11.1.5 The system initiates and directs orderly shutdown of facility systems.

4.11.1.6 The system monitors the status of operational safety systems.

4.11.1.7 The system monitors and directs facility-wide operational start-up.

4.11.1.8 The system provides alarms, messages, and status indications.

4.11.1.9 The system manages the performance of selected surface and subsurface components.

4.11.1.10 The system exchanges information with other MGR systems.

4.11.1.11 The system provides for centralized monitoring of data, voice, and video communications.

4.11.1.12 The system monitors the status of the Site Radiological Monitoring System.

4.11.1.13 The system manages environmental data.

4.11.1.14 The system provides supervisory and remote control of waste emplacement operations.

4.11.1.15 The system provides supervisory and remote control of performance confirmation operations.

4.11.1.16 The system provides features to minimize radiation exposures to workers.

4.11.2 System Design Criteria

The system design criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2).

4.11.2.1 System Performance Criteria

The system performance criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.1).

4.11.2.2 Safety Criteria

The safety criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.2).

4.11.2.3 System Environment Criteria

The system environment criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.3).

4.11.2.4 System Interfacing Criteria

The system interfacing criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.4).

4.11.2.5 Operational Criteria

The operational criteria for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.5).

4.11.2.6 Codes And Standards Criteria

The codes and standards for the WHB Instrumentation and Control System are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2).

4.12 WASTE HANDLING BUILDING UTILITY SYSTEMS

4.12.1 System Functions

Functions are excerpted from the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.1).

4.12.1.1 This system provides CHW, hot water, potable water, industrial air, and instrument air as required to support waste handling operations.

4.12.2 System Design Criteria

4.12.2.1 System Performance Criteria

The system performance criteria for the WHB Utility Systems are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000x, Section 1.2.1).

4.12.2.2 System Safety Criteria

The system safety criteria for the WHB Utility Systems are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000x, Section 1.2.2).

4.12.2.3 Codes and Standards Criteria

The codes and standards criteria for the WHB Utility Systems are as identified in the *Waste Handling Building Electrical System Description Document* (CRWMS M&O 2000x, Section 1.2.6).

4.13 WASTE HANDLING BUILDING RADIOLOGICAL MONITORING SYSTEM

4.13.1 System Functions

Central or "built-in" monitoring systems that give information on the dose rate and concentration of airborne radioactive material in selected station areas can reduce the exposure of station personnel. The central or "built-in" monitoring systems can provide timely information regarding radioactive material in the areas.

This section to be completed during the License Application design phase.

4.13.2 System Design Criteria

The selection or design and installation of a central or "built-in" monitoring system should include consideration of the following desirable features, based on *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable* (Regulatory Guide 8.8, Rev. 3, 1978, p. 11, Section g):

1. Readout capability at the main radiation protection access control point

2. Placement of detectors for optimum coverage of areas

3. Circuitry that indicates component failure

4. Local alarm and readout

5. Clear and unambiguous readout

6. Ranges adequate to ensure readout of the highest anticipated radiation levels and to ensure positive readout at the lowest anticipated levels

7. Capability to record the readout of all systems.

Codes and standards for the WHB radiological monitoring system are as identified in the *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD)* (CRWMS M&O 2000n, Section 1.2.6).

This section to be completed during the License Application design phase.

<u>**WASTE TREATMENT BUILDING**</u>

4.14 WASTE TREATMENT BUILDING SYSTEM

4.14.1 System Functions

The following functions for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.1):

4.14.1.1 The system provides the required space, layout, and structures to support and optimize the low-level waste (LLW) processing operations (including the control systems).

4.14.1.2 The system receives, handles, and stores packaging materials used in packaging of LLW for off-site disposal.

4.14.1.3 The system provides space, layout, and structural support for staging and shipping of packaged waste.

4.14.1.4 The system protects SSCs within the WTB from the external environment.

4.14.1.5 The system provides fire protection for the WTB SSCs.

4.14.1.6 The system receives, handles, and stores materials and chemicals used in LLW processing.

4.14.1.7 The system helps maintain worker and public radiation doses ALARA.

4.14.1.8 The system provides safe work areas with a suitable environment for personnel and equipment to support operations, maintenance, and other activities.

4.14.1.9 The system provides the required space and layout in support of access control requirements.

4.14.1.10 The system provides the required space and layout in support of emergency plans.

4.14.1.11 The system provides utilities as required to support LLW processing operations.

4.14.1.12 The system limits the probability and consequences of off-normal conditions.

4.14.1.13 The system limits the spread of liquid LLW within the facility.

4.14.1.14 The system limits the spread of contamination within the facility.

4.14.1.15 The system provides features that facilitate decontamination and decommissioning at repository closure.

4.14.1.16 The system provides space and layout to support inspection, testing, calibration, and maintenance activities.

4.14.2 System Design Criteria

4.14.2.1 System Performance Criteria

The system performance criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.1).

4.14.2.2 Safety Criteria

The safety criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.2).

4.14.2.3 System Environment Criteria

The system environment criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.3).

4.14.2.4 System Interfacing Criteria

The system interfacing criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.4).

4.14.2.5 Operational Criteria

The operational criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.5).

4.14.2.6 Codes and Standards Criteria

The codes and standards criteria for the WTB System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2.6).

4.15 WASTE TREATMENT BUILDING PROCESS SYSTEMS

A discussion of WTB process systems is contained in Sections 4.32, 4.33, 4.34, 4.35, 4.36, and 4.37 of this document.

4.16 WASTE TREATMENT BUILDING PIPED UTILITY SYSTEMS

The functions and design criteria for the WTB Piped Utility Systems are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac).

4.16.1 System functions are those applicable to piped utilities as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.1).

4.16.2 System design criteria are those applicable to piped utilities as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2).

4.17 WASTE TREATMENT BUILDING FIRE PROTECTION SYSTEM

The functions and design criteria for the WTB Fire Protection System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac).

4.17.1 System functions are those applicable to fire protection as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.1).

4.17.2 System design criteria are those applicable to fire protection as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2).

4.18 WASTE TREATMENT BUILDING ELECTRICAL SYSTEM

The functions and design criteria for the WTB Electrical System are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac).

4.18.1 System functions are those applicable to electrical systems as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.1).

4.18.2 System design criteria are those applicable to electrical systems as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.2).

4.19 WASTE TREATMENT BUILDING VENTILATION SYSTEM

4.19.1 System Functions

The following functions for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.1):

4.19.1.1 The system provides the proper environment for personnel comfort and equipment operation in the confinement and non-confinement areas of the WTB.

4.19.1.2 The system limits the spread of airborne contamination within the WTB.

4.19.1.3 The system limits the release of radionuclides to the accessible environment to maintain public and worker radiation exposures ALARA.

4.19.1.4 The system provides status of system parameters and ventilation equipment operation.

4.19.1.5 The system provides active and passive features for the safety of personnel and for maintaining radiation doses ALARA during normal and off-normal conditions in the WTB.

4.19.1.6 The system permits periodic inspection, testing, and maintenance of system components.

4.19.2 System Design Criteria

4.19.2.1 System Performance Criteria

The system performance for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.1).

4.19.2.2 Safety Criteria

The safety criteria for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.2).

4.19.2.3 System Environment Criteria

The system environment criteria for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.3).

4.19.2.4 System Interfacing Criteria

The system interfacing criteria for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.4).

4.19.2.5 Operational Criteria

The operational criteria for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.5).

4.19.2.6 Codes and Standards Criteria

The codes and standards criteria for the WTB Ventilation System are as identified in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.6).

4.20 WASTE TREATMENT BUILDING RADIOLOGICAL MONITORING SYSTEM

4.20.1 System Functions

Central or "built-in" monitoring systems that give information on the dose rate and concentration of airborne radioactive material in selected station areas can reduce the exposure of station personnel. The central or "built-in" monitoring systems can provide timely information regarding radioactive material in the areas.

This section to be completed during the License Application design phase.

4.20.2 System Design Criteria

The selection or design and installation of a central or "built-in" monitoring system should include consideration of the following desirable features based on *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable* (Regulatory Guide 8.8, Rev. 3. 1978, p. 11, Section g):

1. Readout capability at the main radiation protection access control point
2. Placement of detectors for optimum coverage of areas
3. Circuitry that indicates component failure

4. Local alarm and readout

5. Clear and unambiguous readout

6. Ranges adequate to ensure readout of the highest anticipated radiation levels and to ensure positive readout at the lowest anticipated levels

7. Capability to record the readout of all systems.

This section to be completed during the License Application design phase.

CARRIER PREPARATION BUILDING (CPB)

4.21 CARRIER PREPARATION BUILDING SYSTEM

4.21.1 System Functions

The following functions for the Carrier Preparation Building (CPB) are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.1):

4.21.1.1 The system provides structure and layout, and supports building SSCs to permit optimum operations.

4.21.1.2 The system controls the operating environment.

4.21.1.3 The system protects carrier preparation and supporting subsystems from external natural environments.

4.21.1.4 The system provides fire protection for the building SSCs.

4.21.1.5 The system provides facility safety equipment (i.e., alarm, lights, signals, etc.) and emergency ingress/egress.

4.21.1.6 The system controls access to radiation areas and supports controls to operations involving radiation areas.

4.21.1.7 The system provides habitable areas for support personnel.

4.21.1.8 The system provides utilities and subsystems to support carrier preparation material handling system operations.

4.21.1.9 The system provides space and accommodations for equipment and supplies.

4.21.1.10 The system reduces the risk of, responds to, and recovers from off-normal events.

4.21.1.11 The system shall protect the natural environment from CPB contaminants.

4.21.1.12 The system provides features for the inspection, testing, calibration and maintenance of system equipment.

4.21.1.13 The system accommodates Transportation System cask systems and carriers (i.e., facility space).

4.21.2 System Design Criteria

The system design criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2).

4.21.2.1 System Performance Criteria

The system performance criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.1).

4.21.2.2 Safety Criteria

The safety criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.2).

4.21.2.3 System Environment Criteria

The system environment criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.3).

4.21.2.4 System Interfacing Criteria

The system interfacing criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.4).

4.21.2.5 Operational Criteria

The operational criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.5).

4.21.2.6 Codes and Standards

The codes and standards criteria for the CPB are as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2.6.)

4.22 CARRIER PREPARATION BUILDING MATERIALS HANDLING SYSTEM

4.22.1 System Functions

The following functions for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.1):

4.22.1.1 The system accommodates carriers with empty or loaded casks from, and returns them to, the Carrier/Cask Transport System (CCTS).

4.22.1.2 The system removes/retracts and reinstalls the personnel barriers.

4.22.1.3 The system performs a physical inspection of the cask and carrier.

4.22.1.4 The system performs a contamination survey of the cask and associated carrier.

4.22.1.5 The system measures the external temperature of the transportation cask.

4.22.1.6 The system removes/retracts and reinstalls the transportation cask impact limiters.

4.22.1.7 The system removes and reinstalls cask tie-down devices.

4.22.1.8 The system removes and installs cask trunnions.

4.22.1.9 The system supports the collection of material control and accounting data.

4.22.1.10 The system operates within the environmental conditions of the CPB.

4.22.1.11 The system provides features to minimize radiation exposure to workers.

4.22.1.12 The system provides features and equipment for reducing the risk of, responding to, and recovering from off-normal events and credible DBEs.

4.22.1.13 The system provides features for the inspection, testing, and maintenance of system equipment.

4.22.1.14 The system facilitates decontamination and decommissioning prior to repository closure.

4.22.1.15 The system decontaminates transportation systems, excluding the casks and overpacks.

4.22.2 System Design Criteria

The system design criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2).

4.22.2.1 System Performance Criteria

The system performance criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.1).

4.22.2.2 Safety Criteria

The safety criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.2).

4.22.2.3 System Environment Criteria

The system environment criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.3).

4.22.2.4 System Interfacing Criteria

The system interfacing criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.4).

4.22.2.5 Operational Criteria

The operational criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.5).

4.22.2.6 Codes and Standards

The codes and standards criteria for the CPB Materials Handling System are as identified in the *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2.6).

4.23 CARRIER PREPARATION BUILDING ELECTRICAL SYSTEM

4.23.1 System functions are those applicable to electrical systems as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.1).

4.23.2 System design criteria are those applicable to electrical systems as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2).

4.24 CARRIER PREPARATION BUILDING FIRE PROTECTION SYSTEM

4.24.1 System functions are those applicable to fire protection as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.1).

4.24.2 System design criteria are those applicable to fire protection as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2).

4.25 CARRIER PREPARATION BUILDING VENTILATION SYSTEM

4.25.1 System functions are those applicable to ventilation systems as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.1).

4.25.2 System design criteria are those applicable to ventilation systems as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2).

4.26 CARRIER PREPARATION BUILDING PIPED UTILITY SYSTEMS

4.26.1 System functions are those applicable to piped utilities as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.1).

4.26.2 System design criteria are those applicable to piped utilities as identified in the *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2).

4.27 CARRIER PREPARATION BUILDING RADIOLOGICAL MONITORING SYSTEM

4.27.1 System Functions

Central or "built-in" monitoring systems that give information on the dose rate and concentration of airborne radioactive material in selected station areas can reduce the exposure of station personnel. The central or "built-in" monitoring systems can provide timely information regarding radioactive material in the areas.

This section to be completed during the License Application design phase.

4.27.2 System Design Criteria

The selection or design and installation of a central monitoring system should include consideration of the following desirable features, based on *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable* (Regulatory Guide 8.8, Rev. 3, 1978, p. 11, Section 8):

1. Readout capability at the main radiation protection access control point
2. Placement of detectors for optimum coverage of areas
3. Circuitry that indicates component failure
4. Local alarm and readout
5. Clear and unambiguous readout
6. Ranges adequate to ensure readout of the highest anticipated radiation levels and to ensure positive readout at the lowest anticipated levels
7. Capability to record the readout of all systems.

This section to be completed during the License Application design phase.

4.28 TRANSPORTER MAINTENANCE BUILDING SYSTEM

This section to be completed during the License Application design phase.

4.29 CARRIER/CASK RAIL SYSTEM

This section to be completed during the License Application design phase.

4.30 CARRIER/CASK ROAD SYSTEM

This section to be completed during the License Application design phase.

4.31 SITE PRIME MOVER SYSTEM

4.31.1 System Functions

The following functions for the Site Prime Mover (SPM) System are as identified in the *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Sections 6.1.1 and 6.3.1.1):

4.31.1.1 The SPM transports rail and truck carriers containing radioactive waste containers, waste handling equipment, and other heavy loads inside the MGR Radiologically Controlled Area (RCA).

4.31.1.2 The track-guided SPM transports rail carriers containing transportation casks between the waste entry point at the repository security gate and the carrier staging (rail yard parking) area.

4.31.1.3 The tire-mounted SPM transports truck carriers containing transportation casks between the waste entry point at the repository security gate and the carrier staging (truck parking) area.

4.31.1.4 The rail and tire-mounted SPMs transport rail and truck carriers containing transportation casks between the carrier staging areas and the surface waste handling facilities (CPB and WHB).

4.31.1.5 The track-guided SPM transports rail carriers containing empty DPC overpacks, empty DCs, and waste handling equipment between the repository security gate and the WHB.

4.31.1.6 The track-guided SPM transports rail carriers containing emplacement equipment and other heavy loads between the repository security gate and the WP Transporter Maintenance Building (TMB).

4.31.1.7 The track-guided SPM transports the WP Transporter between the repository security gate and the WP TMB.

4.31.1.8 The tire-mounted SPM transports truck carriers containing DC emplacement pallets, equipment, and other heavy loads inside the MGR RCA.

4.31.2 System Design Criteria

4.31.2.1 The design criteria for the SPMs are as identified and developed in the following documents:

- *Canister Transfer System Description Document* (CRWMS M&O 2000d, Section 1.2)
- *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 4.2)
- *Carrier Preparation Building Materials Handling System Description Document* (CRWMS M&O 2000e, Section 1.2)
- *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.2)

4.31.2.2 The waste handling system shall be capable of accommodating shipments of spent fuel and high-level waste (HLW) delivered by legal weight truck (LWT), heavy-haul transport (HHT), and rail carriers (CRWMS M&O 2000e, Section 1.2).

4.31.2.3 The waste handling system shall be capable of handling waste at the annual throughput rates described in Table 1 of the *Carrier/Cask Handling System Description Document*. (CRWMS M&O 2000f, Section 1.2.1.2)

4.31.2.4 The system shall have an operational life of 40 years. (CRWMS M&O 2000f, Section 1.2.1.1)

4.31.2.5 The waste transport system shall be designed to limit occupational radiation exposures to an ALARA level without exceeding 500 mrem/year while performing carrier/cask transport operations. (CRWMS M&O 2000g, Section 5.1, and CRWMS M&O 1997b, Section 4.3.4)

4.31.2.6 "The waste handling system shall provide for worker safety in accordance with applicable sections of 29 CFR 1910, Occupational Safety and Health Regulations." (CRWMS M&O 2000g, Section 4.2.16)

4.31.2.7 The waste handling system shall be designed for worker safety in accordance with applicable sections of 10 CFR 20, Standards for Protection Against Radiation. (CRWMS M&O 2000g, Section 4.2.17)

4.31.2.8 The SPMs shall be designed to haul carriers of the capacity and dimensional envelopes shown in Table 6-2 of the *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 6.4.2).

4.31.2.9 The system shall interface with the CPB Materials Handling System, the CCHS, the DCHS, the WHB System, and the MGR Site Layout.

SECONDARY LOW-LEVEL WASTE TREATMENT SYSTEM

4.32 WASTE MANAGEMENT OVERVIEW

Functions and design criteria for the overall management of MGR site-generated LLW and mixed waste are established in *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t).

4.32.1 System functions are those applicable to waste management overview as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.1).

4.32.2 System design criteria are those applicable to waste management overview as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.2).

4.33 LIQUID LOW-LEVEL WASTE RADIOACTIVE WASTE MANAGEMENT SYSTEM

Functions and design criteria for the liquid LLW (both recyclable and non-recyclable liquids) radioactive waste management system are established in *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t).

4.33.1 System functions are those applicable to LLW radioactive waste management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.1).

4.33.2 System design criteria are those applicable to LLW radioactive waste management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.2).

4.34 SOLID LOW-LEVEL WASTE MANAGEMENT SYSTEM

Functions and design criteria for the solid LLW management system are established in the *Site-Generated Radiological Waste Handling System Description* (CRWMS M&O 2000t).

4.34.1 System functions are those applicable to solid LLW management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.1).

4.34.2 System design criteria are those applicable to solid LLW management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.2).

4.35 MIXED WASTE MANAGEMENT SYSTEM

Functions and design criteria for the mixed waste management system are established in *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t).

4.35.1 System functions are those applicable to mixed waste management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.1).

4.35.2 System design criteria are those applicable to mixed waste management as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.2).

4.36 PROCESS RADIOLOGICAL MONITORING AND SAMPLING SYSTEM

Functions and design criteria for the process radiological monitoring system are established in *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t).

4.36.1 System functions are those applicable to process radiological monitoring and sampling as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.1).

4.36.2 System design criteria are those applicable to process radiological monitoring and sampling as identified in the *Site-Generated Radiological Waste Handling System Description Document* (CRWMS M&O 2000t, Section 1.2).

4.37 SOURCE TERMS

The establishment of functions and design criteria are not applicable to the discussion of source terms.

ADDITIONAL RADIOLOGICALLY CONTROLLED AREA

4.38 NORTH PORTAL ACCESS VESTIBULE

This section to be completed during the License Application design phase.

Codes and standards include:

- *1997 Uniform Building Code* (ICBO 1997)
- NFPA 101, *Life Safety Code*

4.39 SAFEGUARDS AND SECURITY SYSTEM

4.39.1 System Functions

The following functions for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.1):

4.39.1.1 The system provides multiple, graded barriers to the MGR facilities, SNF, and HLW.

4.39.1.2 The system monitors for, and assesses, unauthorized accesses and intrusions to MGR perimeters, protected areas, and other restricted areas.

4.39.1.3 The system responds to unauthorized accesses and intrusions to MGR perimeters, protected areas, and other restricted areas, and communicates reportable events to the required agencies.

4.39.1.4 The system controls personnel access to and within the MGR perimeters, protected areas, and other restricted areas.

4.39.1.5 The system monitors for firearms, explosives, incendiary devices, and other prohibited articles and prevents their entry into the MGR.

4.39.1.6 The system documents system operations and alarm events.

4.39.1.7 The system records the receipt and transfer of SNF and HLW at and within MGR boundaries.

4.39.1.8 The system documents the inventory of SNF and HLW.

4.39.1.9 The system provides for the evacuation of facility personnel.

4.39.2 System Design Criteria

The system design criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2).

4.39.2.1 System Performance Criteria

The system performance criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.1).

4.39.2.2 Safety Criteria

The safety criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.2).

4.39.2.3 System Environment Criteria

The system environment criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.3).

4.39.2.4 System Interfacing Criteria

The system interfacing criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.4).

4.39.2.5 Operational Criteria

The operational criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.5).

4.39.2.6 Codes and Standards Criteria

The codes and standards criteria for the Safeguards and Security System are as identified in the *Safeguards and Security System Description Document* (CRWMS M&O 1999s, Section 1.2.6).

4.40 DECONTAMINATION AND DECOMMISSIONING OF SURFACE FACILITIES

This section to be completed during the License Application design phase.

4.41 RADIOLOGICAL ASSESSMENT

This section to be completed during the License Application design phase.

BALANCE OF PLANT

4.42 BALANCE OF PLANT FACILITIES

This section to be completed during the License Application design phase.

4.43 SITE ELECTRICAL POWER SYSTEM

4.43.1 System Functions

The following functions for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.1):

4.43.1.1 The system distributes electrical power during construction, operation, caretaker, and closure phases of the repository.

4.43.1.2 The system receives electrical power from the Offsite Utilities System.

4.43.1.3 The system monitors incoming power quality, system operating parameters, and equipment status.

4.43.1.4 The system provides for the monitoring and control of its operation by either local or remote means.

4.43.1.5 The system provides normal and standby (including dedicated safeguards and security) power.

4.43.1.6 The system distributes and transforms electrical power for the Protected Area facilities (includes Subsurface Facility System [SSF]), BOP facilities, and site support equipment and substations.

4.43.1.7 The system provides lighting, grounding, and lightning protection at the North Portal for the surface facilities.

4.43.1.8 The system operates within the expected environmental conditions.

4.43.1.9 The system provides safety features to protect personnel and equipment during normal and off-normal conditions.

4.43.1.10 The system provides features for the inspection, testing, calibration, and maintenance of system equipment.

4.43.1.11 The system provides features that facilitate decommissioning at repository closure.

4.43.2 System Design Criteria

The system design criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2).

4.43.2.1 System Performance Criteria

The system performance criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.1).

4.43.2.2 Safety Criteria

The safety criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.2).

4.43.2.3 System Environment Criteria

The system environment criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.3).

4.43.2.4 System Interfacing Criteria

The system interfacing criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.4).

4.43.2.5 Operational Criteria

The operational criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.5).

4.43.2.6 Codes and Standards Criteria

The codes and standards criteria for the Site Electrical Power System are as identified in the *Site Electrical Power System Description Document* (CRWMS M&O 1999v, Section 1.2.6).

4.44 SITE WATER SYSTEM

The system functions and design criteria for the Site Water System have not been established. Certain design criteria for potable water have been identified from Section 4.2.1.1 of the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j):

- Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6.
- The potable water system shall be designed and installed to comply with Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

- The water quality monitoring system shall have the capability to sample, measure, and analyze physical, chemical, and biological conditions consistent with the requirements of the Clean Water Act of 1972, as amended (CWA) (33 USC 1251) and the Safe Drinking Water Act (42 USC 300f). Such capability shall also be compatible with the type and range of concentrations/occurrences of conditions specified in governing regulations (e.g., 40 CFR 122, 141, 143, and State and local regulations).

This section to be completed during the License Application design phase.

4.45 SITE COMMUNICATION SYSTEM

The communication system shall be designed to comply with the applicable provisions of the codes and standards as identified in the *Site Communication and Control Systems Technical Report* (CRWMS M&O 1998h, Section 4.4).

This section to be completed during the License Application design phase.

4.46 SITE COMPRESSED AIR SYSTEM

Specific system functions and design criteria for the Site Compressed Air System have not been established. Certain design criteria pertaining to breathing air have been identified from the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.2):

- ANSI Z88.2-92, Practices for Respiratory Protection
- 29 CFR 1910, Selected General Industry Safety and Health Standards
- ANSI/CGA G-7.1-1966, Commodity Specifications for Air

This section to be completed during the License Application design phase.

4.47 SITE FIRE PROTECTION SYSTEM

4.47.1 System Functions

The following functions for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.1):

4.47.1.1 The system provides the means for detection and annunciation of fires.

4.47.1.2 The system provides the means to control, minimize the propagation of, and extinguish fires.

4.47.1.3 The system provides fire protection water storage and distribution.

4.47.1.4 The system delivers fire suppressants (water and other agents) within the surface areas/facilities other than the WHB, WTB, CPB, and SSF.

4.47.1.5 The system provides the means to detect, control, and mitigate credible explosion hazards except for the WHB, WTB, CPB, and the SSF.

4.47.1.6 The system provides occupant notification of fire emergency conditions within surface facilities except for the WHB, WTB, CPB, and SSF.

4.47.1.7 Reserved

4.47.1.8 The system provides fire protection signals to support site (surface and SSFs) fire alarm requirements.

4.47.1.9 The system provides equipment, storage, and training facilities for manual fire fighting.

NOTE: Design criteria related to this function will be provided in a later version of this document.

4.47.1.10 The system completes fire barriers where penetrations exist.

4.47.2 System Design Criteria

The system design criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2).

4.47.2.1 System Performance Criteria

The system performance criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2.1).

4.47.2.2 Safety Criteria

The safety criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2.2).

4.47.2.3 System Environment Criteria

The system environment criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2.3).

4.47.2.4 System Interface Criteria

The system interface criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2.4).

4.47.2.5 Operational Criteria

The operational criteria for the Site Fire Protection System are as identified in the *Site Fire Protection System Description Document* (CRWMS M&O 2000s, Section 1.2.5).

4.48 SITE RADIOLOGICAL PROTECTION SYSTEM

This section to be completed during the License Application design phase.

4.49 SURFACE ENVIRONMENTAL MONITORING SYSTEM

This section to be completed during the License Application design phase.

4.50 SITE OPERATIONS SYSTEM

4.50.1 System Functions

The following functions for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.1):

4.50.1.1 The system develops and adjusts the repository production schedule to meet customers needs.

4.50.1.2 The system administers an inventory control program to maintain repository production schedules.

4.50.1.3 The system collects facility variables on repository systems and processes.

4.50.1.4 The system stores operational, production, and quality data into a historical database.

4.50.1.5 The system evaluates repository production data and optimizes the repository production operations.

4.50.1.6 The system evaluates production needs and reconfigures the repository processes in response to changing objectives.

4.50.1.7 The system administers preventative and corrective maintenance.

4.50.1.8 The system assesses and ensures the availability of lower level systems to carry out their assigned tasks.

4.50.1.9 The system interfaces with internal and external entities such as Surface Operations Monitoring and Control System, Subsurface Operations Monitoring and Control System, Emergency Response System, Security and Safeguards System, and State and Federal Agencies.

4.50.2 System Design Criteria

4.50.2.1 System Performance Criteria

The system performance criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.1).

4.50.2.2 Safety Criteria

The safety criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.2).

4.50.2.3 System Environment Criteria

The system environment criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.3).

4.50.2.4 System Interfacing Criteria

The system interfacing criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.4).

4.50.2.5 Operational Criteria

The operational criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.5).

4.50.2.6 Codes and Standards Criteria

The codes and standards criteria for the Site Operations System are as identified in the *Site Operations System Description Document* (CRWMS M&O 1998k, Section 1.2.6).

4.51 MAINTENANCE AND SUPPLY SYSTEM

This section to be completed during the License Application design phase.

4.52 MONITORED GEOLOGIC REPOSITORY SITE LAYOUT SYSTEM

4.52.1 System Functions

The functions are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.1).

4.52.1.1 The layout incorporates specific Exploratory Studies Facility (ESF) structures and utilities located on the surface.

4.52.1.2 The layout locates and arranges the MGR systems and features located on the surface.

4.52.1.3 The layout accommodates the entrances to the subsurface facilities.

4.52.1.4 The layout maximizes preclosure radiological safety.

4.52.1.5 The system provides the site preparation and civil features necessary for MGR operations.

4.52.1.6 The layout provides acceptable operating conditions for MGR surface operations.

4.52.1.7 The layout minimizes impacts on historical and archaeological features.

4.52.1.8 The layout minimizes impacts on endangered species.

4.52.1.9 The layout minimizes impacts on the environment.

4.52.1.10 The layout minimizes the effects of natural environments and events.

4.52.1.11 The layout supports construction, emplacement, retrieval, and decommissioning operations.

4.52.1.12 The layout identifies the preclosure controlled area prior to permanent closure.

4.52.1.13 The layout identifies the postclosure controlled area and the geologic repository operations area (GROA) after permanent closure.

4.52.1.14 The system provides features for maintenance of system facilities, structures, and equipment.

4.52.1.15 The system operates within the environmental conditions of the site.

4.52.2 System Design Criteria

4.52.2.1 System Performance Criteria

The system performance criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.1).

4.52.2.2 Safety Criteria

The safety criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.2).

4.52.2.3 System Environment Criteria

The system environment criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.3).

4.52.2.4 System Interfacing Criteria

The system interfacing criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.4).

4.52.2.5 Operational Criteria

The operational criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.5).

4.52.2.6 Codes and Standards Criteria

The codes and standards criteria for the MGR Site Layout are as identified in the *Monitored Geologic Repository Site Layout System Description Document* (CRWMS M&O 1999q, Section 1.2.6).

4.53 HEALTH SAFETY SYSTEM

Design features of radiation protection support facilities should include consideration of control stations for entrance or exit of personnel into radiation and contamination controlled access areas of the station. based on *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable* (Regulatory Guide 8.8, Rev. 3. 1978, p. 15, Section 4.e).

This section to be completed during the License Application design phase.

4.54 GENERAL SITE TRANSPORTATION SYSTEM

This section to be completed during the License Application design phase.

4.55 EMERGENCY RESPONSE SYSTEM

4.55.1 System Functions

System functions for the Emergency Response System (ERS) are found in the *Emergency Response System Description Document*. (CRWMS M&O 1998d, Section 1.1)

4.55.1.1 The radiological ERS activates upon notification of a radiological emergency (i.e., abnormal event or DBE) during the operational life of the MGR and remains

activated and functional as long as radiological emergency response activities are being conducted.

4.55.1.2 Reserved

4.55.1.3 The radiological ERS prevents congestion in the control area and during radiological emergencies.

4.55.1.4 The radiological ERS provides technical assistance to the control area during radiological emergencies.

4.55.1.5 The radiological ERS provides a focal point for assembling, dispatching, and coordinating personnel and associated equipment involved in radiological emergency response activities.

4.55.1.6 The radiological ERS includes voice and data communications as necessary to support radiological emergency response activities.

4.55.1.7 The radiological ERS includes a communication pathway for sending data to the U.S. Nuclear Regulatory Commission (NRC) for its analysis of radiological emergencies.

4.55.1.8 The radiological ERS maintains radiological emergency response records.

4.55.1.9 The radiological ERS includes communications pathways for updating news media and responding to information requests during radiological emergencies.

4.55.1.10 The radiological ERS provides dedicated SSCs and supplies necessary to support radiological emergency response activities.

4.55.1.11 The radiological ERS allows for the inspection, testing, calibration, and maintenance of radiological emergency response SSCs.

4.55.1.12 The radiological ERS interfaces with onsite facilities and SSCs and offsite organizations and agencies as necessary to support radiological emergency response activities.

4.55.2 System Design Criteria

The design criteria for the ERS are as identified in the *Emergency Response System Description Document* (CRWMS M&O 1998d, Section 1.2).

4.55.3 Codes and Standards Criteria

The codes and standards for the ERS are as identified in the *Emergency Response System Description Document* (CRWMS M&O 1998d, Section 1.2.6).

4.56 ADMINISTRATION SYSTEM

This section to be completed during the License Application design phase.

5. REFERENCES

5.1 DOCUMENTS CITED

CRWMS M&O 1993. *Surface Wastewater Calculation.* B00000000-01717-0200-00076 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19940712.0089.

CRWMS M&O 1995a. *Exploratory Studies Facility Package 1A, ESF Water System Supply and First Access P&ID Sheet 1.* YMP-025-1-CIVL-CI108, Rev. 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960523.0293.

CRWMS M&O 1995b. *Mined Geologic Disposal System Design ALARA Program.* B00000000-01717-5705-00023 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960312.0111.

CRWMS M&O 1995c. *Sanitary Sewer Calculation.* B00000000-01717-0200-00077 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960122.0020.

CRWMS M&O 1997a. *Canister Transfer System Design Analysis.* BCBD00000-01717-0200-00008 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980108.0054.

CRWMS M&O 1997b. *Remote Operations Design Guide.* BCBD00000-01717-2500-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980225.0413.

CRWMS M&O 1997c. *Repository Surface Design, MFD - Waste Handling Overview.* BCBD00000-01717-2700-67000 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971007.0727.

CRWMS M&O 1997d. *Secondary Waste Treatment Analysis.* BCBD00000-01717-0200-00005 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971208.0201.

CRWMS M&O 1997e. *Surface Nuclear Facilities Space Program Analysis.* BCBD00000-01717-0200-00012 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980204.0138.

CRWMS M&O 1997f. *Waste Handling Facilities Recovery Analysis.* BCBD00000-01717-0200-00003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971208.0453.

CRWMS M&O 1998a. *Carrier Preparation Building System Description Document.* BCB000000-01717-1705-00002 REV 00. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981111.0032.

CRWMS M&O 1998b. *Carrier/Cask Handling System Design Analysis.* BCBD00000-01717-0200-00006 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981211.0044.

CRWMS M&O 1998c. *CRWMS Modular Design/Construction and Operation Options Report.* A00000000-01717-5700-00022 REV 02. Vienna, Virginia: CRWMS M&O. ACC: MOV.19981218.0001.

CRWMS M&O 1998d. *Emergency Response System Description Document.* BCB000000-01717-1705-00009 REV 00. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990203.0212.

CRWMS M&O 1998e. *Interface Control Document for the Transportation System and the Mined Geological Disposal System Surface Repository Facilities and Systems for Mechanical and Envelope Interfaces Between the Surface Facility Operations and the Waste Acceptance and Transportation Office.* A00000000-01717-8100-00008 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980904.0591.

CRWMS M&O 1998f. *Repository Surface Design Site Layout Analysis.* BCB000000-01717-0200-00007 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980410.0136.

CRWMS M&O 1998g. *Repository Waste Handling Integrated Model Development Report.* BC0000000-01717-6700-00003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980220.0087.

CRWMS M&O 1998h. *Site Communications and Control Systems Technical Report.* BCBC00000-01717-5705-00002 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980702.0410.

CRWMS M&O 1998i. *Site Electrical System Technical Report.* BCBC00000-01717-5705-00003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980702.0372.

CRWMS M&O 1998j. *Site Gas/Liquid Systems Technical Report.* BCBC00000-01717-5705-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980501.0178.

CRWMS M&O 1998k. *Site Operations System Description Document.* BCB000000-01717-1705-00005 REV 00. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981111.0042.

CRWMS M&O 1998l. *Site Safety and Security Systems Technical Report.* BCB000000-01717-5705-00010 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980727.0035.

CRWMS M&O 1998m. *Transportation Cask Physical Envelope Study Report.* B00000000-01717-5705-00089 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980330.0039.

CRWMS M&O 1998n. *WHB, WTB, and CPB Support Systems Technical Report.* BCB000000-01717-5705-00011 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980519.0233.

CRWMS M&O 1999a. *Classification of the MGR Carrier Preparation Building System.* ANL-CBS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0188.

CRWMS M&O 1999b. *Classification of the MGR Health Safety System.* ANL-HSS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990927.0478.

CRWMS M&O 1999c. *Classification of the MGR Offsite Utilities System.* ANL-OUS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0155.

CRWMS M&O 1999d. *Classification of the MGR Pool Water Treatment and Cooling System.* ANL-PLS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0191.

CRWMS M&O 1999e. *Classification of the MGR Site Compressed Air System.* ANL-TCA-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0151.

CRWMS M&O 1999f. *Classification of the MGR Site Generated Radiological Waste Handling System.* ANL-SRW-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0149.

CRWMS M&O 1999g. *Classification of the MGR Site Water System.* ANL-SWS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0179.

CRWMS M&O 1999h. *Classification of the MGR Surface Environmental Monitoring System.* ANL-SEM-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0182.

CRWMS M&O 1999i. *Classification of the MGR Waste Handling Building Electrical System.* ANL-HBE-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990927.0476.

CRWMS M&O 1999j. *Classification of the MGR Waste Handling Building Fire Protection System.* ANL-HBF-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990927.0479.

CRWMS M&O 1999k. *Classification of the MGR Waste Handling Building System.* ANL-HBS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0184.

CRWMS M&O 1999l. *Classification of the MGR Waste Treatment Building System.* ANL-TBS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0211.

CRWMS M&O 1999m. *Developing Engineering Files to Support SR (Work Package 24012123M1).* Activity Evaluation, October 5, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991020.0148.

CRWMS M&O 1999n. *MGR Compliance Program Guidance Package for As Low As Is Reasonably Achievable (ALARA) During the Design Phase.* BA0000000-01717-5600-00017 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991020.0171.

CRWMS M&O 1999o. *Modular Design/Phased Construction Alternative Evaluation Report.* BC0000000-01717-2200-00017 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990609.0159.

CRWMS M&O 1999p. *Monitored Geologic Repository Project Description Document.* B00000000-01717-1705-00003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990701.0328.

CRWMS M&O 1999q. *Monitored Geologic Repository Site Layout System Description Document.* BCB000000-01717-1705-00007 REV 00. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990512.0159.

CRWMS M&O 1999r. *Preliminary Geotechnical Investigation for Waste Handling Building, Yucca Mountain Site Characterization Project.* BCB000000-01717-5705-00016 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990625.0182.

CRWMS M&O 1999s. *Safeguards and Security System Description Document.* BCB000000-01717-1705-00011 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990720.0205.

CRWMS M&O 1999t. *Secondary Low-Level Waste Generation Rate Analysis.* BCBD00000-01717-0200-00020 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990511.0368.

CRWMS M&O 1999u. *Secondary Low-Level Waste Treatment Strategy Analysis.* BCBD00000-01717-0200-00025 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990604.0170.

CRWMS M&O 1999v. *Site Electrical Power System Description Document.* BCB000000-01717-1705-00021 REV 00. Two volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990720.0207.

CRWMS M&O 1999w. *Solar Power System Requirements.* SUF-SEI-99396.T. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0323.

CRWMS M&O 1999x. *Waste Handling Building Fire Hazards Technical Report.* BCBD00000-01717-5705-00009 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991104.0573.

CRWMS M&O 1999y. *Waste Handling Operations - Dose Assessment.* BCBD00000-01717-0200-00010 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990104.0467.

CRWMS M&O 1999z. *Waste Treatment and Carrier Prep Buildings Fire Hazards Technical Report.* BCBD00000-01717-5705-00010 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991104.0574.

CRWMS M&O 1999aa. *WITNESS Model Results and Forecasts for Modular Design of Surface Facilities.* BCBD00000-01717-0210-00005 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990505.0475.

CRWMS M&O 2000a. *Assembly Transfer System Description Document.* SDD-ATS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000214.0305.

CRWMS M&O 2000b. *Assembly Transfer System Input to Support the Site Recommendation Phase.* Input Transmittal 00276.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0129.

CRWMS M&O 2000c. *Calculations from Surface Facilities Operations in Support of the Revision to the Waste Quantity, Mix, and Throughput Study.* Input Transmittal RSO-SUF-99304.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000210.0077.

CRWMS M&O 2000d. *Canister Transfer System Description Document.* SDD-CTS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000214.0303.

CRWMS M&O 2000e. *Carrier Preparation Building Materials Handling System Description Document.* SDD-CMH-SE-000001. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0309.

CRWMS M&O 2000f. *Carrier/Cask Handling System Description Document.* SDD-CCH-SE-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0310.

CRWMS M&O 2000g. *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase.* Input Transmittal 00279.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0132.

CRWMS M&O 2000h. *Decontamination and Decommissioning (D&D) Input for Site Recommendation (SR).* Input Transmittal 00280.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0133.

CRWMS M&O 2000i. *Development Plan for Engineering Files for Site Recommendation.* Development Plan TDP-WHS-MD-000001 REV 03. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0327.

CRWMS M&O 2000j. *Disposal Container Handling System Description Document.* SDD-DCH-SE-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0312.

CRWMS M&O 2000k. *Disposal Container Handling System Input to Support the Site Recommendation Phase.* Input Transmittal 00275.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0128.

CRWMS M&O 2000l. *Estimated Annual MGR Normal Radiological Release.* Input Transmittal RSO-SUF-99389.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000105.0143.

CRWMS M&O 2000m. *Instrumentation and Controls Input to Support the Site Recommendation Phase.* Input Tranmittal 00283.T. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0324.

CRWMS M&O 2000n. *Monitored Geologic Repository (MGR) Operations Monitoring and Control System Description Document (SDD).* SDD-OMC-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0319.

CRWMS M&O 2000o. *Operational Maintenance for the Surface Facilities.* Input Transmittal 00266.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000512.0060.

CRWMS M&O 2000p. *Pool Water Treatment and Cooling System Description Document.* SDD-PLS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0318.

CRWMS M&O 2000q. *Radiation Access Zones.* Input Transmittal 00272.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0127.

CRWMS M&O 2000r. *Repository Subsurface Design Information to Support TSPA-SR (PA-SSR-99218.Tc).* Input Transmittal 00260.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000505.0046.

CRWMS M&O 2000s. *Site Fire Protection System Description Document.* SDD-SFP-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0320.

CRWMS M&O 2000t. *Site-Generated Radiological Waste Handling System Description Document.* SDD-SRW-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0317.

CRWMS M&O 2000u. *Waste Handling Building Electrical System Description Document.* SDD-HBE-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0313.

CRWMS M&O 2000v. *Waste Handling Building Fire Protection System Description Document.* SDD-HBF-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0316.

CRWMS M&O 2000w. *Waste Handling Building Shield Wall Analysis.* BCBD00000-01717-0200-00011 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990111.0156.

CRWMS M&O 2000x. *Waste Handling Building System Description Document.* SDD-HBS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000217.0249.

CRWMS M&O 2000y. *Waste Handling Building Ventilation System Description Document.* SDD-HBV-SE-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0314.

CRWMS M&O 2000z. *Waste Package Remediation System Description Document.* SDD-WPR-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0311.

CRWMS M&O 2000aa. *Waste Package Remediation System Input to Support the Site Recommendation Phase.* Input Transmittal 00278.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0131.

CRWMS M&O 2000ab. *Waste Transfer Pool System Input to Support the Site Recommendation Phase.* Input Transmittal 00277.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000518.0130.

CRWMS M&O 2000ac. *Waste Treatment Building System Description Document.* SDD-TBS-SE-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0308.

CRWMS M&O 2000ad. *Waste Treatment Building Ventilation System Description Document.* SDD-TVS-SE-000001 REV 01. Las Vegas, NV: CRWMS M&O. URN-0315.

CRWMS M&O 2000ae. *WHB Electrical Input to Support the Site Recommendation Phase.* Input Transmittal 00282.T. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0325.

CRWMS M&O 2000af. *WHB/WTB Space Program Analysis for Site Recommendation.* ANL-WHS-AR-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0326.

DOE (U.S. Department of Energy) 1997. *Nevada Test Site Waste Acceptance Criteria.* DOE/NV-325, Rev. 1. Las Vegas, Nevada: U.S. Department of Energy. ACC: MOL.19990318.0235.

DOE (U.S. Department of Energy) 1998. *Preliminary Design Concept for the Repository and Waste Package.* Volume 2 of *Viability Assessment of a Repository at Yucca Mountain.* DOE/RW-0508. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19981007.0029.

DOE (U.S. Department of Energy) 1999. *U.S. Department of Energy Spent Nuclear Fuel to the Monitored Geologic Repository for Mechanical and Envelope Interfaces.* Volume 1 of *Integrated Interface Control Document.* DOE/RW-0511, Rev. 0. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19990428.0236.

DOE (U.S. Department of Energy) 2000. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 10. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000427.0422.

Dyer, J.R. 1999. "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada." Letter from Dr. J.R. Dyer (DOE/YMSCO) to Dr. D.R. Wilkins

(CRWMS M&O), September 3, 1999, OL&RC:SB-1714, with enclosure, "Interim Guidance Pending Issuance of New NRC Regulations for Yucca Mountain (Revision 01)." ACC: MOL.19990910.0079.

Meyers, S.J. 1997. "Waste Handling Flow Diagram Assumptions (Revision 1)." Interoffice correspondence from S.J. Meyers (CRWMS M&O) to K.E. Schwartztrauber, May 20, 1997, LV.SD.SJM.4/97-012A. ACC: MOL.19971106.0341.

5.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES CITED

10 CFR 20. Energy: Standards for Protection Against Radiation. Readily Available

10 CFR 60. 1990. Energy: Disposal of High-Level Radioactive Wastes in Geologic Repositories. Readily Available

10 CFR 61. Energy: Licensing Requirements for Land Disposal of Radioactive Waste. Readily Available

40 CFR 122. Protection of Environment: EPA Administered Permit Programs: The National Pollution Discharge Elimination System. Readily Available

40 CFR 141. Protection of Environment: National Primary Drinking Water Regulations. Readily Available

40 CFR 143. Protection of Environment: National Secondary Drinking Water Regulations. Readily Available

ANSI/ANS-40.35-1991. *Volume Reduction of Low-Level Radioactive Waste or Mixed Waste.* La Grange Park, Illinois: American Nuclear Society. TIC: 240264.

ANSI/ANS-55.1-1992. *Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants.* La Grange Park, Illinois: American Nuclear Society. TIC: 241063.

ANSI/ANS-55.6-1993. *Liquid Radioactive Waste Processing System for Light Water Reactor Plants.* La Grange Park, Illinois: American Nuclear Society. TIC: 243644.

ANSI/ANS-57.7-1988. *Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type).* La Grange Park, Illinois: American Nuclear Society. TIC: 238870.

AP-2.13Q, Rev. 0, ICN 3. *Technical Product Development Planning.* Washington, D.C.: U. S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL. 20000504.0305.

AP-3.11Q, Rev. 1. *Technical Reports.* Washington, D.C.: U. S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000516.0008.

AP-3.15, Rev. 1, ICN 1. *Managing Technical Product Inputs.* Washington, D.C.: U. S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000218.0069.

AP-SI.1Q, Rev. 2, ICN 4. *Software Management.* Washington, D.C.: U. S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000223.0508.

AP-SV.1Q, *Control of the Electronic Management of Data.* Washington, D.C.: U. S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC MOL.20000512.0068.

Clean Water Act. 33 U.S.C. 1251 Readily Available

Energy Policy Act of 1992. 42 U.S.C. 13201 et seq Readily Available

ICBO (International Conference of Building Officials) 1997. *1997 Uniform Building Code.* Three volumes. Whittier, California: International Conference of Building Officials. TIC: 233816; 233817; 233818.

NFPA 13. 1999. *Standard for the Installation of Sprinkler Systems.* 1999 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 247109.

NFPA 101. 1997. *Life Safety Code.* 1997 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 238714.

QAP-2-0, Rev. 5. *Conduct of Activities.* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980826.0209.

QAP-2-3, Rev. 10. *Classification of Permanent Items.* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990316.0006.

Regulatory Guide 8.8, Rev. 3. 1978. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable.* Washington, D.C.: U.S. Nuclear Regulatory Commission. Readily Available

6. USE OF COMPUTER SOFTWARE

Software used in the development of this analysis was limited to standard commercial software (Excel and Microsoft Word) provided by the Yucca Mountain Project and loaded on standard workstation computers. As standard office automation software, this software is exempt from qualification under the requirements of AP-SI.1Q, *Software Management.* No macros or software routines were used or developed to perform this work.

7. CONCLUSIONS

The *Engineering Files for Site Recommendation* (EFSR) provides a centralized file of referenceable, discrete, and identifiable functions, processes, features, services and equipment used for defining functional areas and functional relationships for the current state of knowledge of the proposed surface facilities of the Monitored Geologic Repository. The EFSR compiles functional descriptions, requirements, applicable codes and standards, general system information, design criteria, and acceptance criteria for surface facilities. As such, the document presents no conclusions on its own, nor does it provide analyses, models, or conclusions that affect any system's critical characteristics, scientific results, or provide data that can be directly relied upon to address waste isolation issues. There is no effect on the safety classification of any surface SSC.

Use of any data from this report for input into documents supporting procurement, fabrication, or construction is required to be controlled as to be verified (TBV) in accordance with AP-3.15Q, *Managing Technical Product Inputs*: "This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database."

ATTACHMENT I
FIGURES

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FIGURES (Continued)

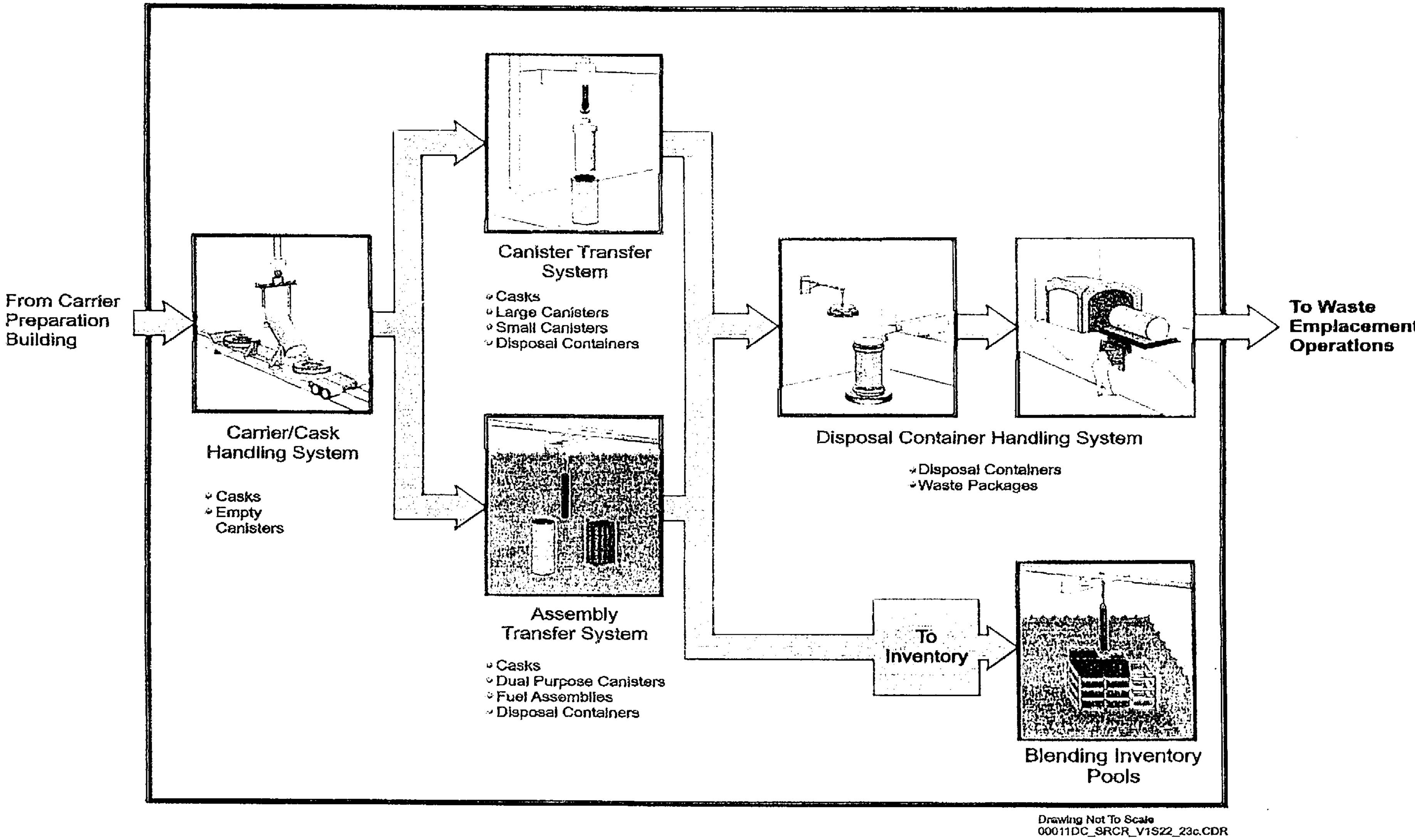


Figure I-1. Waste Handling Building Operations

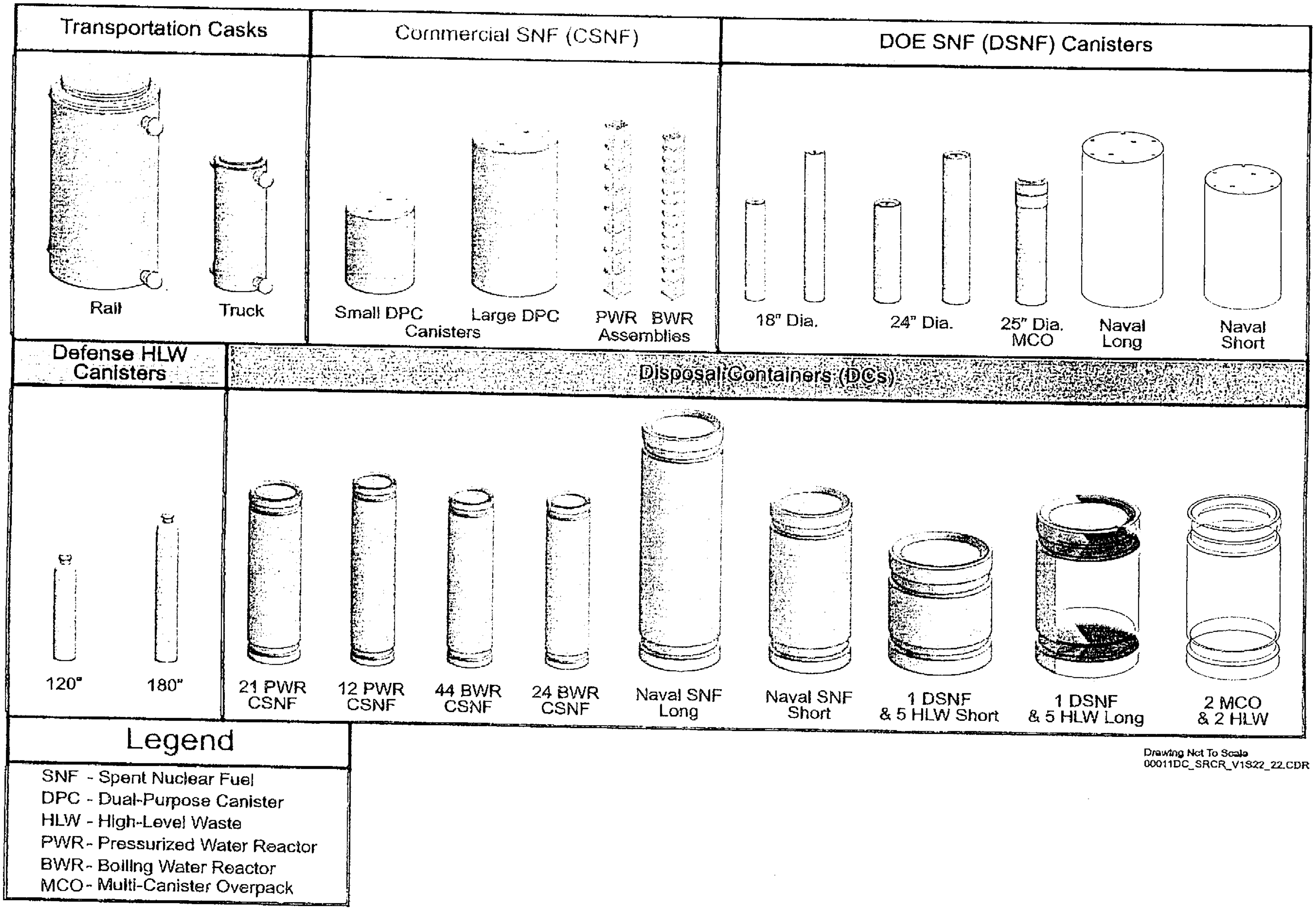


Figure I-2. Surface Facility Waste Forms Handled

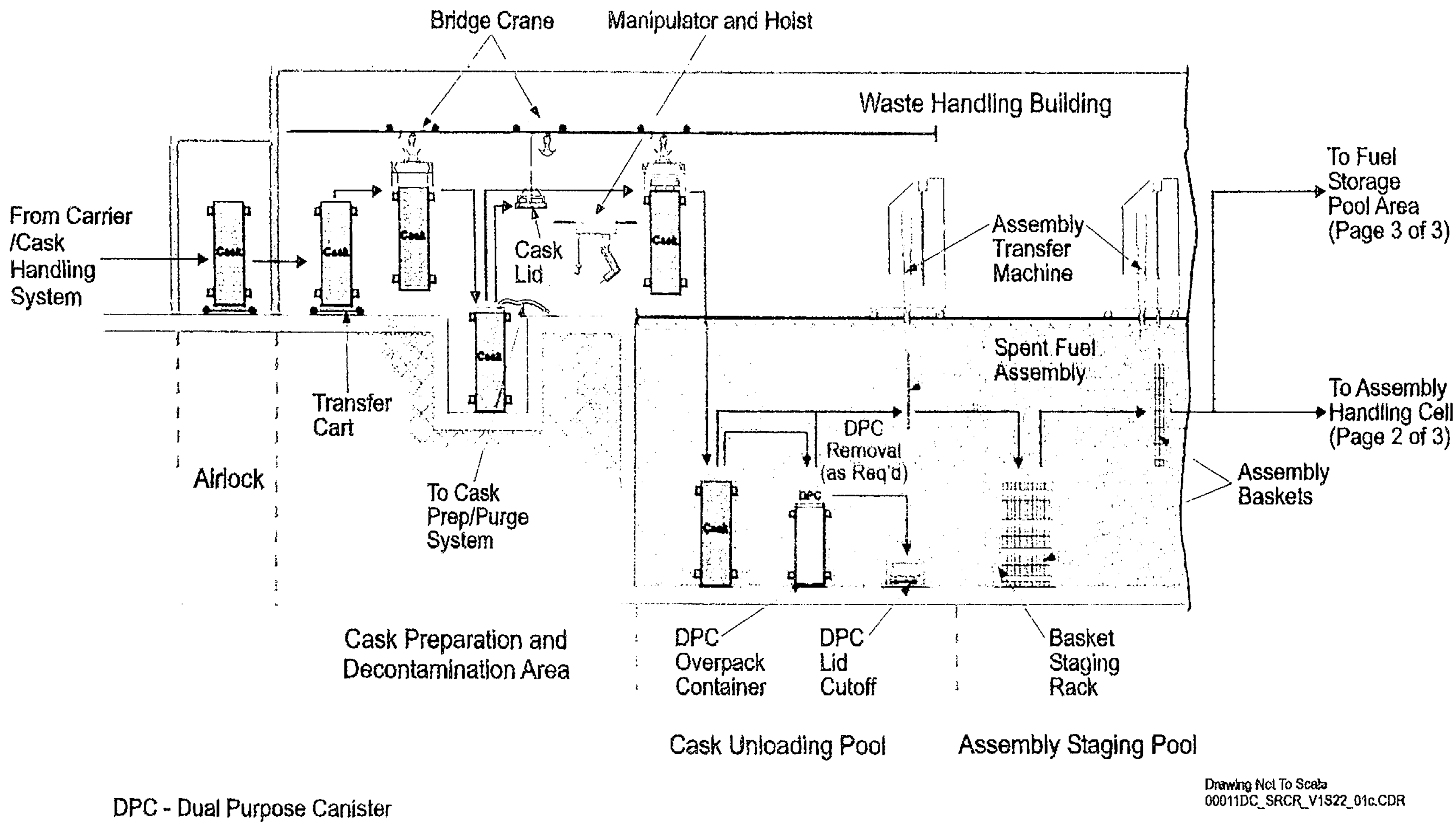


Figure I-3. Assembly Transfer System (page 1 of 3)

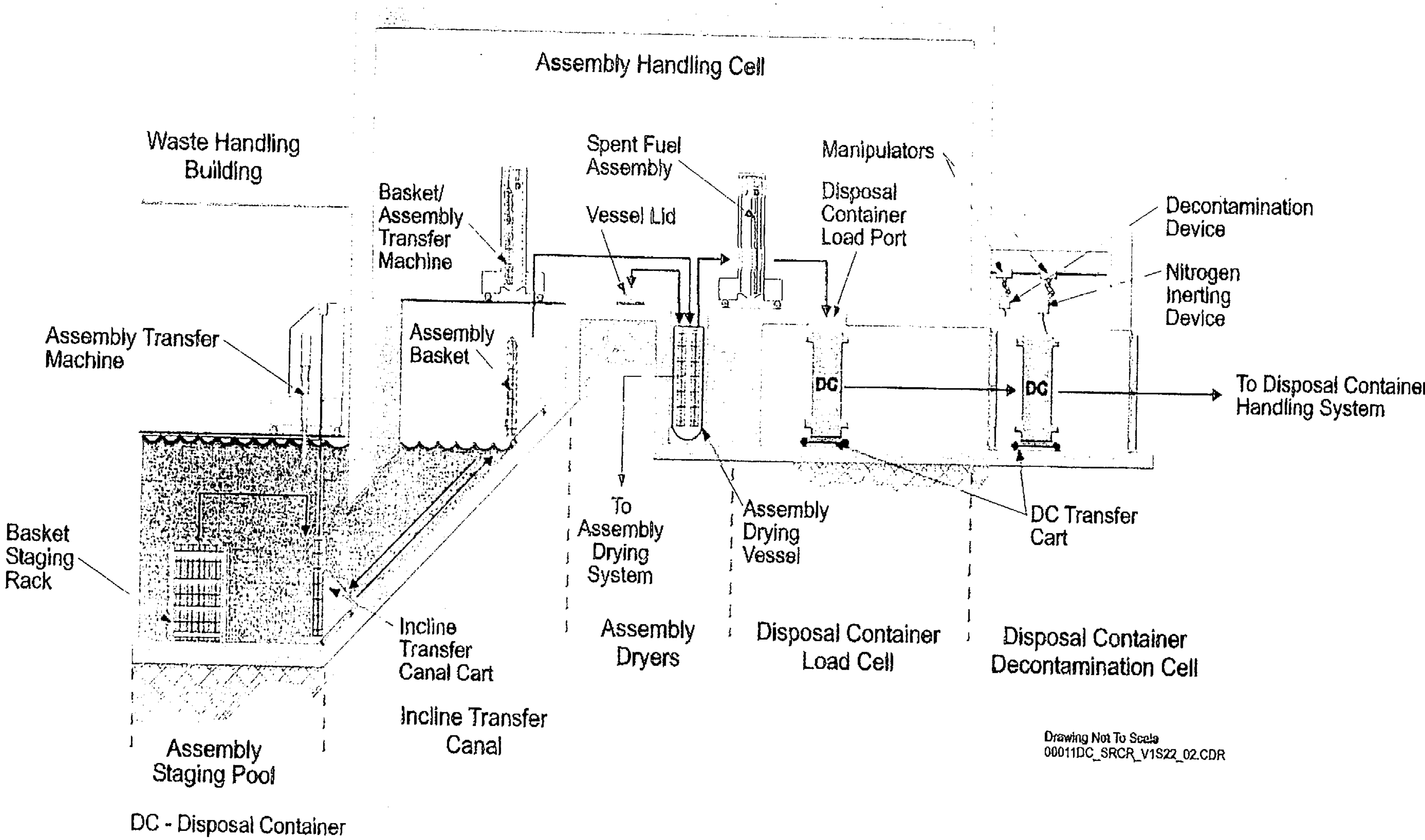
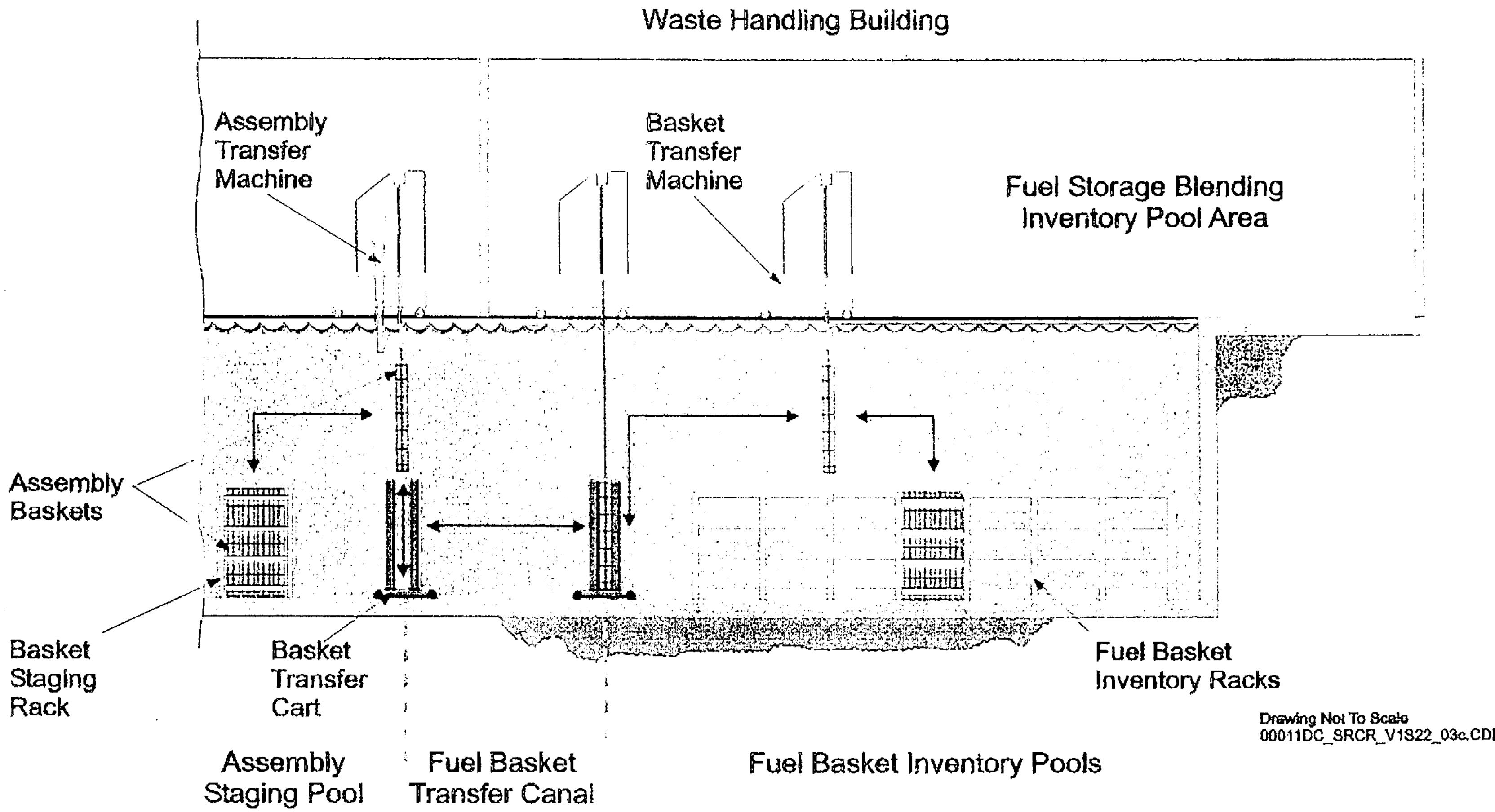


Figure I-4. Assembly Transfer System (page 2 of 3)



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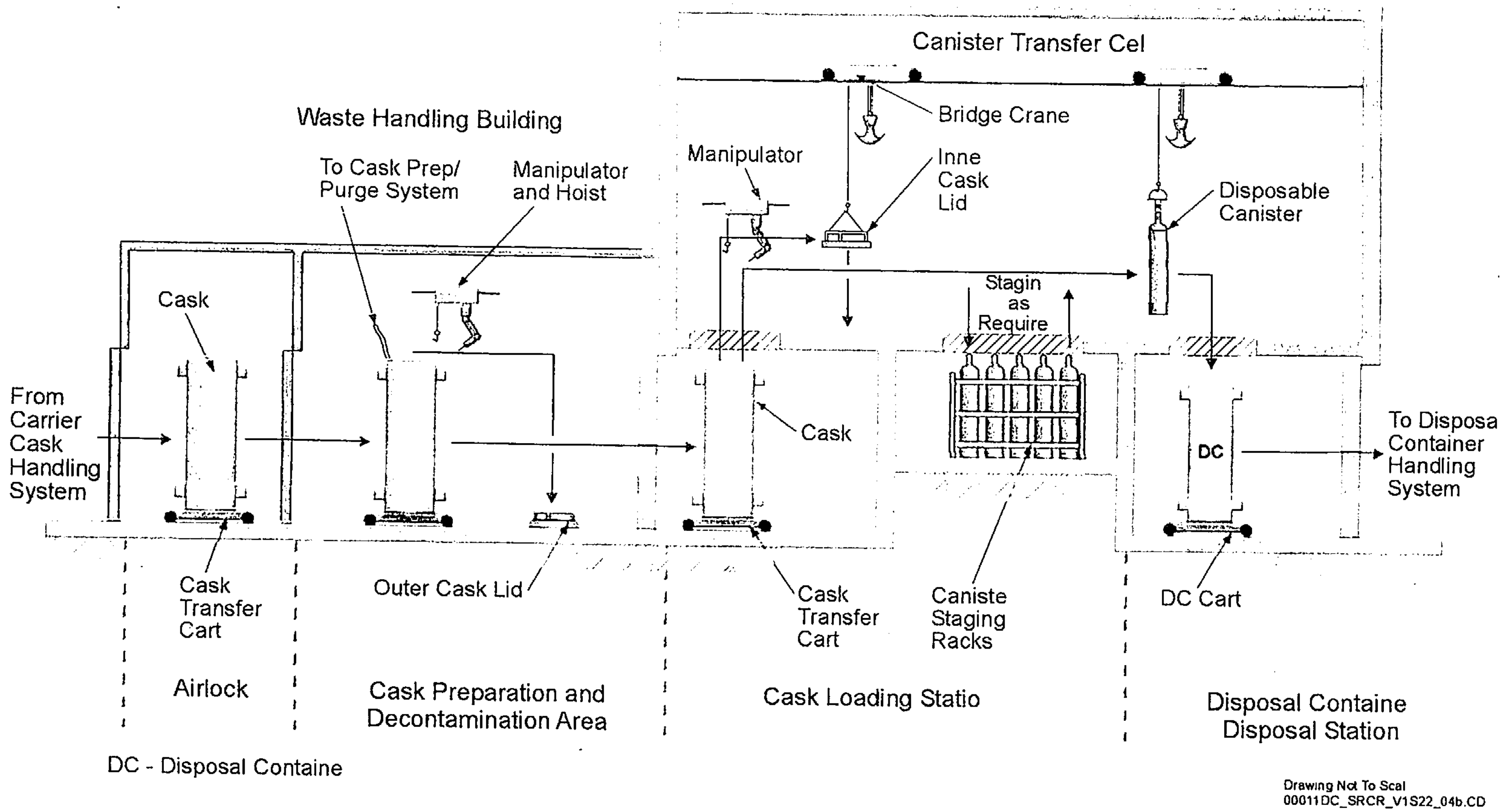

Figure I-6. Canister Transfer System

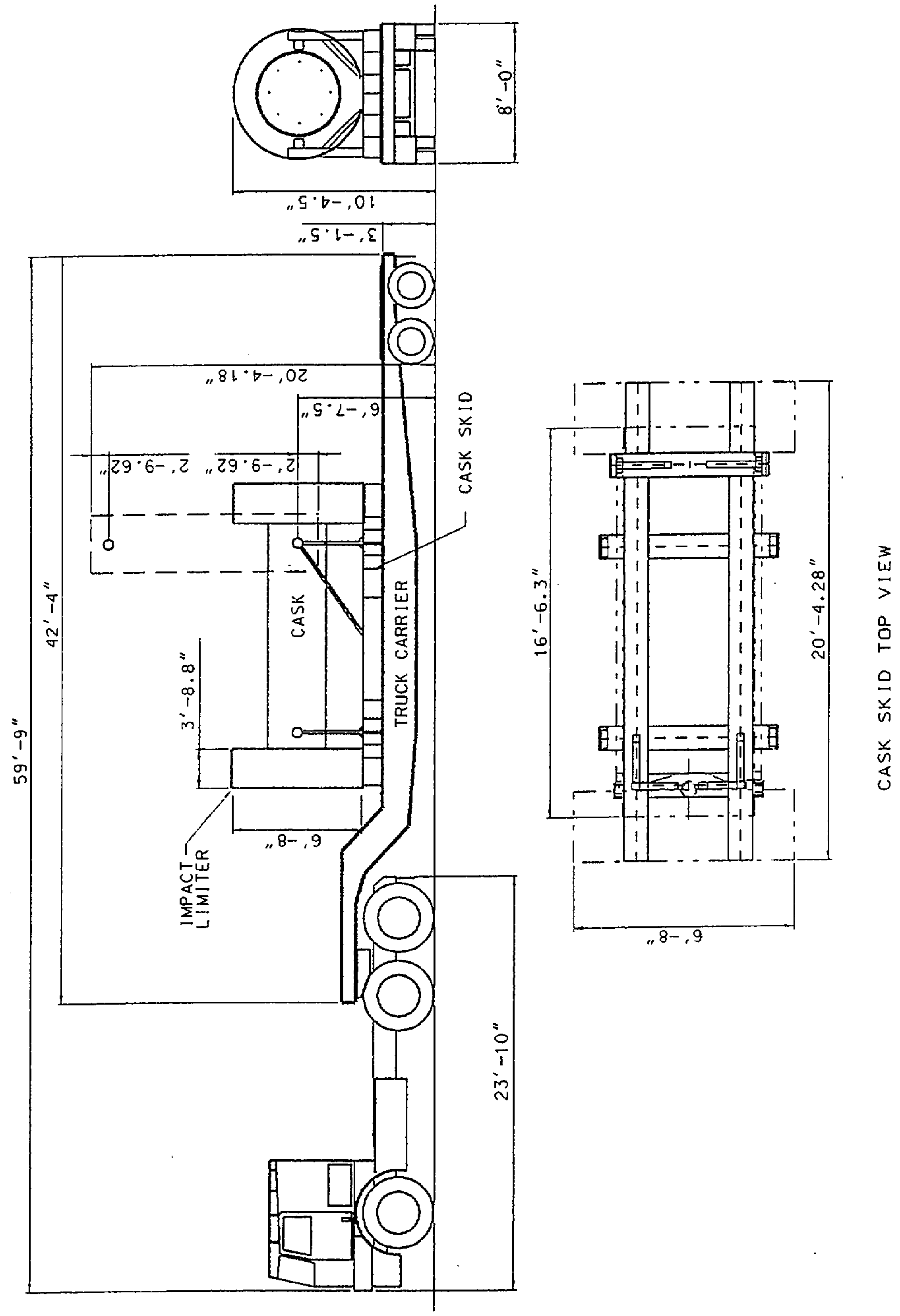

FIGURE I-7
LEGAL WEIGHT TRUCK
CARRIER DIMENSIONS

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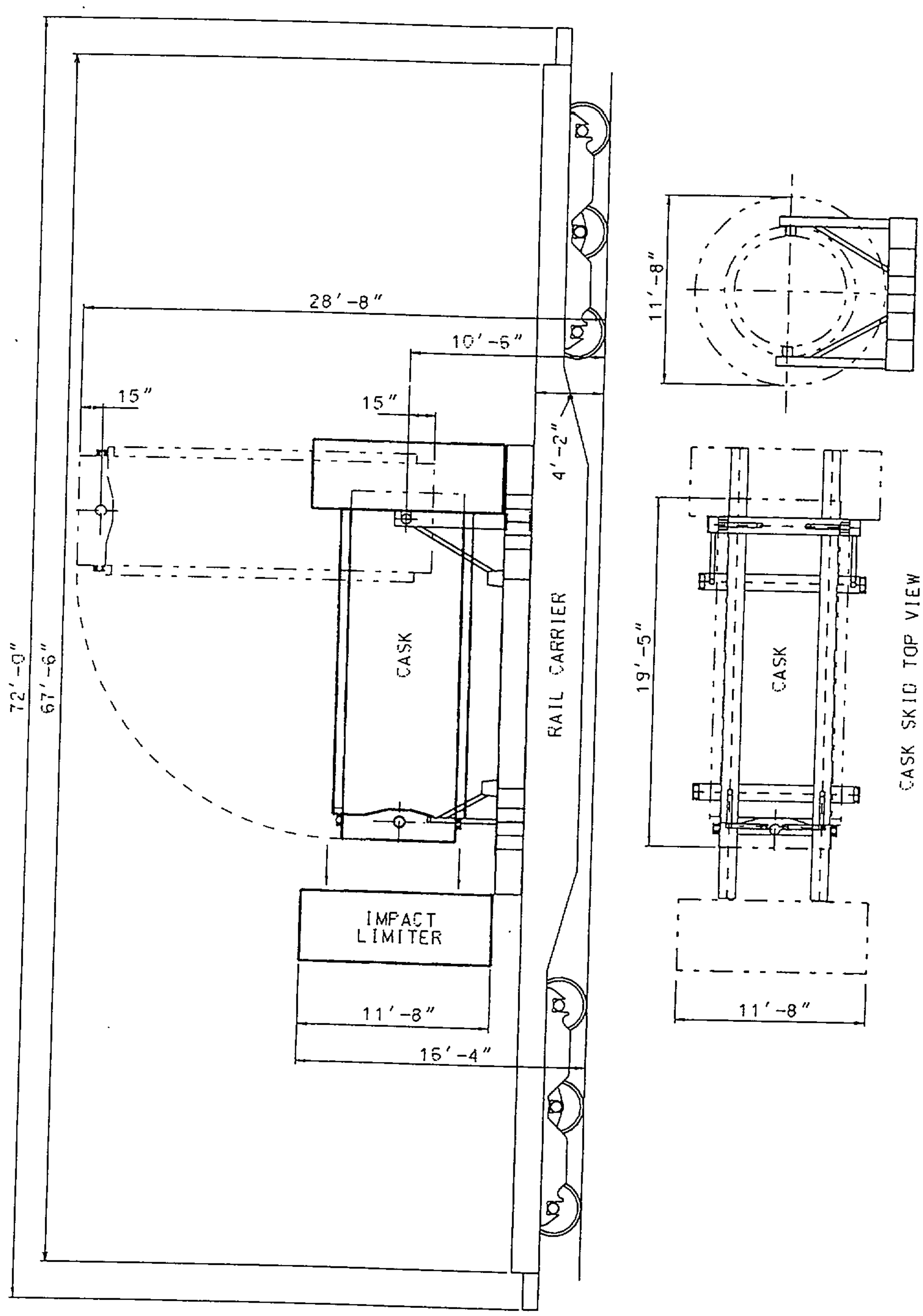


FIGURE I-8
RAIL
CARRIER DIMENSIONS

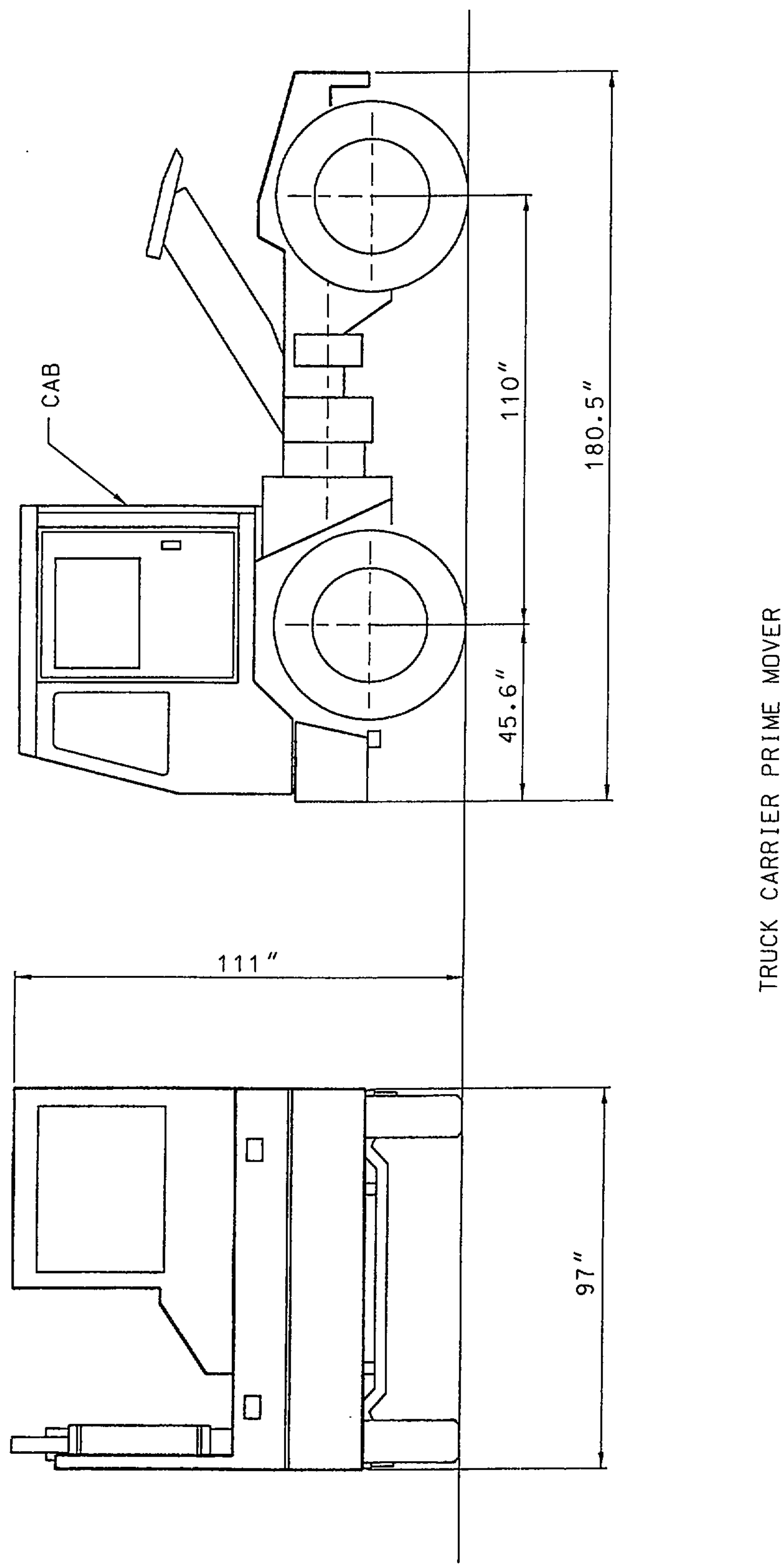
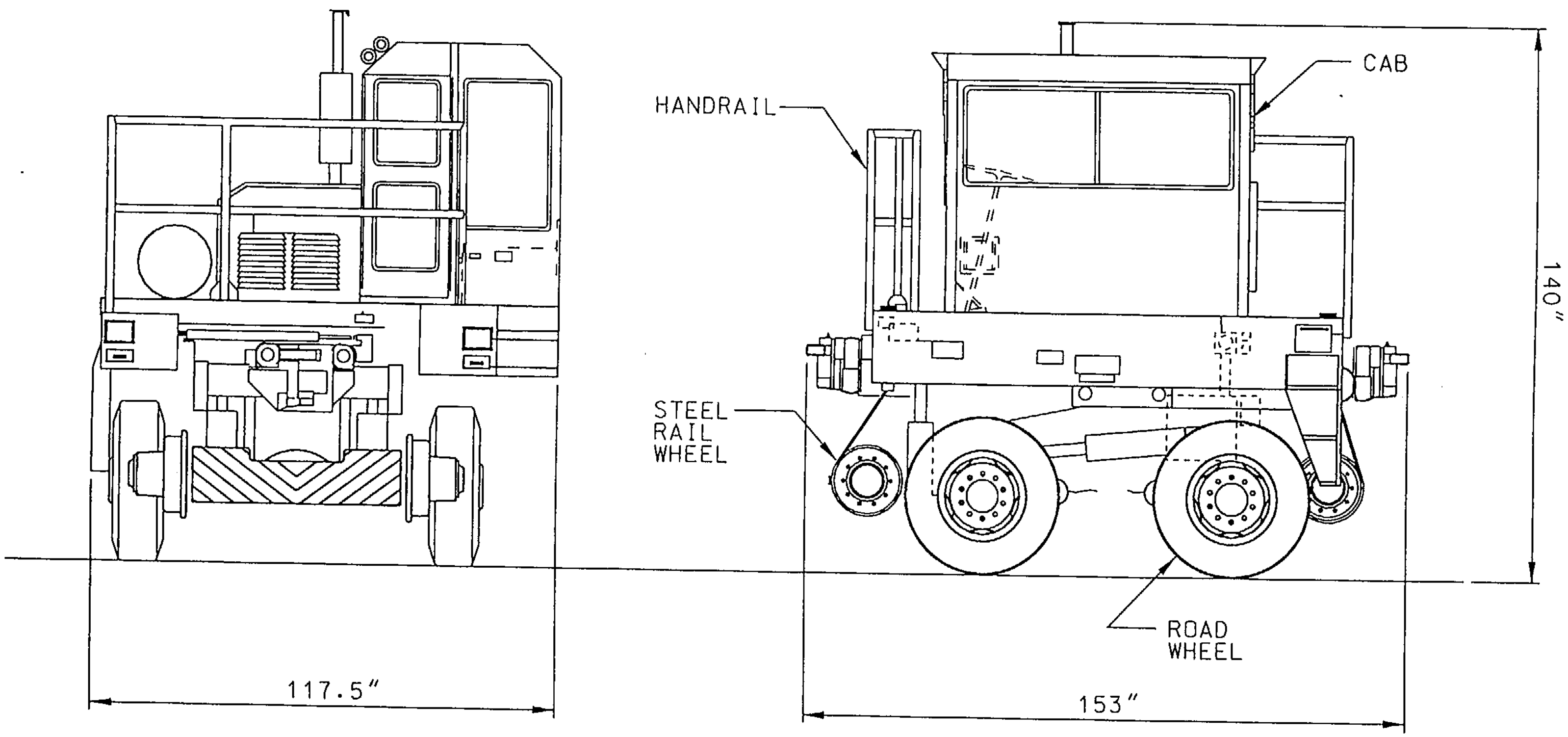


FIGURE I-9
TRUCK CARRIER
PRIME MOVER



RAIL CARRIER PRIME MOVER

FIGURE I-10
RAIL CARRIER
PRIME MOVER

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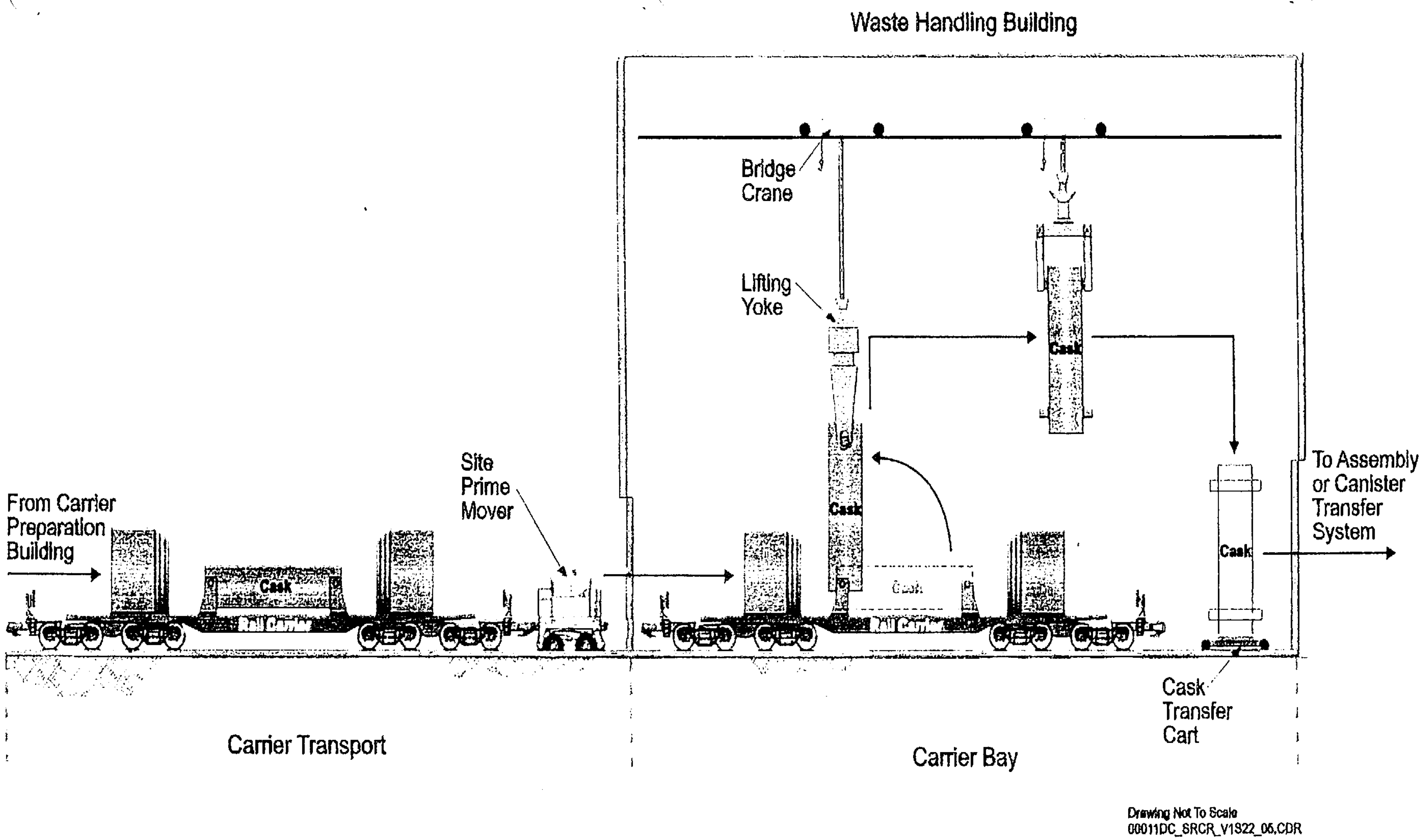
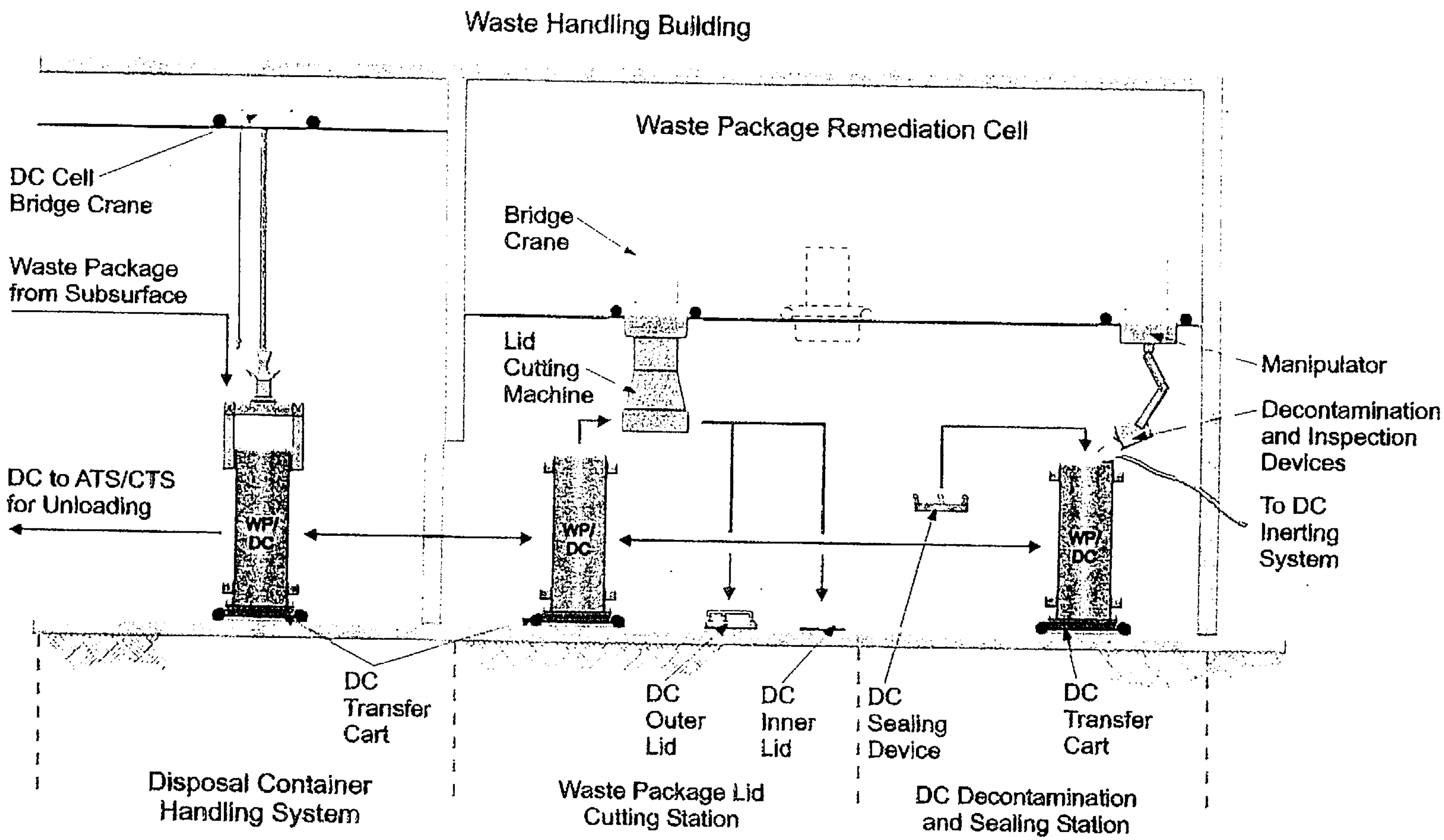
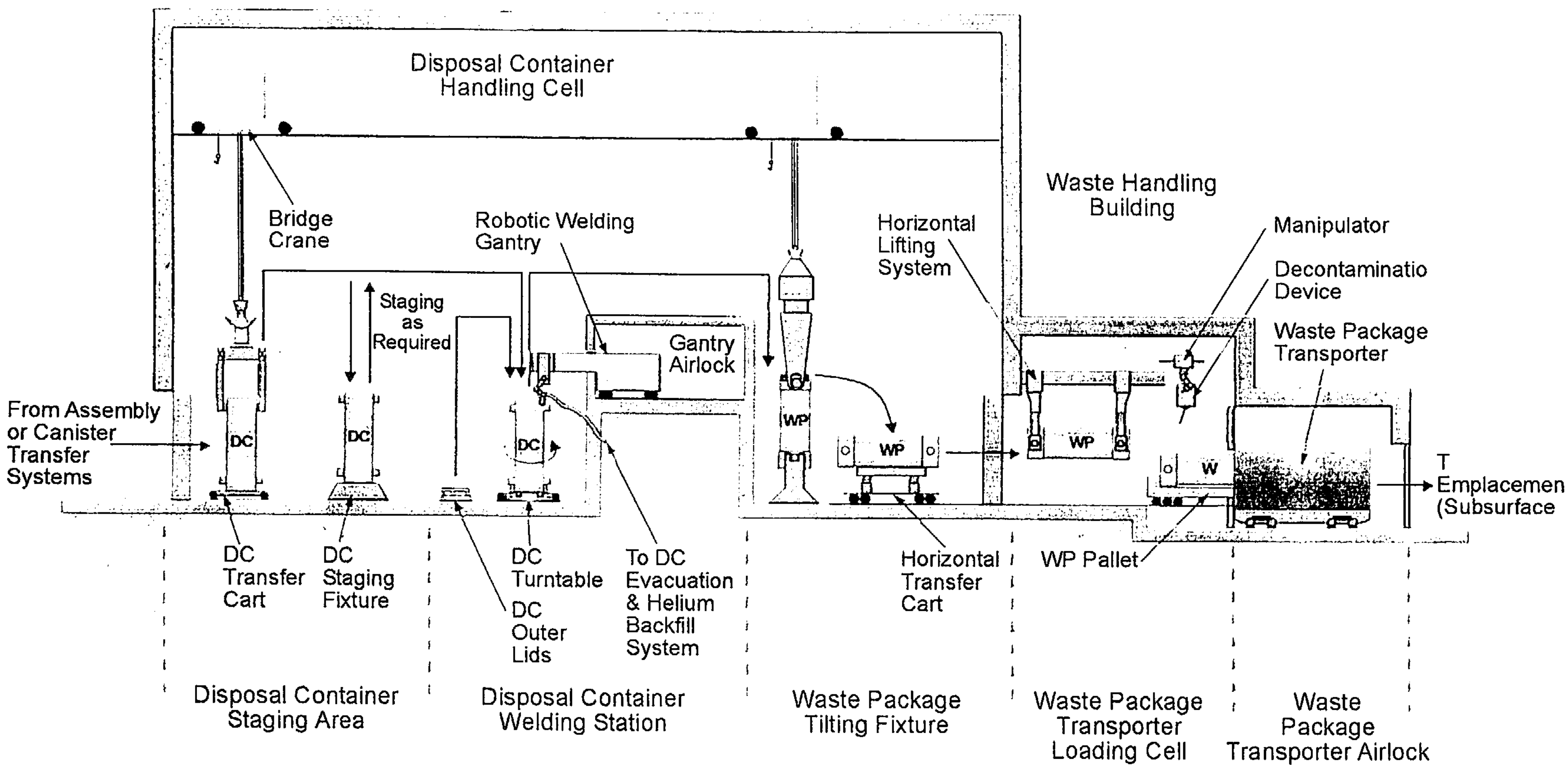


Figure I-11. Carrier/Cask Handling System



DC - Disposal Container
WP - Waste Package
ATS - Assembly Transfer System
CTS - Canister Transfer System

Figure I-12. Waste Package Remediation System



DC - Disposal Container
WP - Waste Package

Drawing Not To Scal
00011DC_SRCR_V1S22_08 CD

Figure I-13. Disposal Container Handling System

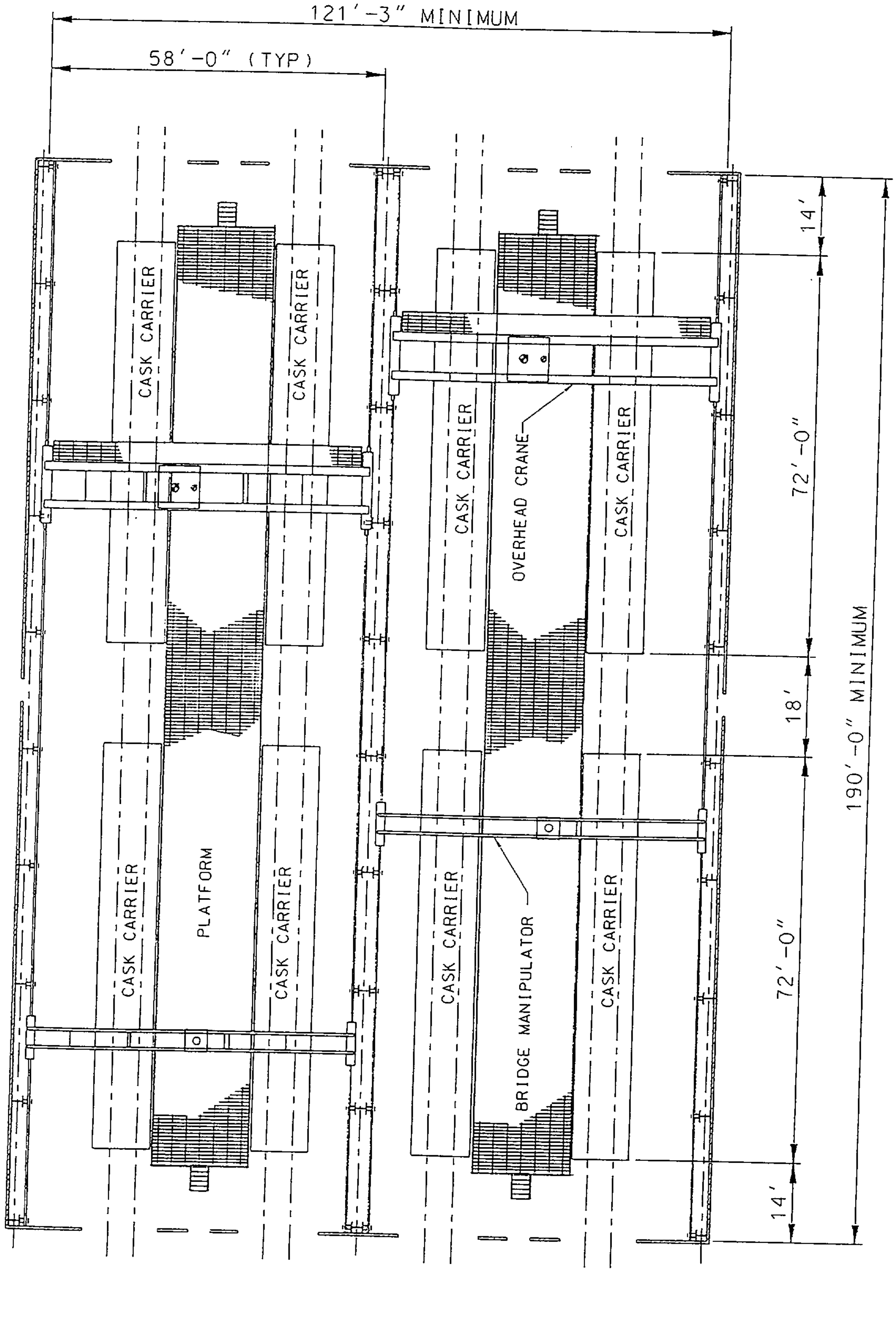


FIGURE I-14
CARRIER PREPARATION BLDG
FLOOR PLAN

08-MAY-2000 11:59

CAD FILE: t:*reps*arch*dgn*efsr*carrierprep.dgn

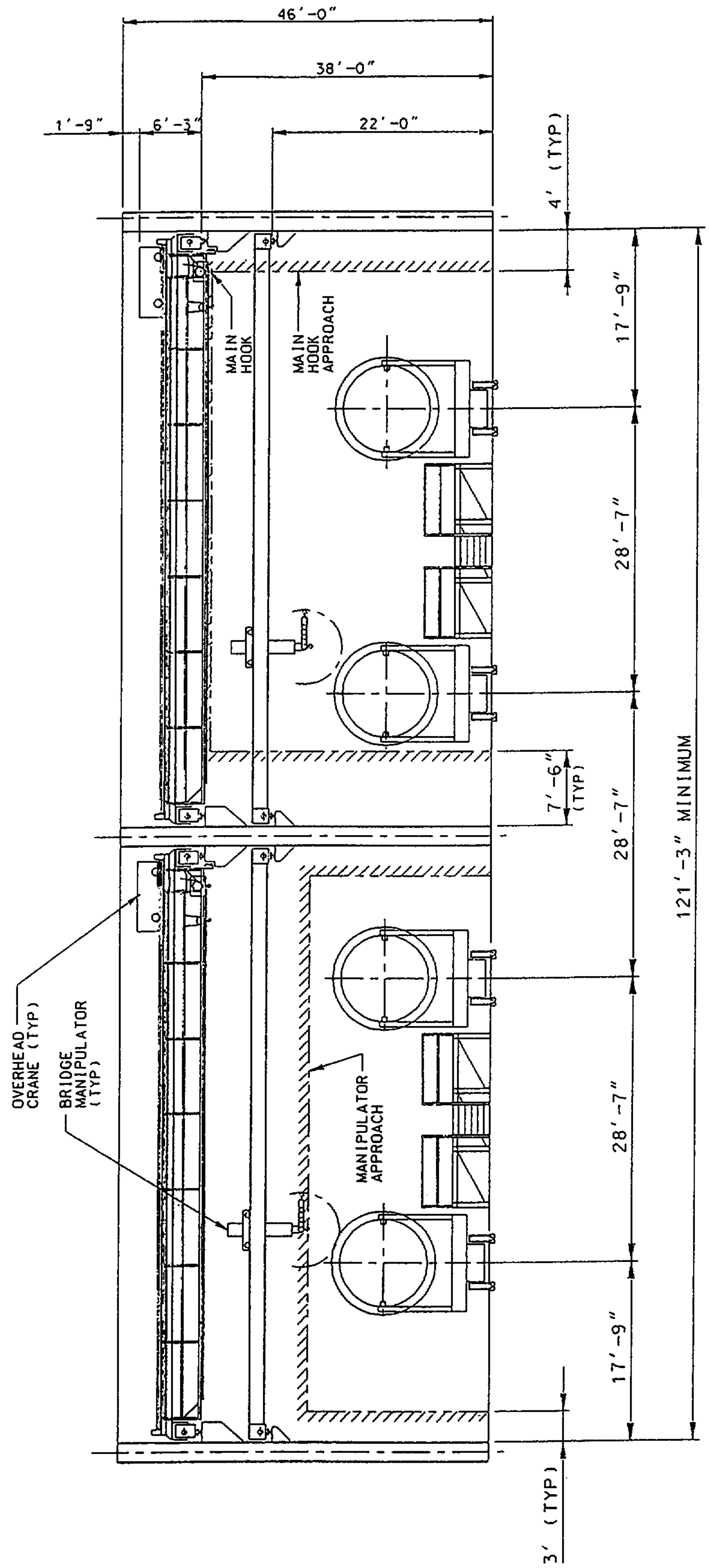


FIGURE I-15
CARRIER PREPARATION BLDG
BUILDING SECTION

08-MAY-2000 12:05

CAD FILE: t:*reps*arch*dgn*efsr*carrierprsect.dgn

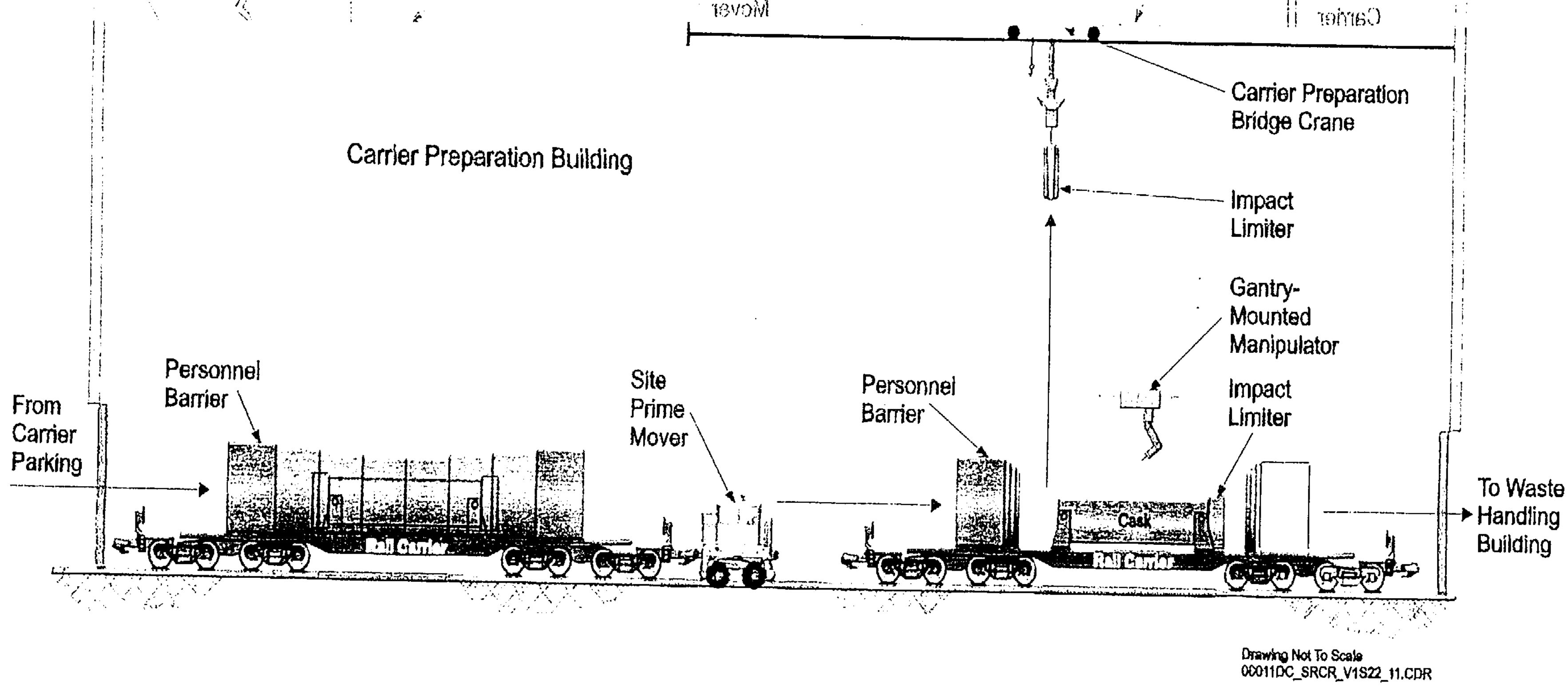
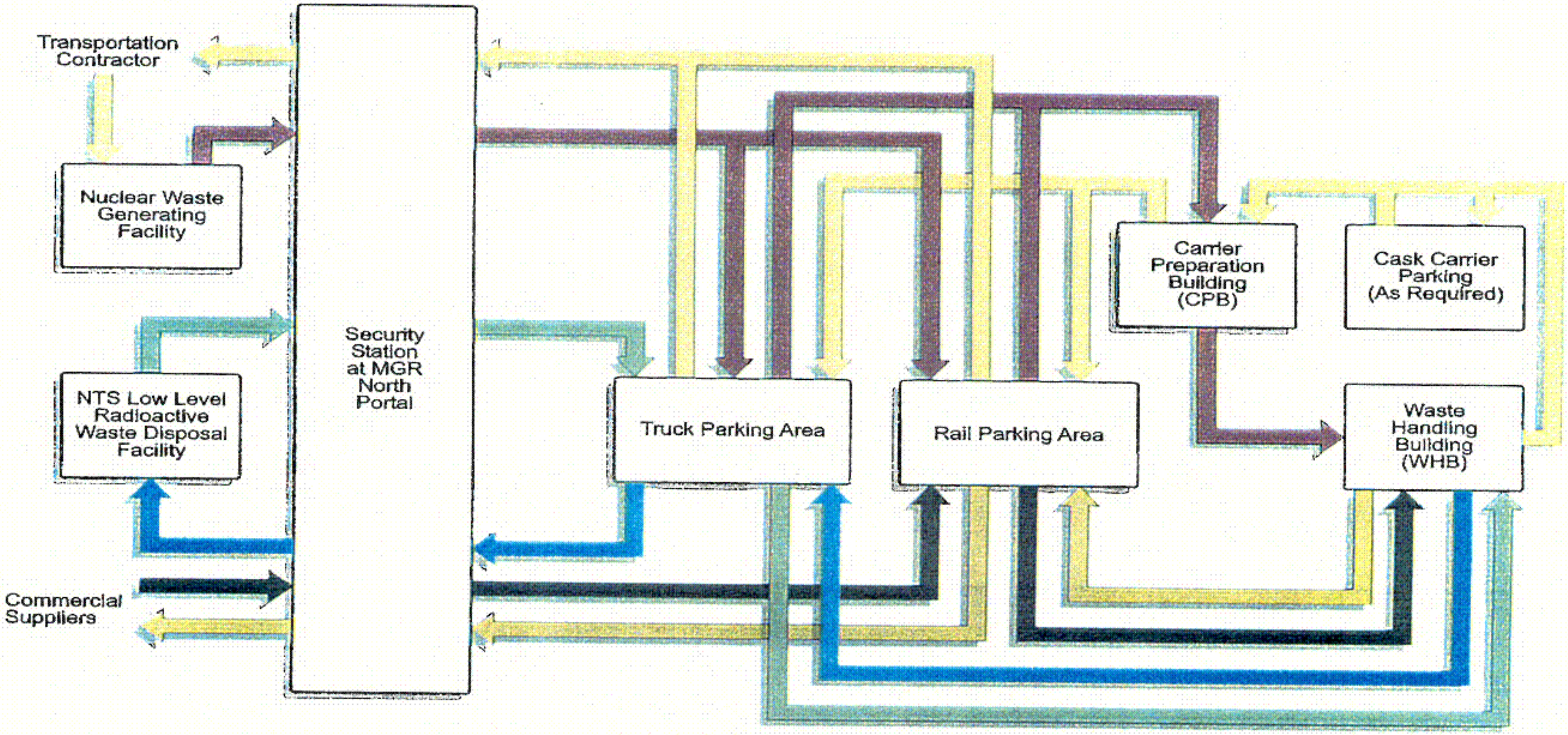


Figure I-16. CPB Materials Handling System



Legend

	By Rail or Truck	By Truck Only	By Rail Only
NTS Nevada Test Site DC Disposal Container DPC Dual-Purpose Container (R) Rail Carrier (T) Truck Carrier	Empty Cask Carrier (R/T) Loaded Cask Carrier (R/T)	Empty DPC Overpack (T) Loaded DPC Overpack (T)	Empty DC Carrier (R) Empty Carrier (R)

Figure I-17. MGR Surface Facility Carrier Transport Flow Diagram

C01

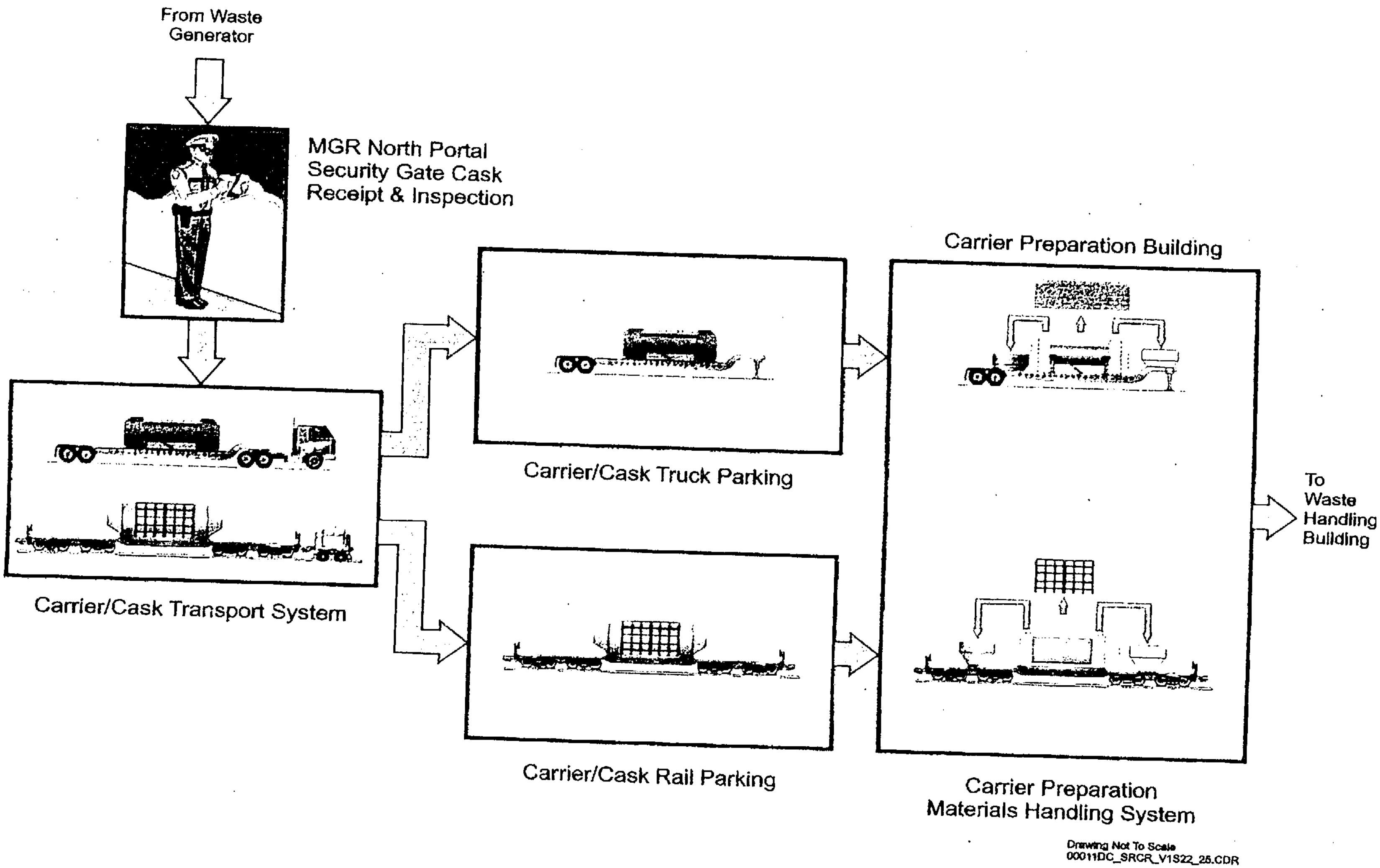


Figure I-18. Waste Receiving Operations

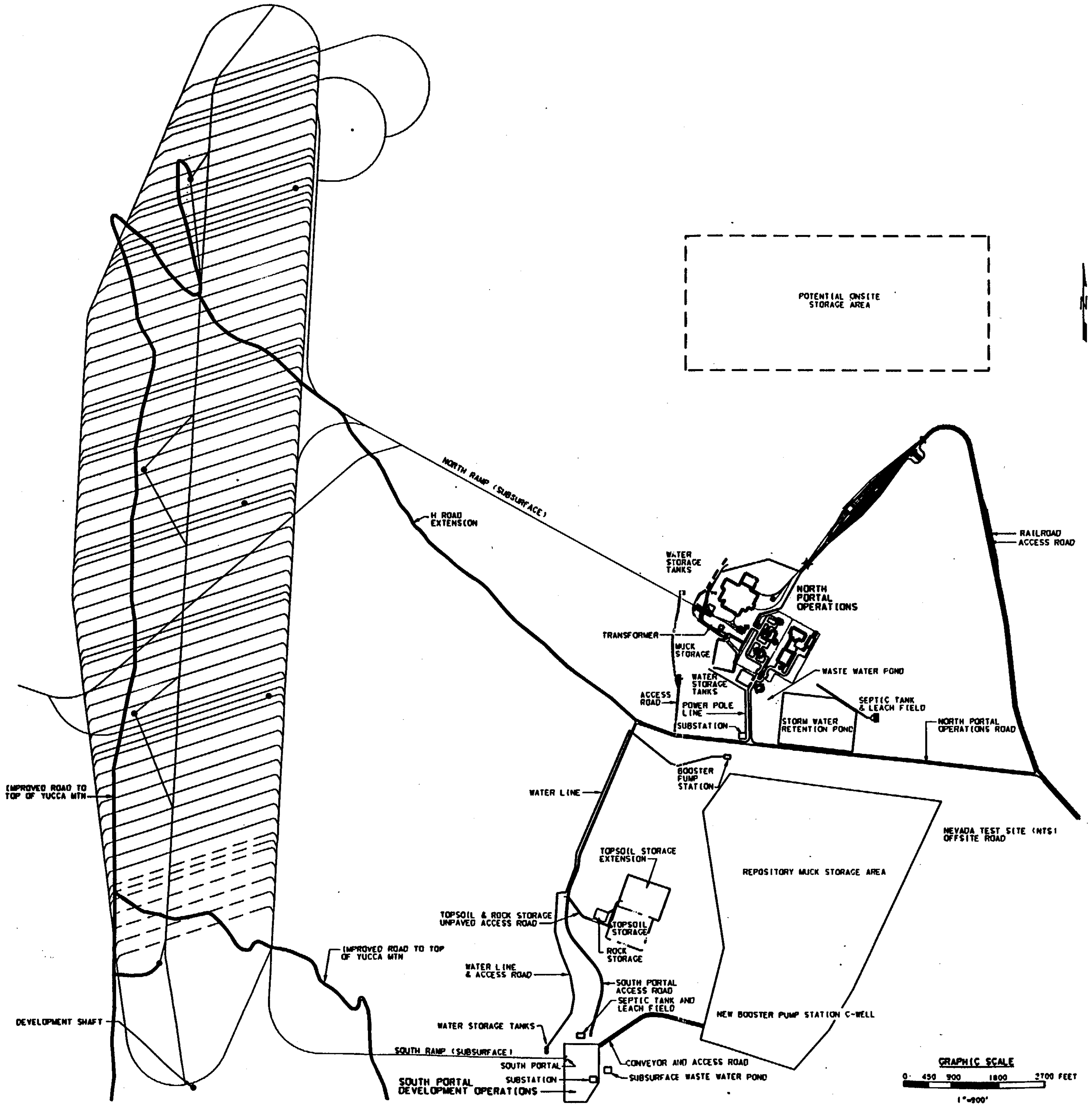


FIGURE I-19
REPOSITORY
OVERALL SITE PLAN

SAUERT

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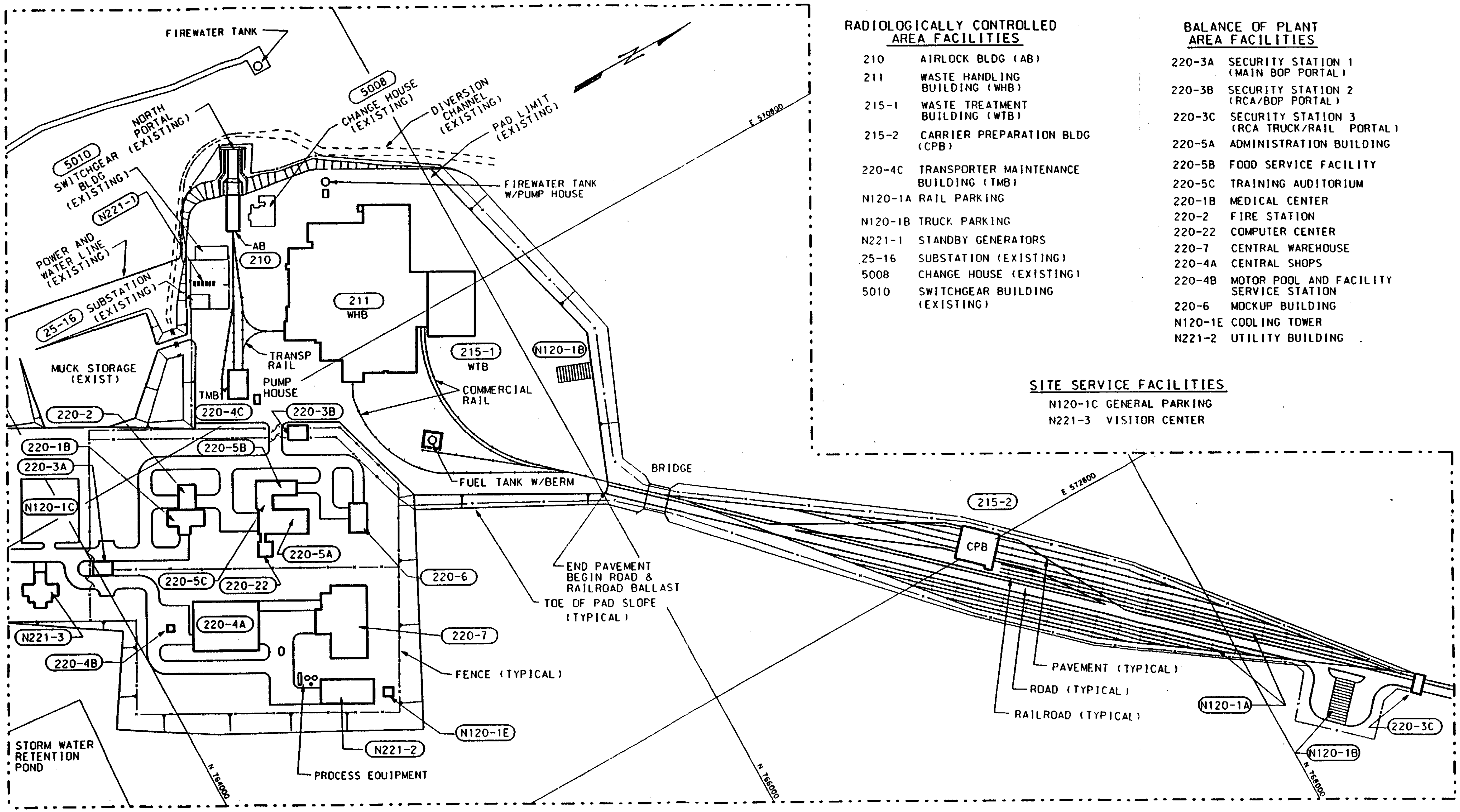

RADIOLOGICALLY CONTROLLED AREA FACILITIES

210	AIRLOCK BLDG (AB)
211	WASTE HANDLING BUILDING (WHB)
215-1	WASTE TREATMENT BUILDING (WTB)
215-2	CARRIER PREPARATION BLDG (CPB)
220-4C	TRANSPORTER MAINTENANCE BUILDING (TMB)
N120-1A	RAIL PARKING
N120-1B	TRUCK PARKING
N221-1	STANDBY GENERATORS
25-16	SUBSTATION (EXISTING)
5008	CHANGE HOUSE (EXISTING)
5010	SWITCHGEAR BUILDING (EXISTING)

BALANCE OF PLANT AREA FACILITIES

220-3A	SECURITY STATION 1 (MAIN BOP PORTAL)
220-3B	SECURITY STATION 2 (RCA/BOP PORTAL)
220-3C	SECURITY STATION 3 (RCA TRUCK/RAIL PORTAL)
220-5A	ADMINISTRATION BUILDING
220-5B	FOOD SERVICE FACILITY
220-5C	TRAINING AUDITORIUM
220-1B	MEDICAL CENTER
220-2	FIRE STATION
220-22	COMPUTER CENTER
220-7	CENTRAL WAREHOUSE
220-4A	CENTRAL SHOPS
220-4B	MOTOR POOL AND FACILITY SERVICE STATION
220-6	MOCKUP BUILDING
N120-1E	COOLING TOWER
N221-2	UTILITY BUILDING

SITE SERVICE FACILITIES

N120-1C	GENERAL PARKING
N221-3	VISITOR CENTER

GRAPHIC SCALE
0 100 200 400 600 FEET
1" = 200'

FIGURE I-20
NORTH PORTAL REPOSITORY AREA SITE PLAN

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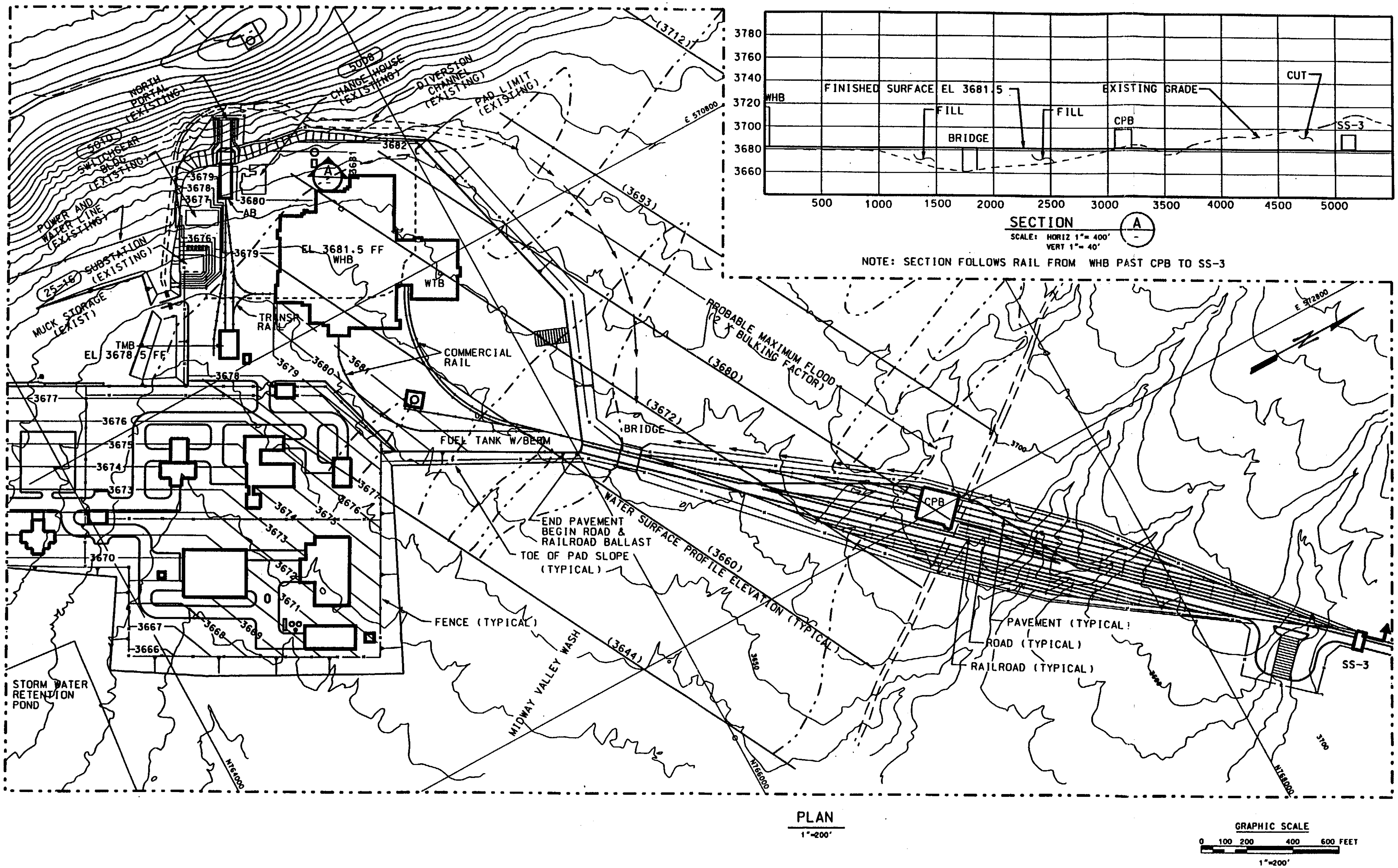

FIGURE I-21
NORTH PORTAL REPOSITORY
GRADING PLAN

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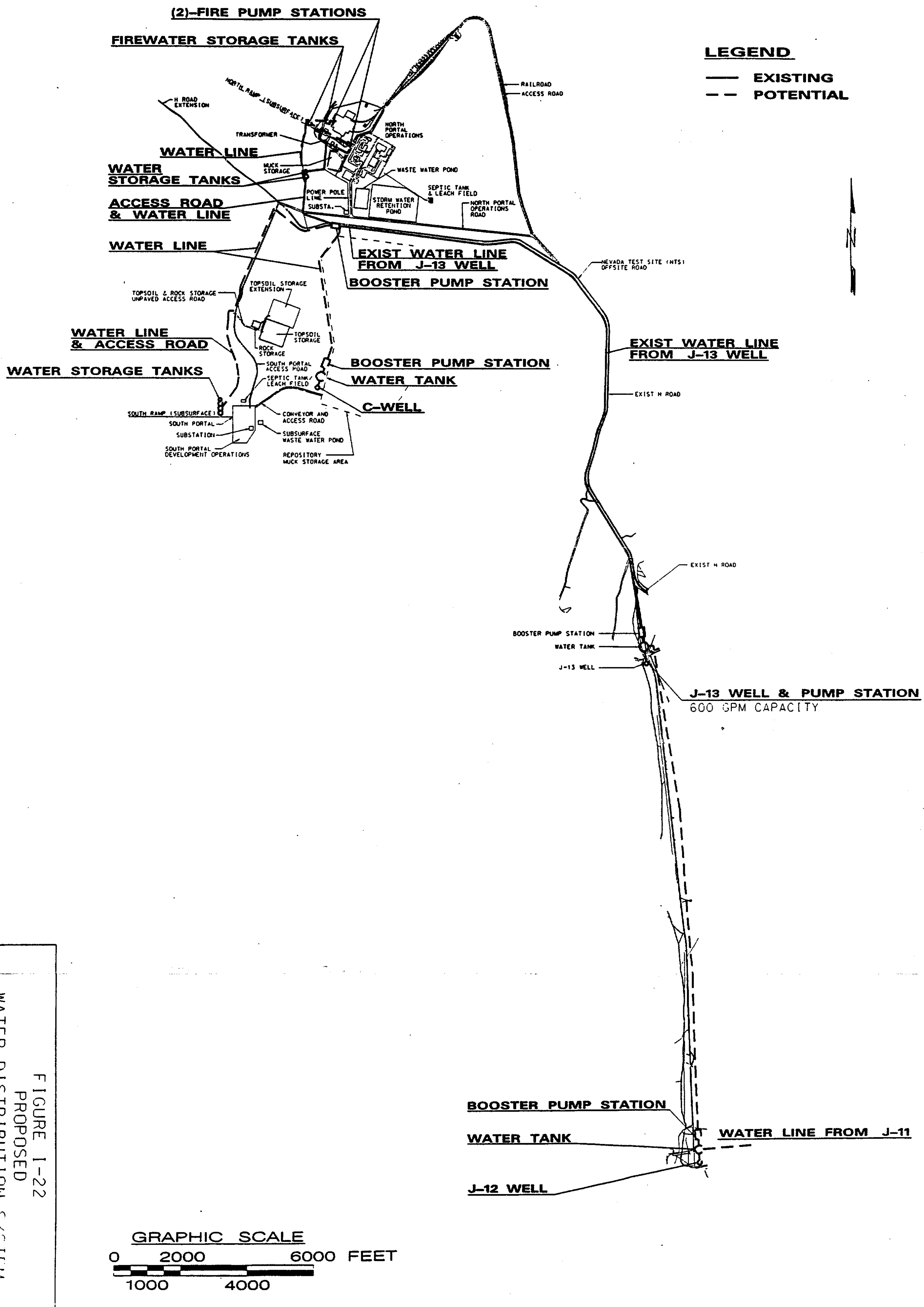

FIGURE 1-22
PROPOSED
WATER DISTRIBUTION SYSTEM

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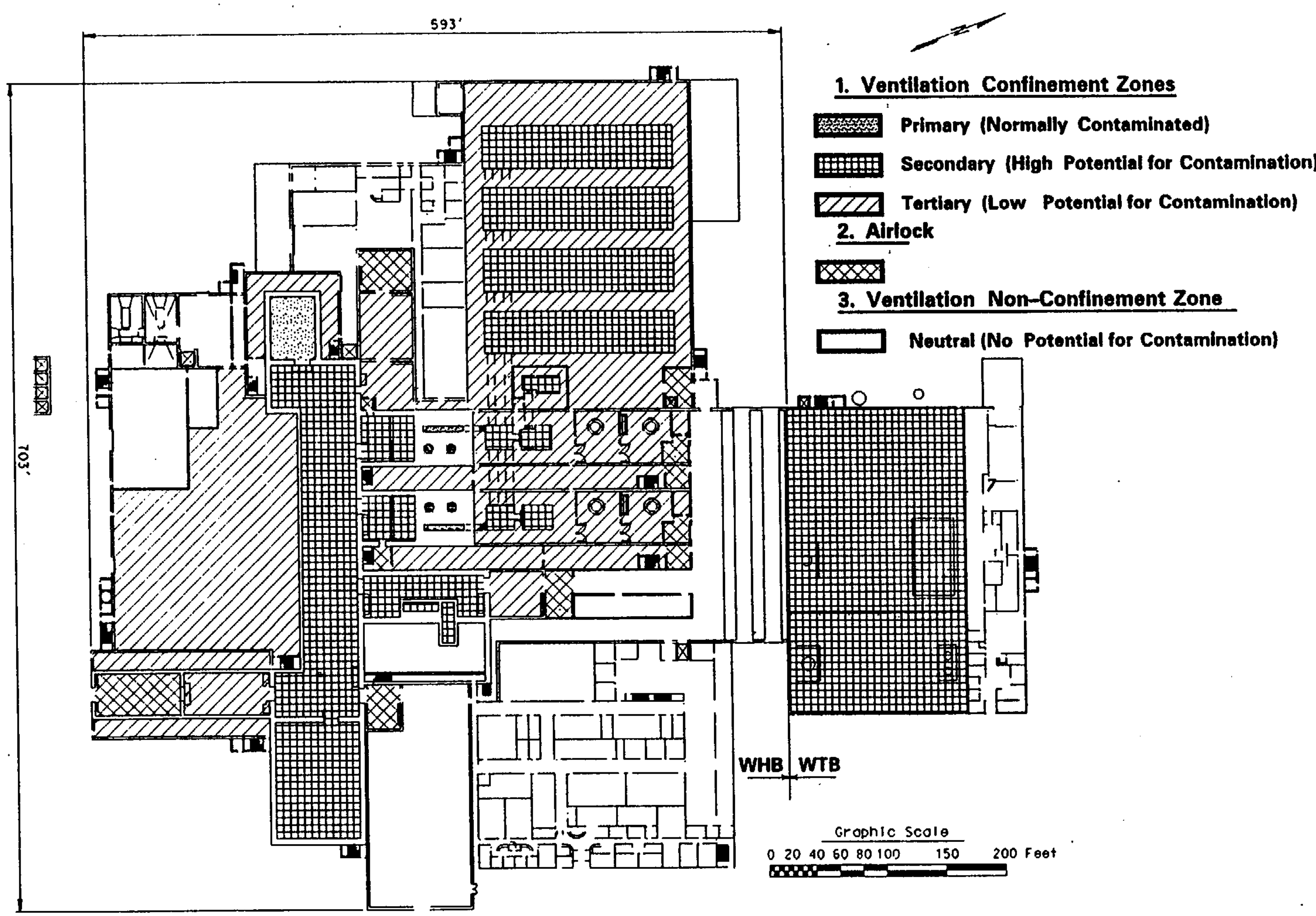
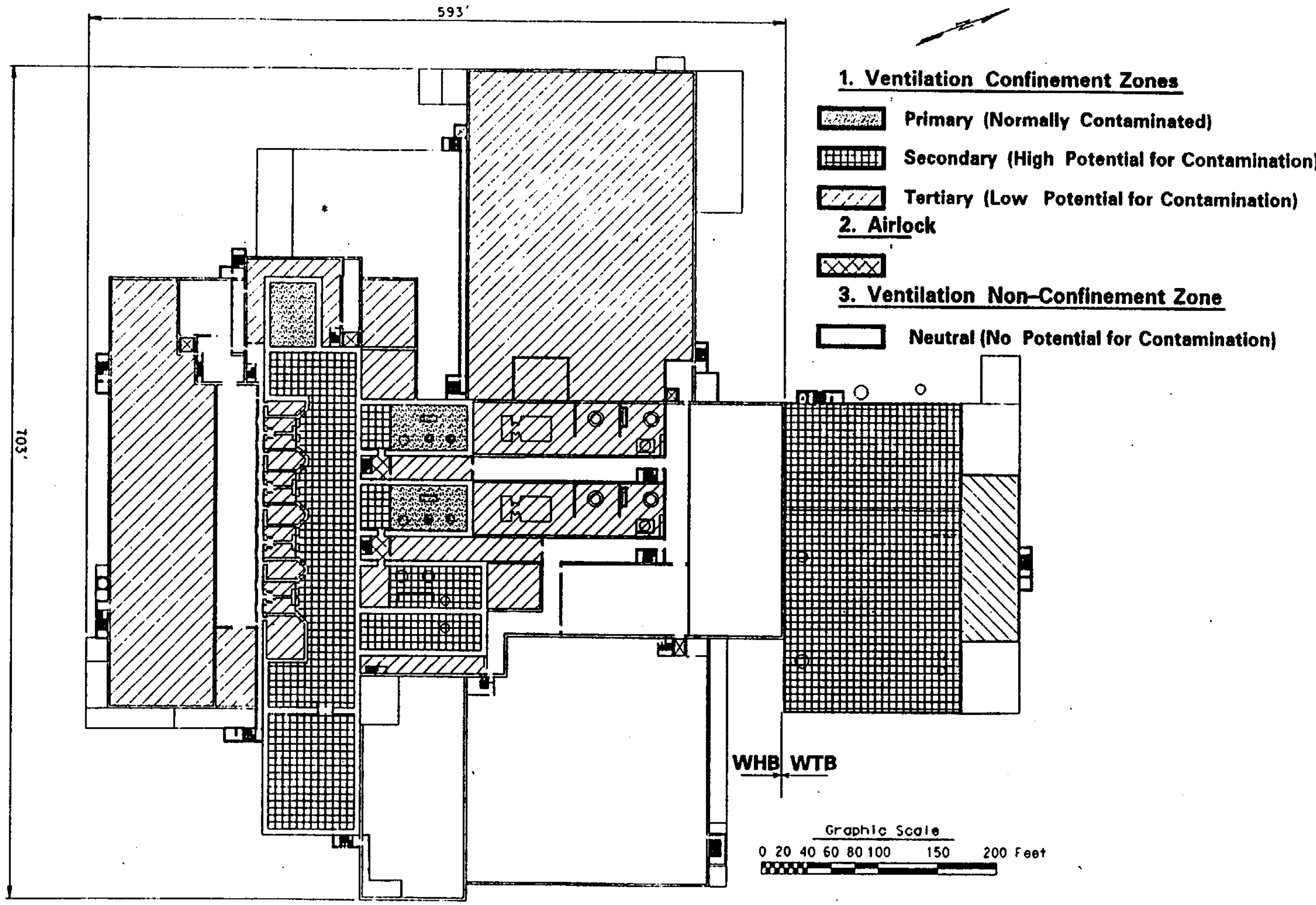


WASTE HANDLING/WASTE TREATMENT BUILDING VENTILATION CONFINEMENT ZONES CONFIGURATION at EL. 100+0

FIGURE I-23
WASTE HANDLING/WASTE TREATMENT BUILDING VENTILATION CONFINEMENT ZONES CONFIGURATION at EL. 100+0

08-MAY-2000 13:03

CAD FILE: t:*reps*arch*dgn*efsr*envir1.dgn



WASTE HANDLING/WASTE TREATMENT BUILDING VENTILATION CONFINEMENT ZONES CONFIGURATION at EL. 130+0

FIGURE I-24
WASTE HANDLING/WASTE TREATMENT BUILDING VENTILATION CONFINEMENT ZONES CONFIGURATION at EL. 130+0

12-MAY-2000 13:38

CAD FILE: t:*eps*arch*dgn*efsr*envir2.dgn

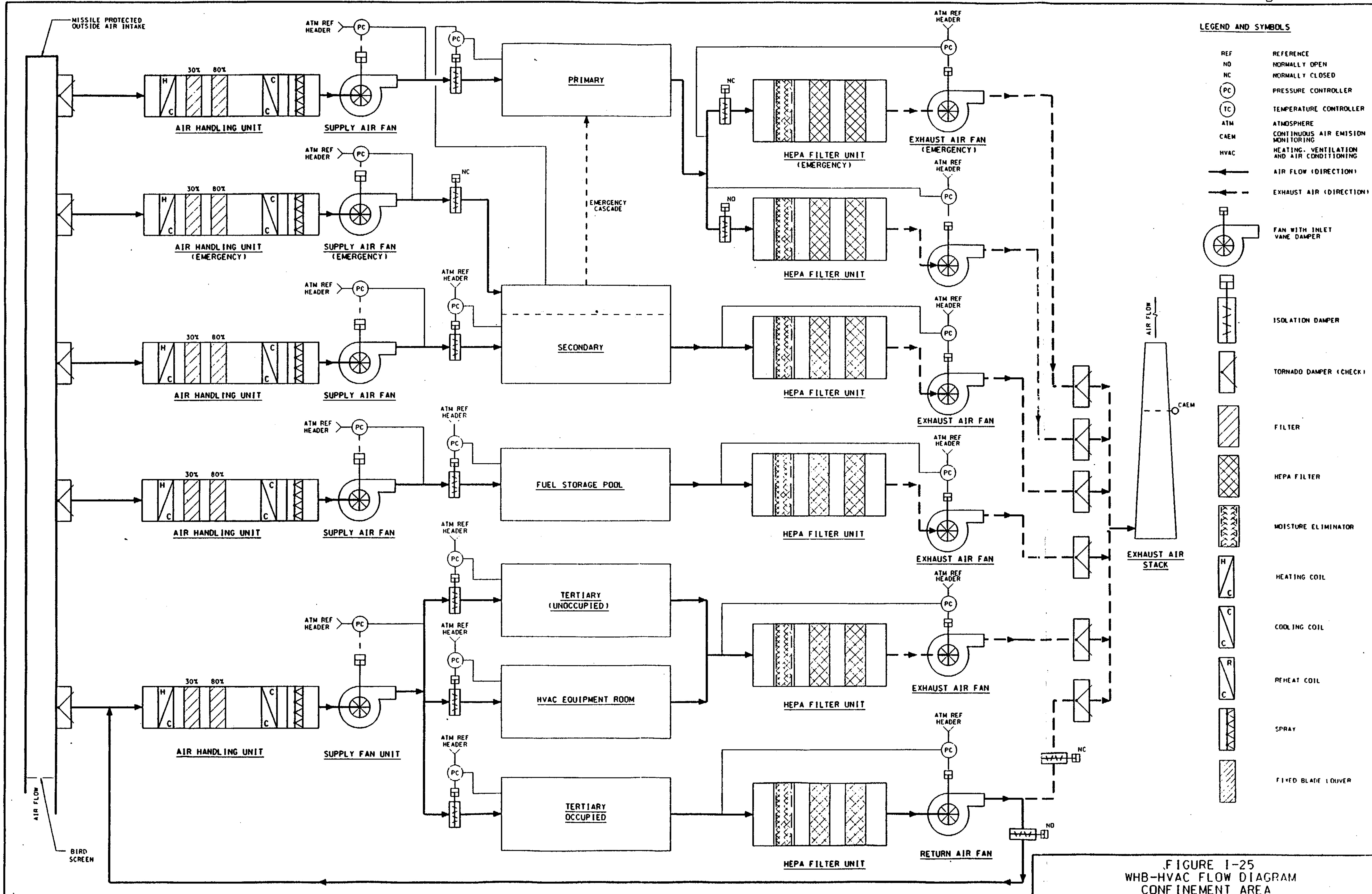


FIGURE I-25
WHB-HVAC FLOW DIAGRAM
CONFINEMENT AREA

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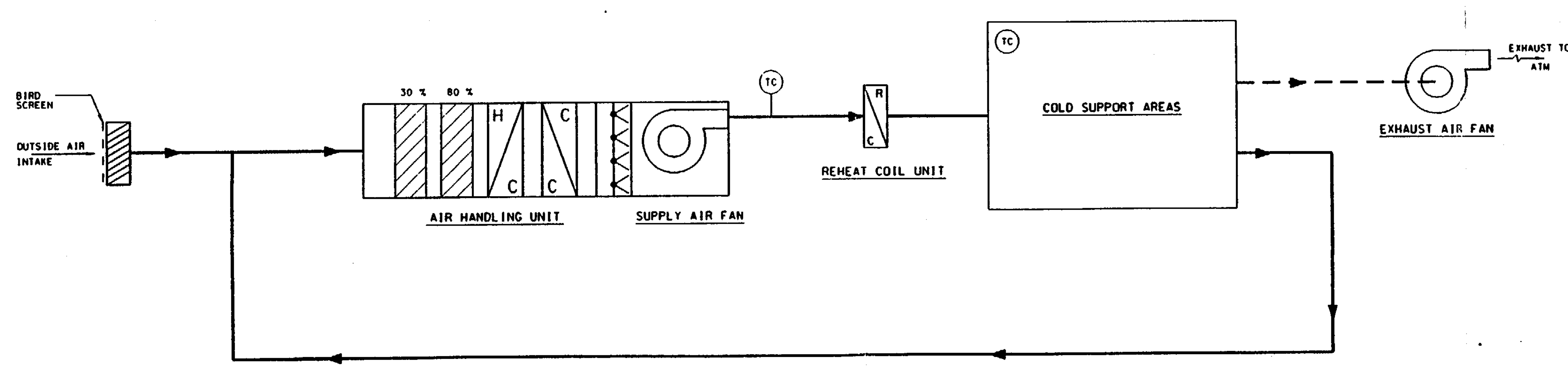

FIGURE I-26
WHB-HVAC FLOW DIAGRAM
NON-CONFINEMENT AREA

INTENTIONALLY LEFT BLANK

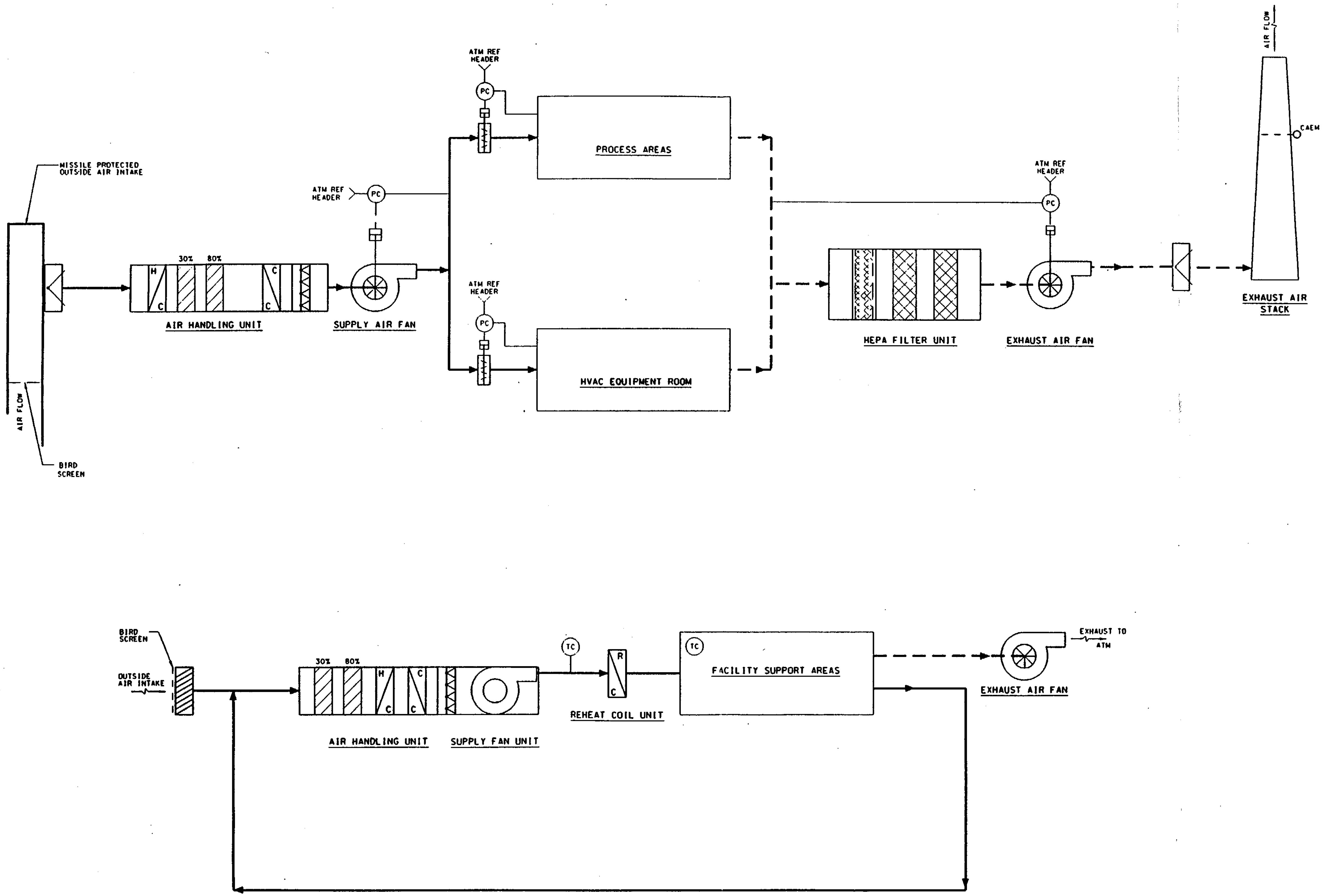

FIGURE I-27
WTB-HVAC FLOW DIAGRAM

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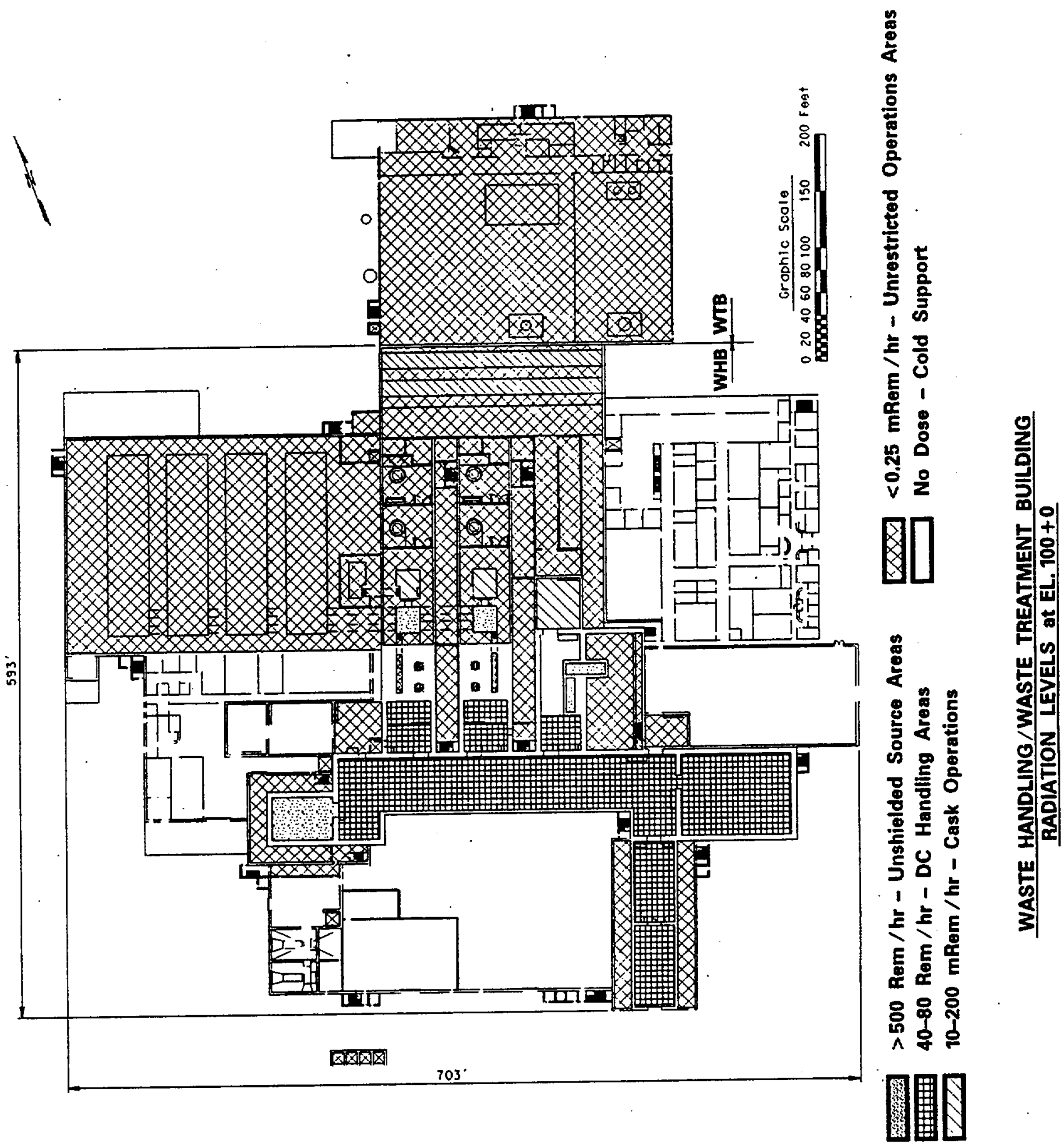
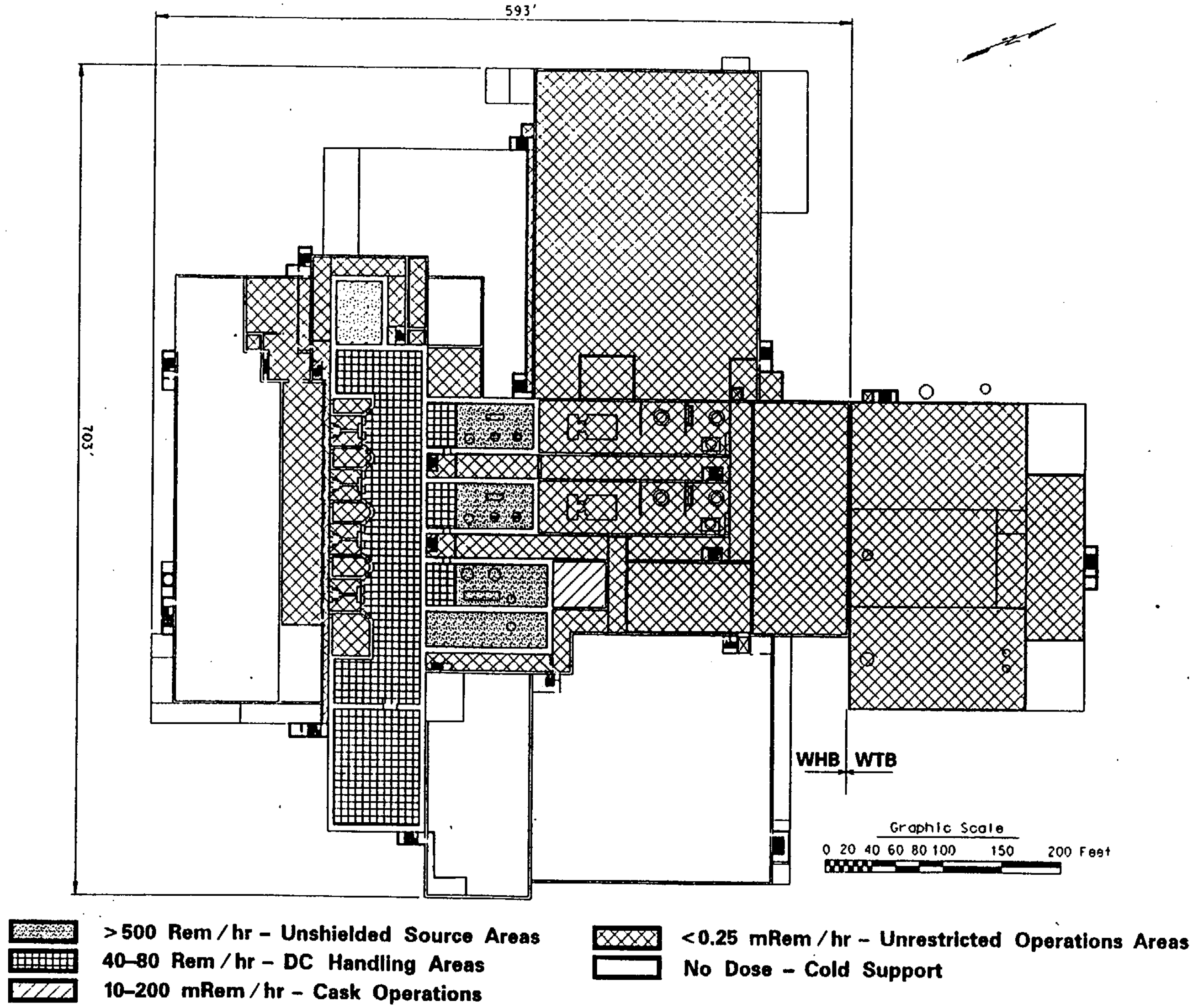


FIGURE I-28
WASTE HANDLING/WASTE TREATMENT BUILDING
RADIATION LEVELS at EL. 100+0

08-MAY-2000 12:22 CAD FILE: t:*reps*arch*dgn*efsr*rad1.dgn



**WASTE HANDLING/WASTE TREATMENT BUILDING
RADIATION LEVELS at EL. 130+0**

FIGURE I-29
WASTE HANDLING/WASTE TREATMENT BUILDING
RADIATION LEVELS at EL. 130+0

08-MAY-2000 12:24

CAD FILE: t:*reps*arch*dgn*efsr*rad2.dgn

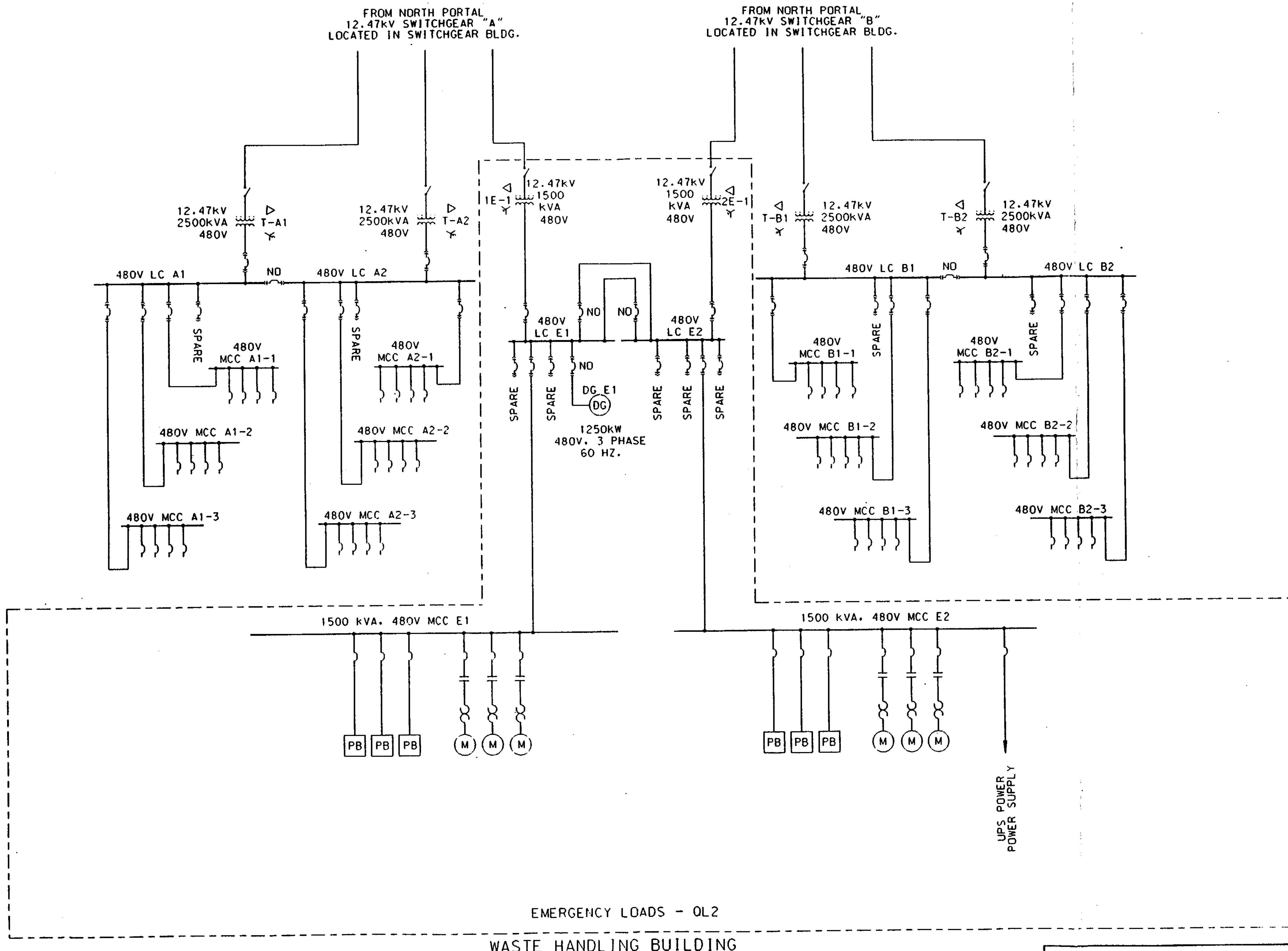


FIGURE I-30
WHB ELECTRICAL POWER DISTRIBUTION
ONE-LINE DIAGRAM

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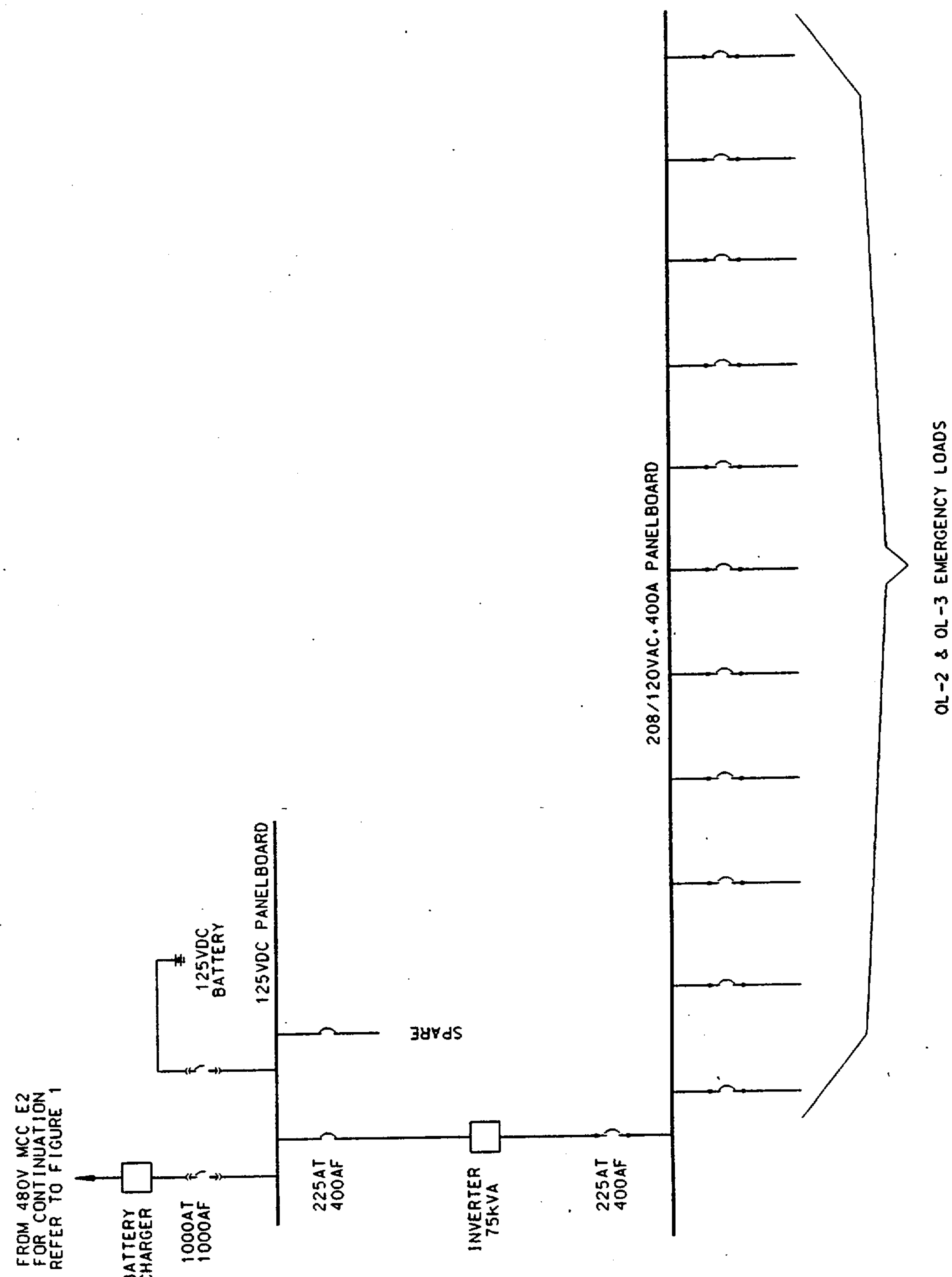

FIGURE I-31
WHB I&C UPS SYSTEM
ONE-LINE DIAGRAM

08-MAY-2000 12:58

CAD FILE: t:*reps*arch*dgn*efsr*whbicups.dgn

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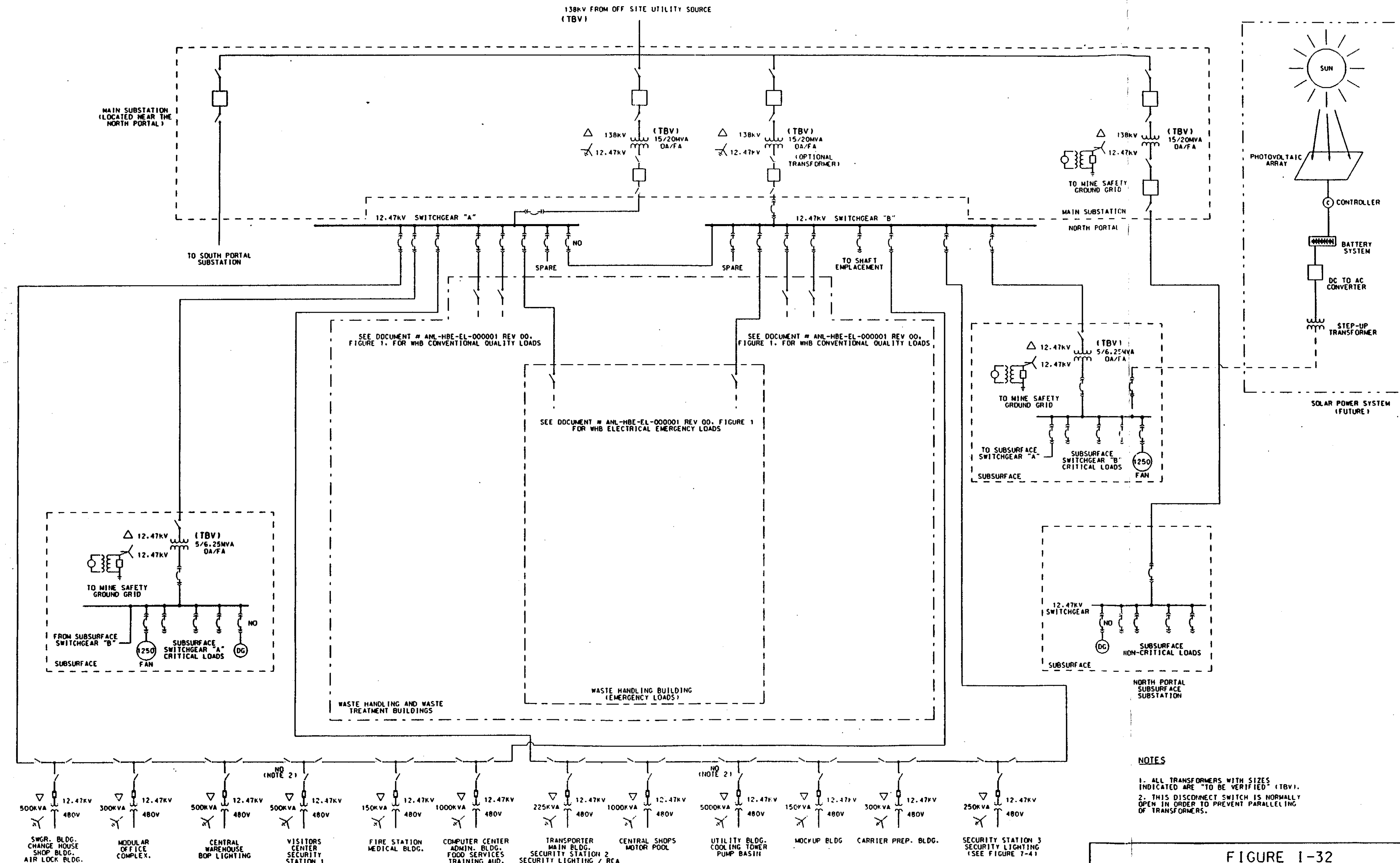

FIGURE I-32
MGR SITE
ELECTRICAL POWER DISTRIBUTION
ONE-LINE DIAGRAM

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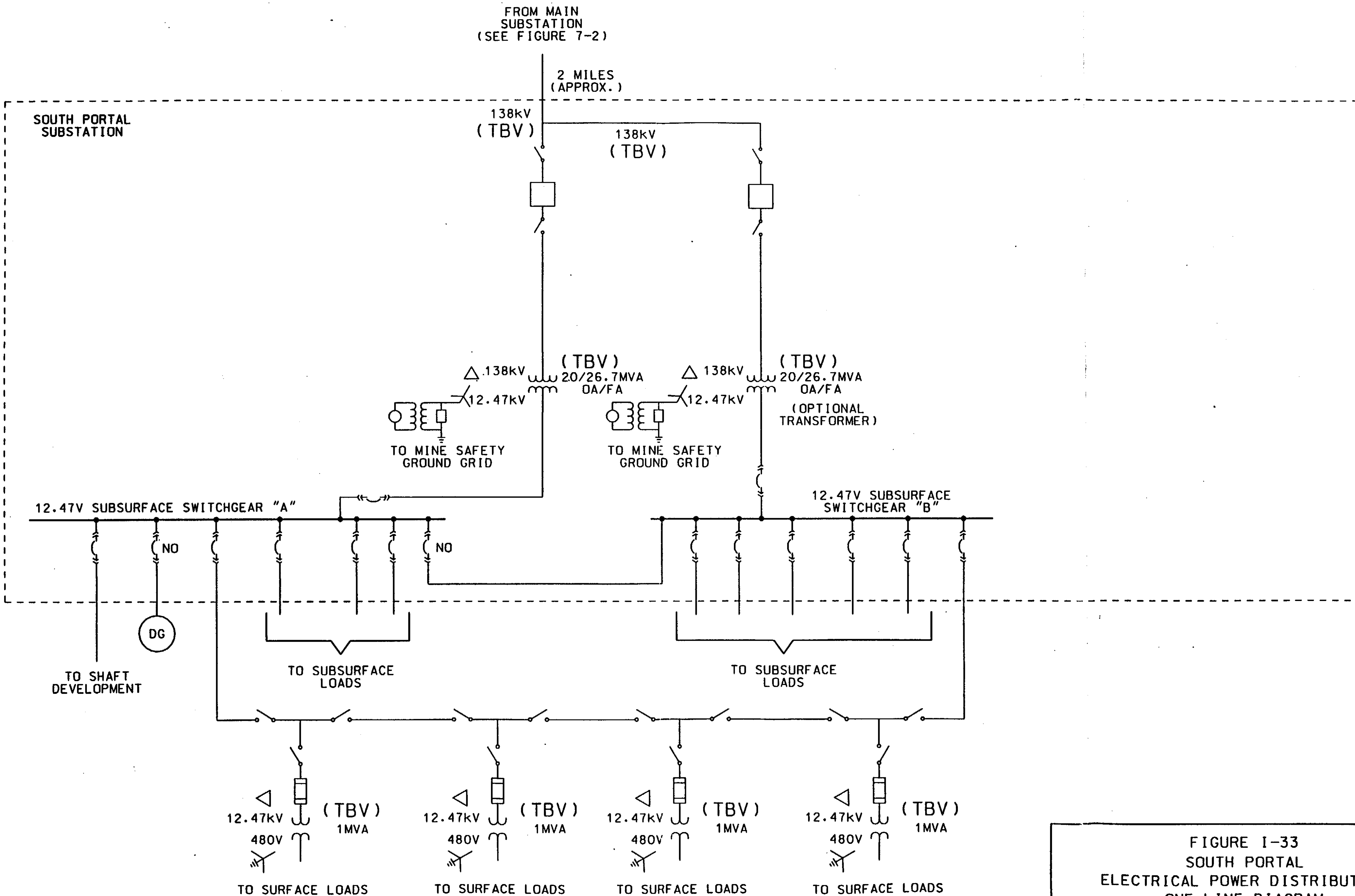

FIGURE I-33
SOUTH PORTAL
ELECTRICAL POWER DISTRIBUTION
ONE-LINE DIAGRAM

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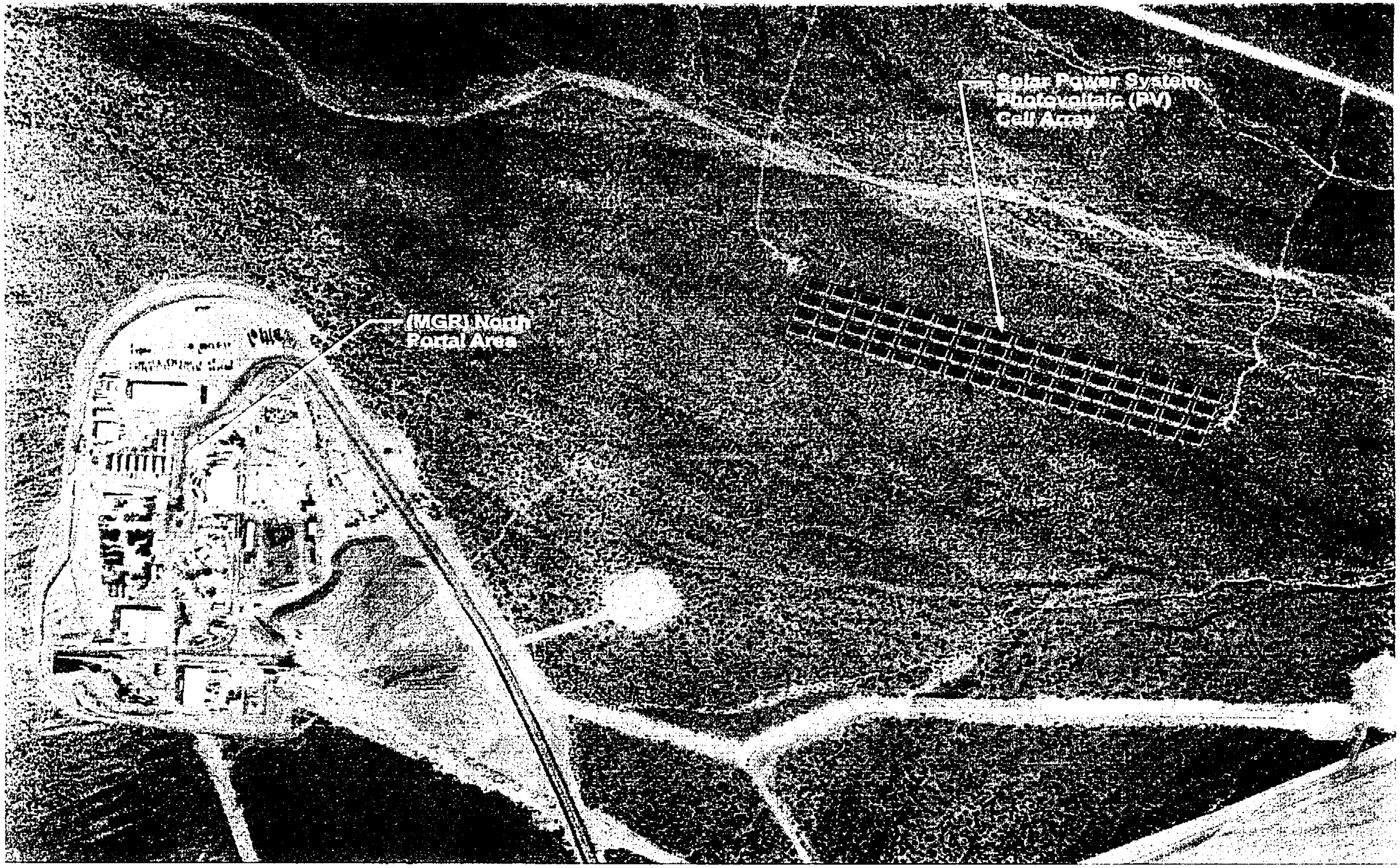

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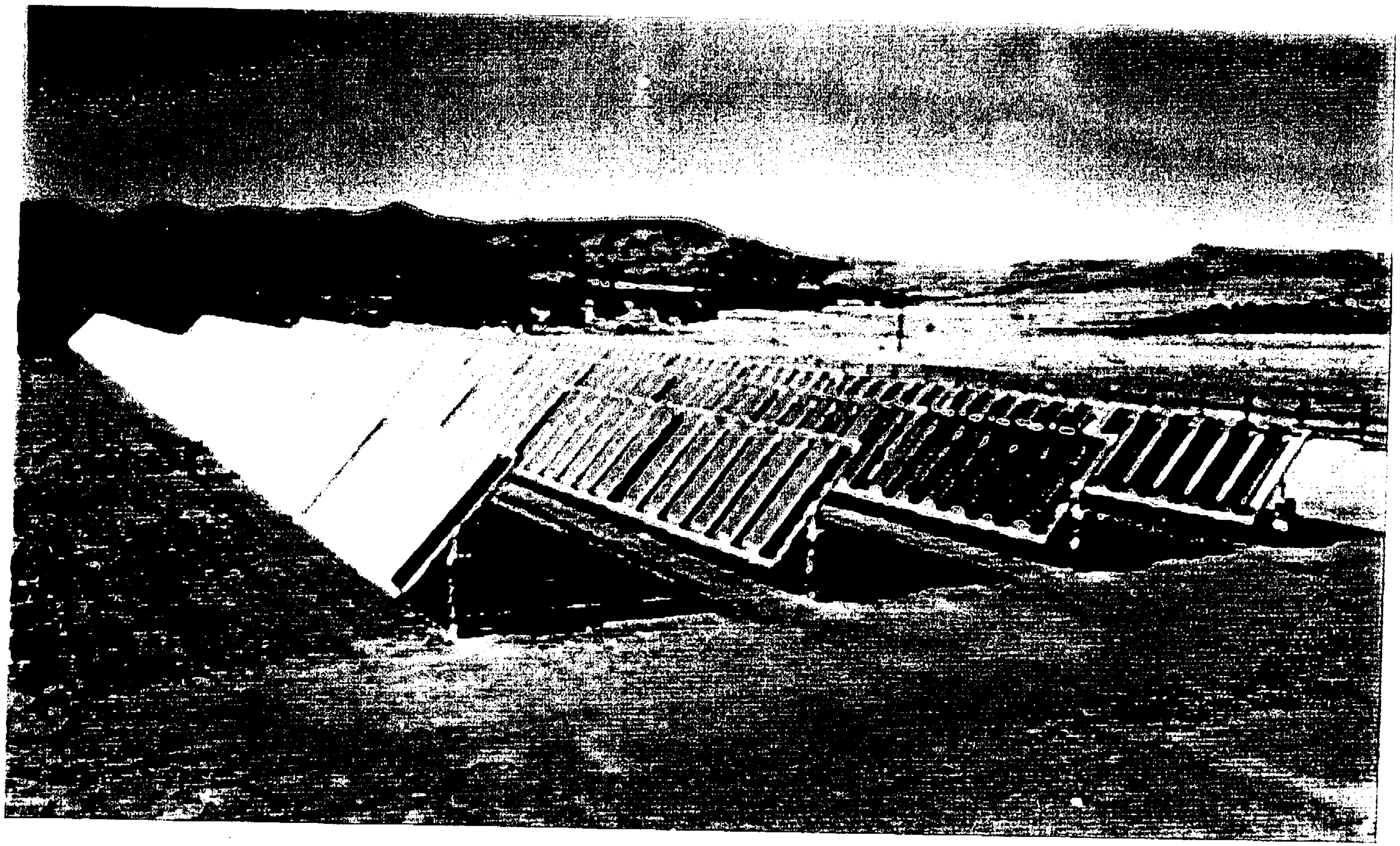
Figure I-34. Proposed Solar Power System



Drawing Not To Scale
00011DC_SRCR_V1S22_21.CDR

Figure I-35. Typical Arrangement of a Solar Power Photovoltaic (PV) Array

CRWMS SURFACE NUCLEAR FACILITIES
GENERAL ARRANGEMENT FIGURES

FIGURE LIST

FIGURE	TITLE
EF-GA 1	TITLE SHEET
WASTE HANDLING/WASTE TREATMENT BUILDING	
EF-GA 2	FLOOR PLAN AT EL. 50+0
EF-GA 3	FLOOR PLAN AT EL. 80+0
EF-GA 4	FLOOR PLAN AT EL. 100+0
EF-GA 5	FLOOR PLAN AT EL. 130+0
EF-GA 6	FLOOR PLAN AT EL. 142+0
EF-GA 7	FLOOR PLAN AT EL. 173+0
EF-GA 8	ROOF PLAN
EF-GA 9	BUILDING SECTIONS

ROOM LEGEND

WASTE HANDLING BUILDING

PRIMARY AREAS

CARRIER/CASK HANDLING SYSTEM (CCHS)
- H-100A CARRIER BAY

ASSEMBLY TRANSFER SYSTEM (ATS)
- H-040 VACUUM PUMP ROOM
- H-101 (A,B) CASK AIRLOCK
- H-102 (A,A2,B,B2) CASK PREP AND DECONTAMINATION
- H-103 (A,B) CASK UNLOAD POOL AREA
- H-103 (A1,B1) POOL, STAGING & CASK UNLOAD
- H-104 (A,B) INCLINE TRANSFER CANAL
- H-105 (A,B) DC LOAD CELL
- H-106 (A,B) DC DECONTAMINATION CELL
- H-183 FUEL STORAGE POOL AREA
- H-183 (A,B,C,D) FUEL BASKET STORAGE POOL
- H-183E NON-STANDARD FUEL POOL
- H-183 (F,G) FUEL BASKET TRANSFER CANAL
- H-183H NON-STANDARD FUEL BASKET TRANSFER CANAL
- H-183J NON-STANDARD FUEL HANDLING AREA
- H-205 (A,B) ASSEMBLY HANDLING CELL (AHC)
- H-206 (A,B) AHC CRANE MAINTENANCE BAY
- H-301 (A,B) POOL AREA CRANE MAINT BAY

CANISTER TRANSFER SYSTEM (CTS)
- H-100B CASK TRANSFER CORRIDOR
- H-103C CANISTER TRANSFER (CT) CELL, LOWER LEVEL
- H-103D CANISTER STAGING
- H-104C OFF-NORMAL CANISTER TRANSFER TUNNEL
- H-107A CASK AIRLOCK
- H-108A CASK PREP & DECONTAMINATION
- H-205C CANISTER TRANSFER CELL UPPER LEVEL
- H-205C1 OFF-NORMAL CANISTER HANDLING CELL
- H-209A CT CELL CRANE MAINTENANCE BAY

DISPOSAL CONTAINER HANDLING SYSTEM (DCHS)
- H-110 DC HANDLING CELL
- H-111 WP TRANSPORTER LOADING CELL
- H-112 WP TRANSPORTER AIRLOCK
- H-113 LOADED DC STAGING AREA
- H-115 EMPTY DC PREPARATION AIRLOCK
- H-117 EMPTY DC PREPARATION
- H-208 (A,B,C,D,E,F,G,H) WELDER #1-8
- H-301 DC HANDLING CELL CRANE MAINTENANCE BAY

WASTE PACKAGE REMEDIATION SYSTEM (WPRS)
- H-114 WP REMEDIATION CELL

PRIMARY SUPPORT AREAS
- H-116 CONTAMINATED EQUIPMENT ROOM
- H-118 (A,B,C,E,F,G,H) OPERATING GALLERY
- H-119 WASTE HANDLING OPERATION CNTR
- H-120 CONTAMINATED EQUIPMENT & DECONTAMINATION
- H-120A STAGING AREA (HOT SUPPORT)
- H-122 MAINTENANCE EQUIP STORAGE
- H-123 TOOL STORAGE
- H-124 MAINTENANCE SHOP
- H-125 LLW COLLECTION & PACKAGING
- H-126 FORKLIFT STAGING & SERVICING
- H-203 WELDER MAINTENANCE BAY
- H-207 (A,B,C,D,F,G,H,I,J) OPERATING GALLERY
- H-211 WELDER MATERIALS STORAGE
- H-213 WELDER MAINTENANCE HOT SHOP
- H-402 ASSEMBLY & CANISTER TRANSFER CORRIDOR
- H-403 DC HANDLING & WP REMEDIATION EQUIPMENT TRANSFER CORRIDOR

POOL SUPPORT AREAS
- H-020 POOL TREATMENT EQUIP ROOM
- H-083 POOL TREATMENT EQUIP ROOM
- H-084 (A,B) POOL TREATMENT EQUIP ROOM
- H-085 CORRIDOR

FACILITY SUPPORT AREAS

MAINTENANCE
- H-019 EQUIPMENT MAINTENANCE SHOP
- H-019B INSTRUMENT MAINTENANCE SHOP
- H-121 SHIPPING & RECEIVING
- H-159 TOOL STORAGE
- H-160 MAINTENANCE MATERIAL STORAGE
- H-161 (A,B) HEPA FILTER STORAGE
- H-162 JANITOR CLOSET
- H-163 SHIPPING/RECEIVING
- H-164 WASTE STAGING
- H-165 GAS BOTTLE STORAGE

OPERATIONS
- H-016A MEN'S CHANGE ROOM
- H-016B WOMEN'S CHANGE ROOM
- H-017 (A,B) COVERALL STORAGE
- H-133 (A,B) HEALTH PHYSICS LABORATORY
- H-134 (A,B,C,D) LABORATORY TECHNICIANS OFFICE
- H-135 LABORATORY MATERIAL STORAGE
- H-136 FIRST AID ROOM & OFFICE
- H-137 OPERATIONS LUNCHROOM
- H-138 JANITOR CLOSET

ADMINISTRATION
- H-018 (A,B) SUPERVISOR OFFICE
- H-018B SUPERVISOR OFFICE
- H-139 ENTRY LOBBY
- H-140 (A,B) SUPERVISOR OFFICE
- H-141 PLNT OPERATIONS MANAGER OFFICE
- H-142 (A,B) QA/QC OPERATIONS OFFICE
- H-143 (A,B,C,D) OPERATIONS STAFF OFFICE
- H-144 STAFF SUPPORT-OPEN OFFICE
- H-145 (A,B) SECRETARIAL OFFICE
- H-146 (A,B) DOE MANAGER OFFICE
- H-147 (A,B,C,D) DOE STAFF OFFICES
- H-148 (A,B) DOE STAFF SUPPORT-SECRETARIAL
- H-149 DOE STAFF SUPPORT-CLERICAL
- H-150 CONFERENCE ROOM
- H-151 OPERATIONS CLERK OFFICE
- H-151A DOCUMENT CONTROL
- H-152 COPY ROOM
- H-153 STORAGE ROOM
- H-154A RESTROOM, WOMEN
- H-154B RESTROOM, MEN
- H-155 LUNCHROOM
- H-156 JANITOR CLOSET

RADIATION PROTECTION
- H-010 REGULATED CHANGE ROOM
- H-011 RADIATION PROTECTION PORTAL
- H-012 PERSONNEL DECON ROOM
- H-013 PERSONNEL RADIATION PROTECTION EQUIPMENT STORAGE
- H-014 HEALTH PHYSICS OFFICE
- H-015 (A,B) PROTECTIVE CLOTHING STORAGE
- H-129 CALIBRATION SHOP
- H-302 REGULATED CHANGE ROOM
- H-305 REGULATED CHANGE ROOM
- H-405 REGULATED CHANGE ROOM

SECURITY
- H-130 (A,B) SECURITY PORTAL
- H-131 SECURITY ALARM STATION
- H-132 (A,B) OFFICE

HVAC EQUIPMENT AREAS
- H-157 COLD SUPPORT HVAC
- H-171 TERTIARY CONFINEMENT EXHAUST
- H-171A ELECTRICAL DISTRIBUTION HVAC
- H-171 (B,C) STACK MONITOR ROOM
- H-200 TERTIARY CONFINEMENT SUPPLY
- H-201 TERTIARY CONFINEMENT EXHAUST/RECIRCULATING
- H-204 HYDRONIC EQUIPMENT ROOM
- H-300 PRIMARY/SECONDARY CONFINEMENT SUPPLY
- H-308 (A,B) PRIMARY CONFINEMENT EMERGENCY SUPPLY
- H-383A FUEL STORAGE POOL TERTIARY CONFINEMENT SUPPLY
- H-383B FUEL STORAGE POOL TERTIARY CONFINEMENT EXHAUST
- H-400 SECONDARY CONFINEMENT EXHAUST
- H-400A PRIMARY CONFINEMENT EXHAUST
- H-400 (B,C) EMERGENCY CONFINEMENT EXHAUST

MISCELLANEOUS BUILDING SUPPORT AREAS

AIRLOCK AND VESTIBULE
- H-086 VESTIBULE
- H-100C ACCESS CORRIDOR
- H-100 (D,E,F) VESTIBULE
- H-101 (D,E,F,G,H) AIRLOCK
- H-116A ACCESS CORRIDOR
- H-183K VESTIBULE
- H-217 AIRLOCK
- H-220 AIRLOCK
- H-223 VESTIBULE
- H-228 VESTIBULE
- H-303 AIRLOCK
- H-304 VESTIBULE
- H-307 AIRLOCK
- H-309 ACCESS CORRIDOR
- H-310 VESTIBULE
- H-312 VESTIBULE
- H-313 VESTIBULE
- H-317 VESTIBULE
- H-404 AIRLOCK
- H-406 AIRLOCK
- H-407 AIRLOCK

COMMUNICATIONS
- H-170 COMMUNICATION ROOM

CORRIDORS & HALLWAYS
- H-050 CORRIDOR
- H-051 CORRIDOR
- H-052 CORRIDOR
- H-053 CORRIDOR
- H-054 CORRIDOR
- H-120B CORRIDOR
- H-127 ACCESS CORRIDOR
- H-128 ACCESS CORRIDOR
- H-181 ACCESS CORRIDOR
- H-182 ACCESS CORRIDOR
- H-218 ACCESS CORRIDOR
- H-219 ACCESS CORRIDOR
- H-221 ACCESS CORRIDOR
- H-224 ACCESS CORRIDOR
- H-225 ACCESS CORRIDOR
- H-226 ACCESS CORRIDOR
- H-227 ACCESS CORRIDOR
- H-306 ACCESS CORRIDOR
- H-314 ACCESS CORRIDOR
- H-315 ACCESS CORRIDOR
- H-316 ACCESS CORRIDOR
- H-401 (A,B,C,D,E,F) ACCESS CORRIDOR

ELECTRICAL
- H-168 ELECTRICAL POWER DISTRIBUTION
- H-169 (A,B) EMERGENCY GENERATOR
- H-172 (A,B) SAFETY ELECTRICAL EQUIPMENT

FIRE PROTECTION
- H-167 (A,B,C,D,E,F,G) FIRE RISER
- H-267 (C,D,E,F) FIRE RISER
- H-367G FIRE RISER

PIPE CHASE
- H-075 PIPE CHASE

WASTE TREATMENT BUILDING

PROCESS AREA
- T-101 SOLID LLW PROCESSING
- T-102 CHEMICAL LIQUID LLW PROCESSING
- T-103 RECYCLABLE LIQUID LLW PROCESSING
- T-104 MIXED & HAZARDOUS WASTE STAGING

FACILITY SUPPORT AREA

SECURITY
- T-105 SECURITY PORTAL
- T-106 SECURITY PORTAL
- T-107 OFFICE

OPERATIONS
- T-108 PARTS STORAGE
- T-109 MEN'S CHANGE ROOM
- T-110 WOMEN'S CHANGE ROOM
- T-111 COVERALL STORAGE
- T-112 LUNCHROOM
- T-113 (A,B) JANITOR CLOSET
- T-114 FORKLIFT STAGING
- T-115 SHIPPING/RECEIVING
- T-129 FORKLIFT CORRIDOR

ADMINISTRATION
- T-116 NOT USED
- T-117 SUPERVISOR OFFICE
- T-118 SUPERVISOR OFFICE
- T-119 PLANT MANAGER OFFICE
- T-120 PLANT MANAGEMENT SUPERVISOR OFFICE
- T-121 STAFF SUPPORT-OPEN OFFICE
- T-122 HEALTH PHYSICS OFFICE
- T-123 QA OFFICE
- T-124 INVENTORY CONTROL OFFICE
- T-125 COPY/STORAGE ROOM
- T-126 INSTRUMENT CALIBRATION
- T-130 VESTIBULE

HVAC EQUIPMENT AREAS
- T-200 FACILITY SUPPORT AREA HVAC
- T-201 PROCESS AREA HVAC SUPPLY
- T-202 PROCESS AREA HVAC EXHAUST

BUILDING SUPPORT AREAS

FIRE PROTECTION
- T-127 (A,B) FIRE RISER ROOM

ELECTRICAL
- T-203 ELECTRICAL POWER DISTRIBUTION
- T-204 ELECTRICAL SWITCHGEAR

COMMUNICATIONS
- T-128 COMMUNICATION ROOM

FIGURE I-36
WASTE HANDLING/WASTE TREATMENT BLDG
TITLE SHEET

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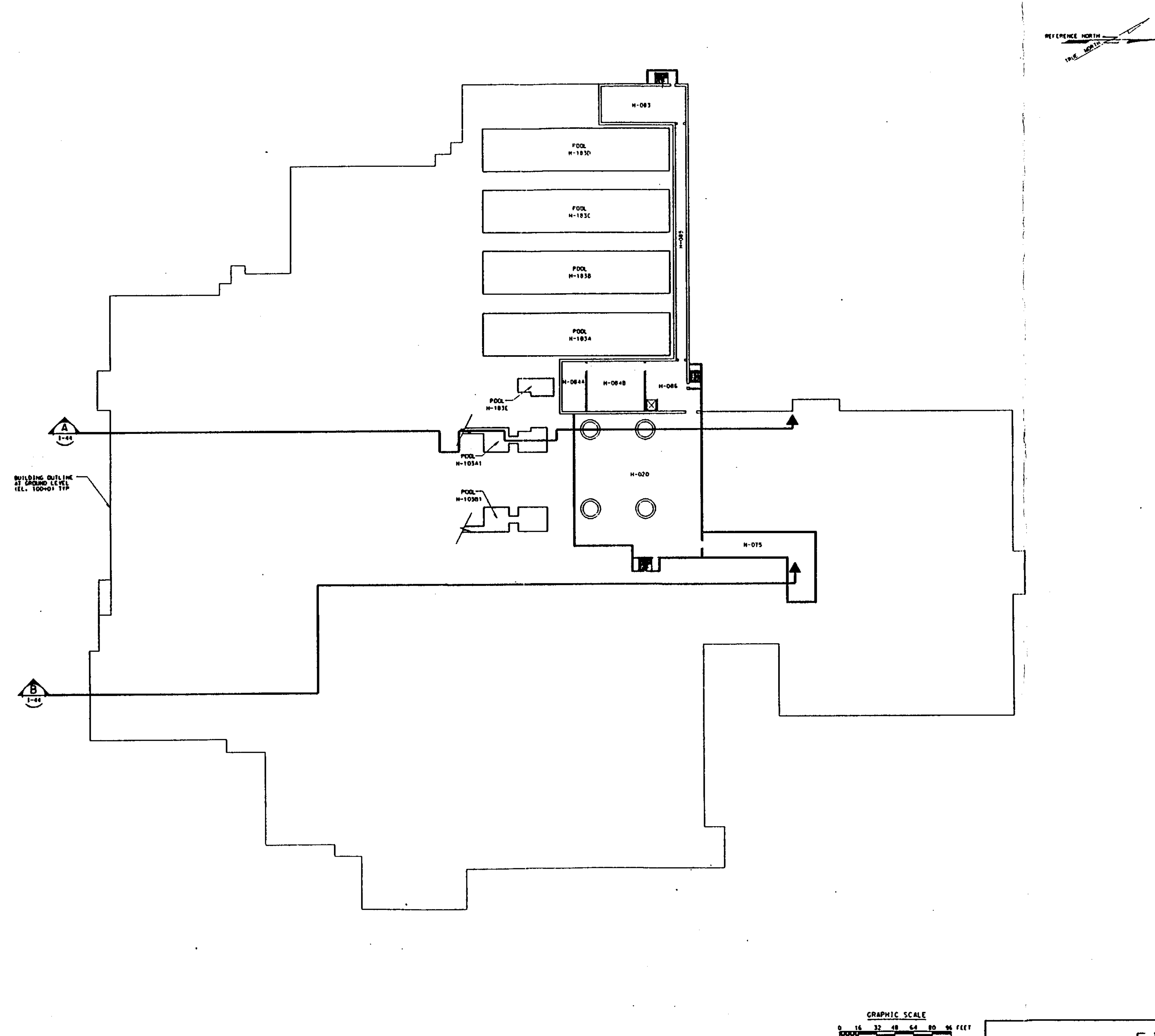

FIGURE I-37
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 50+0

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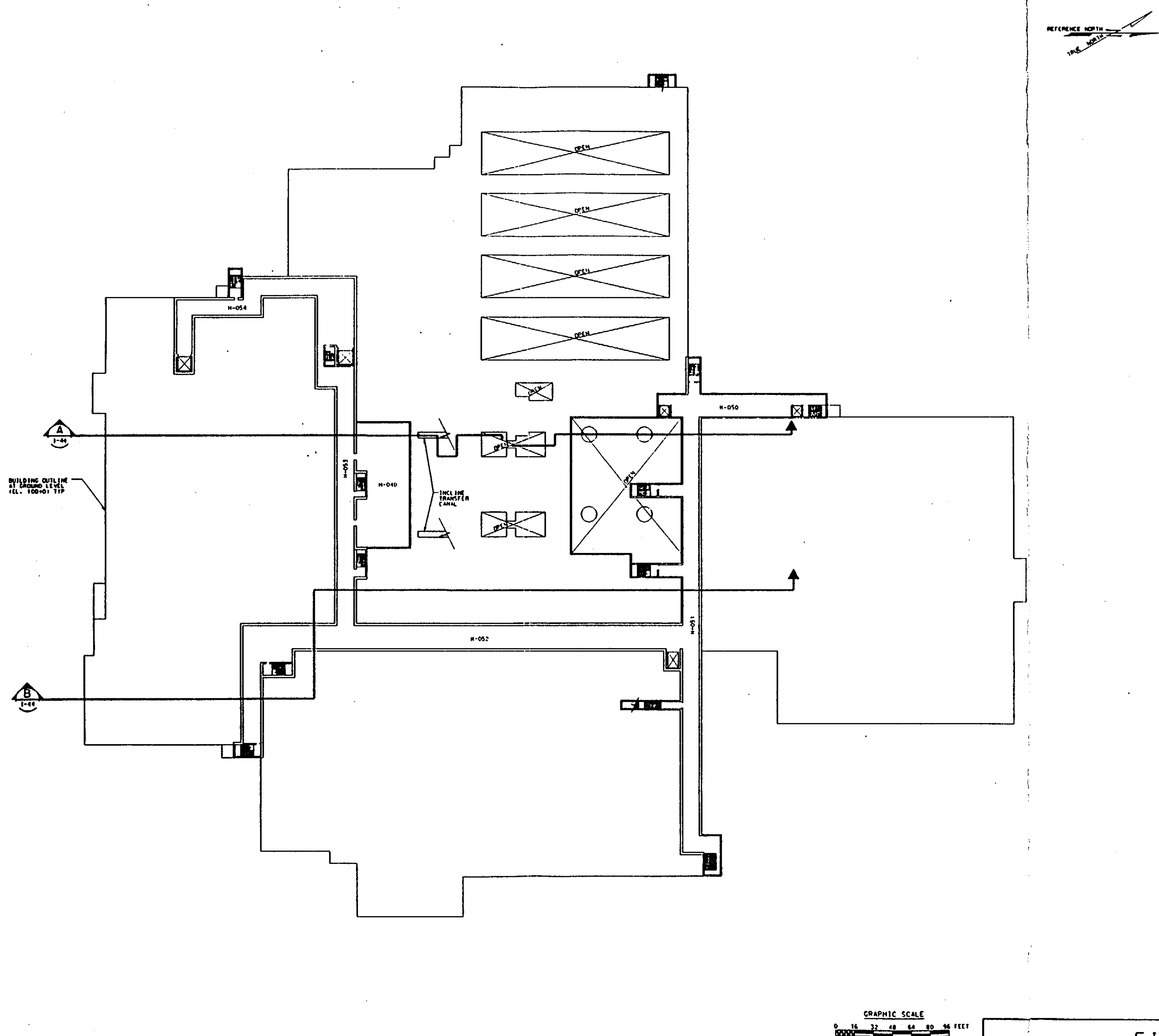

FIGURE I-38
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 80+0

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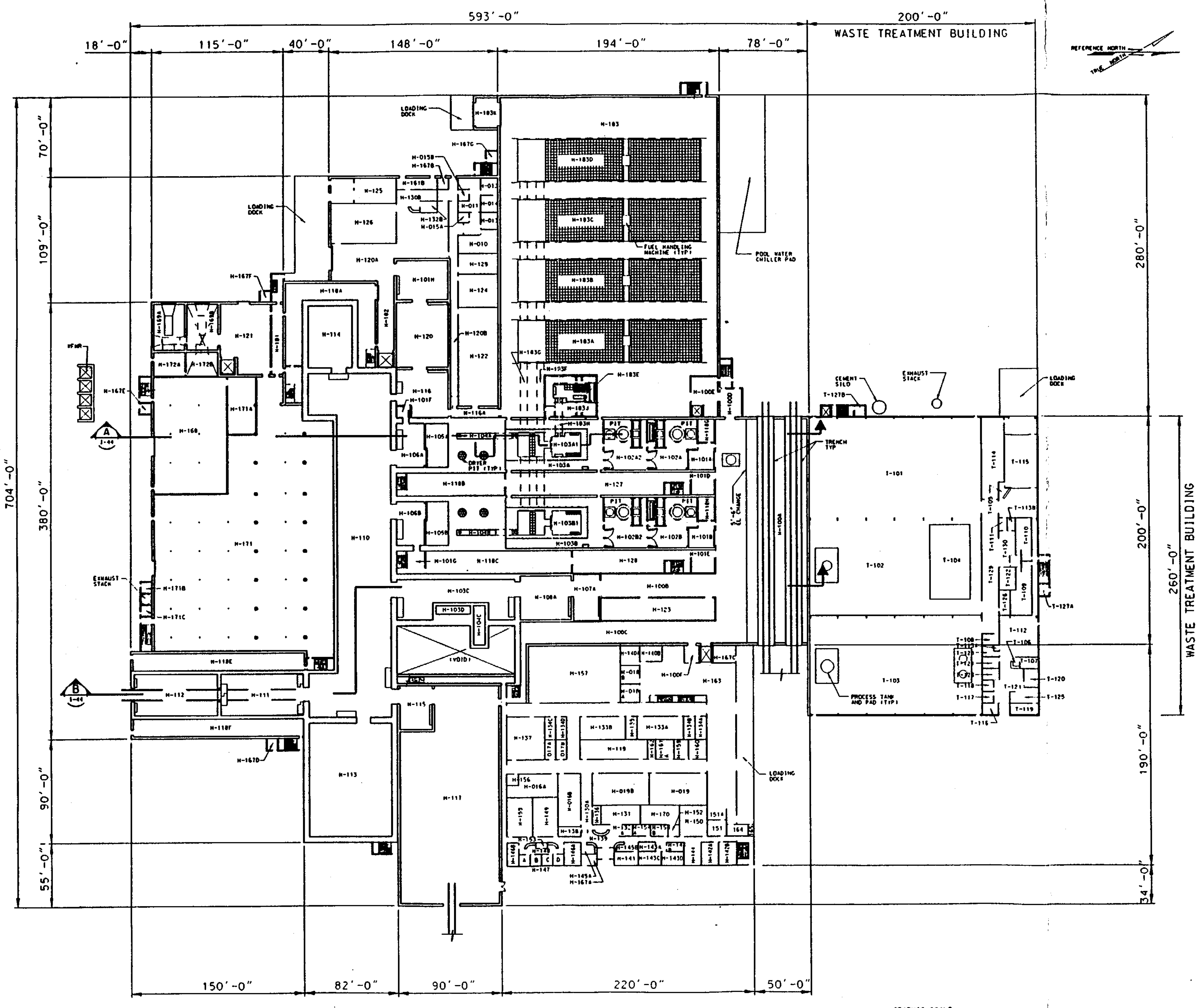

FIGURE I-39
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 100+0

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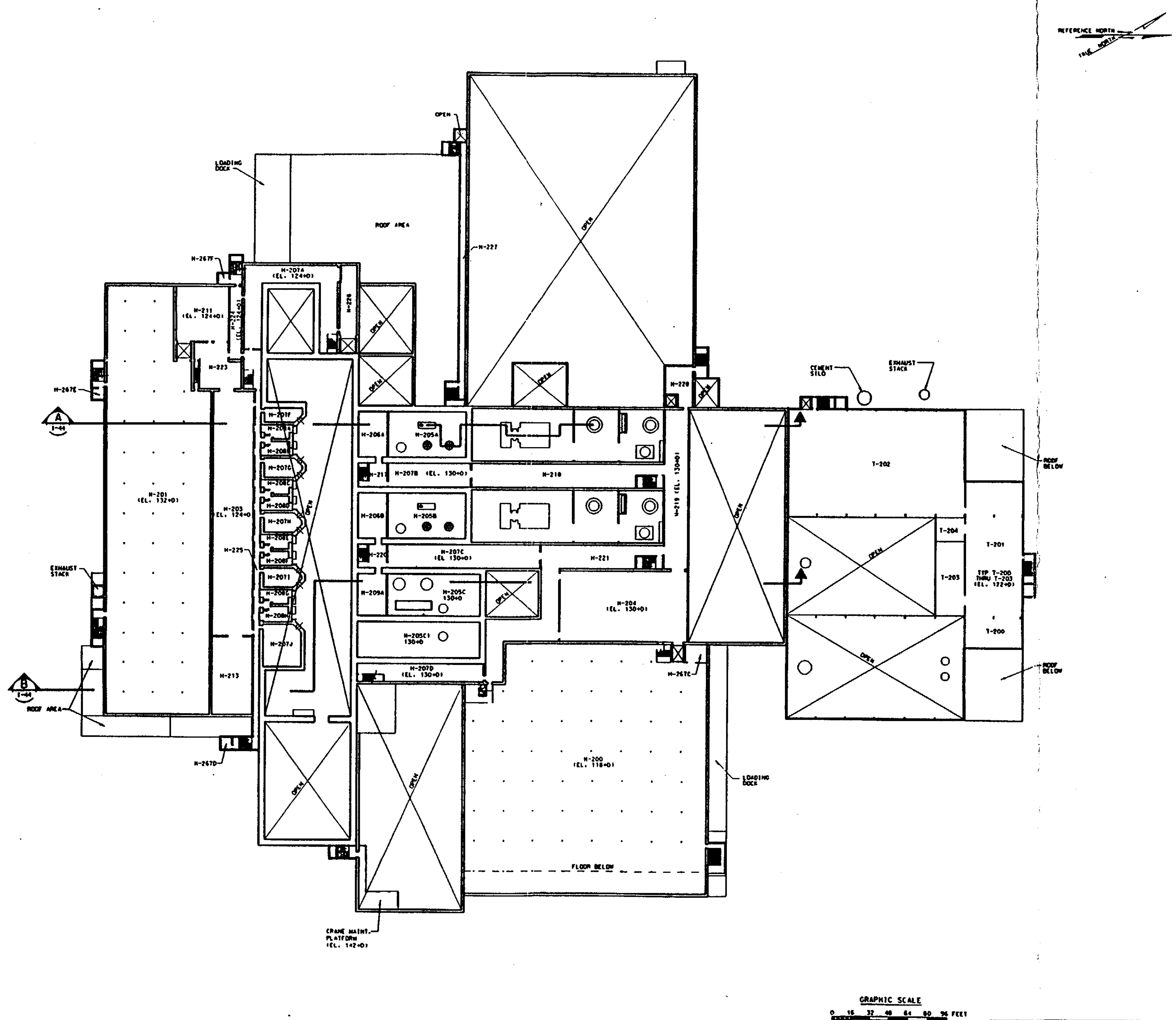

FIGURE I-40
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 130+0

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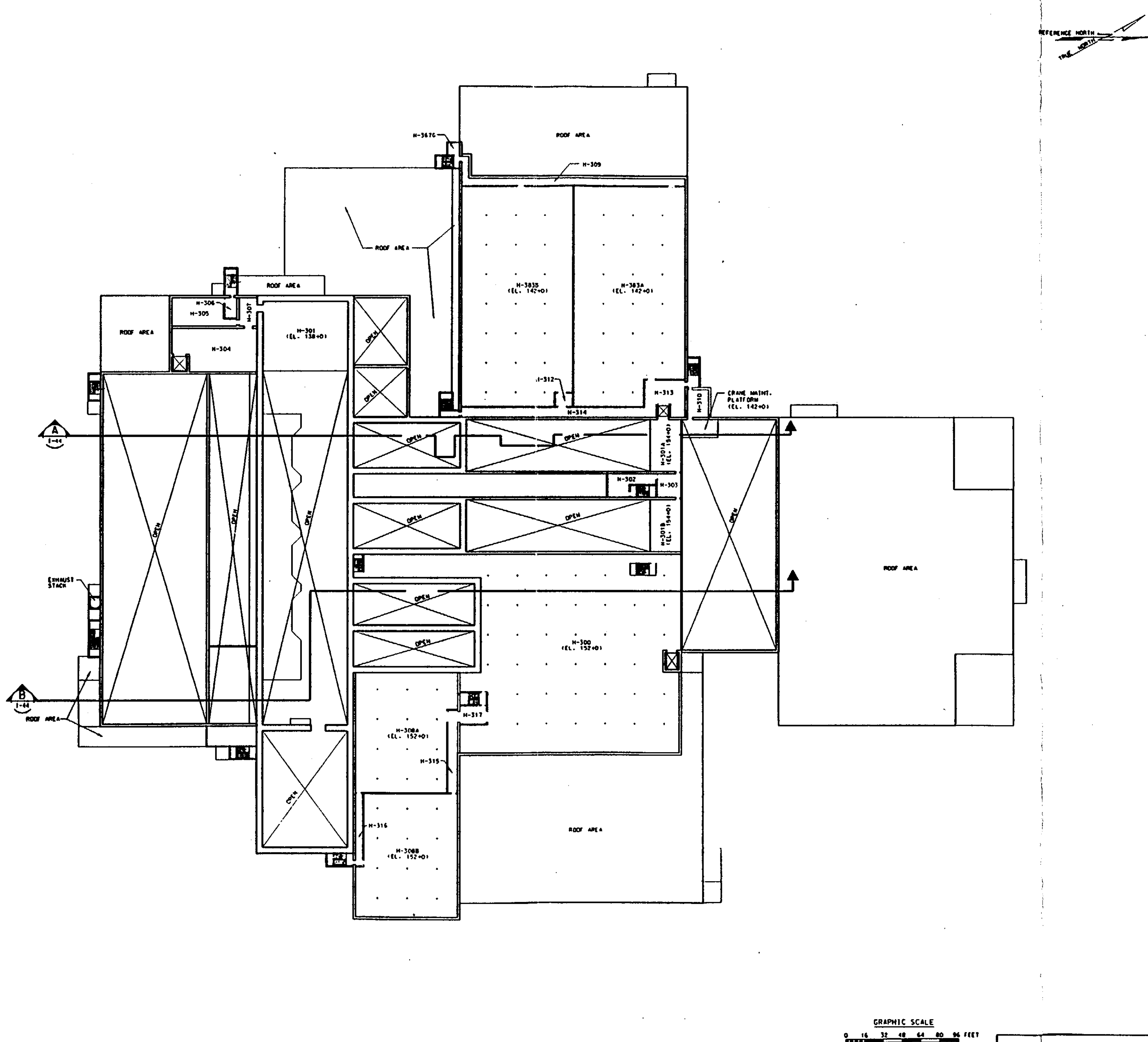

FIGURE I-41
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 142+0

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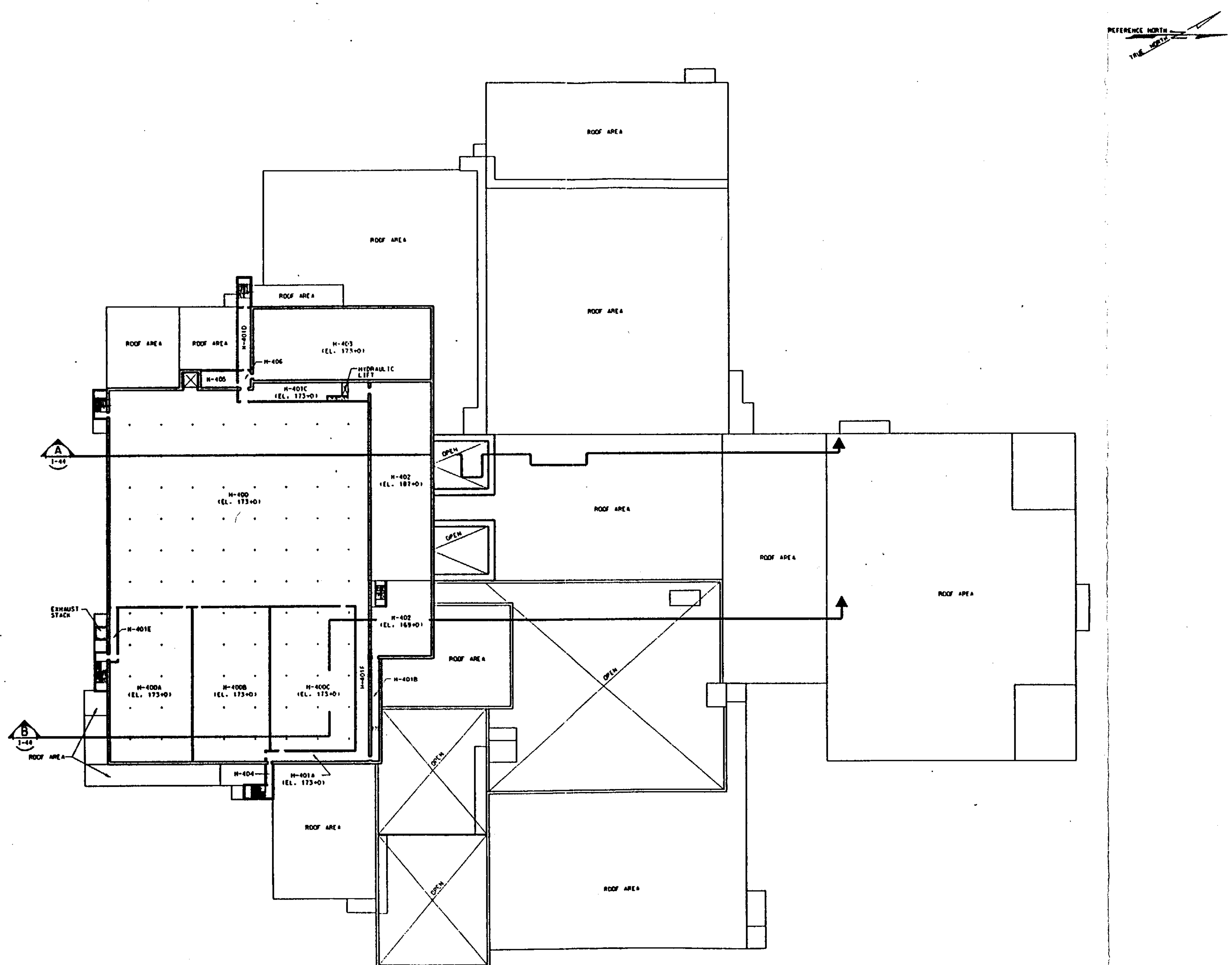

FIGURE I-42
WASTE HANDLING/WASTE TREATMENT BLDG
FLOOR PLAN AT EL. 173+0

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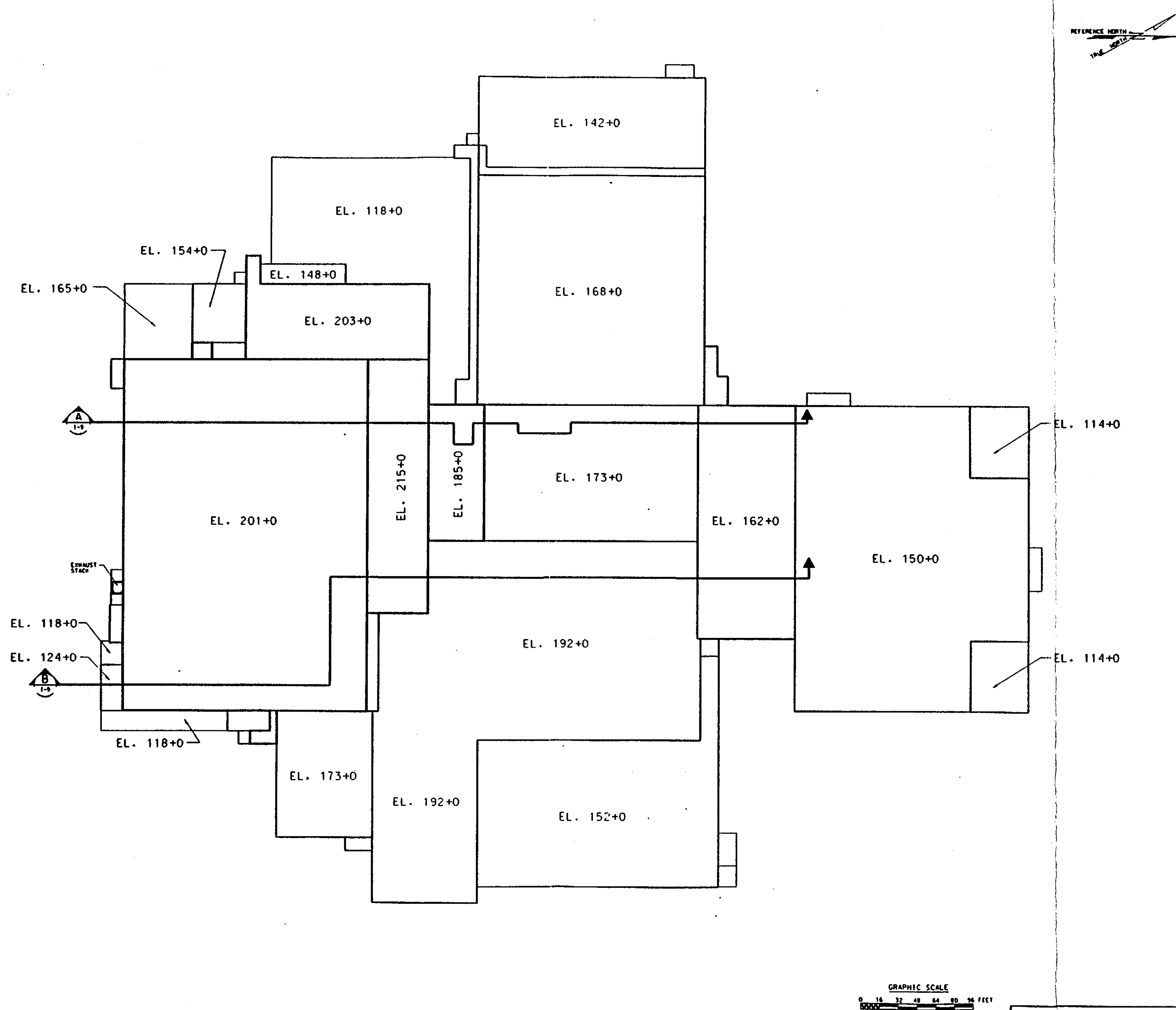

FIGURE I-43
WASTE HANDLING/WASTE TREATMENT BLDG
ROOF PLAN

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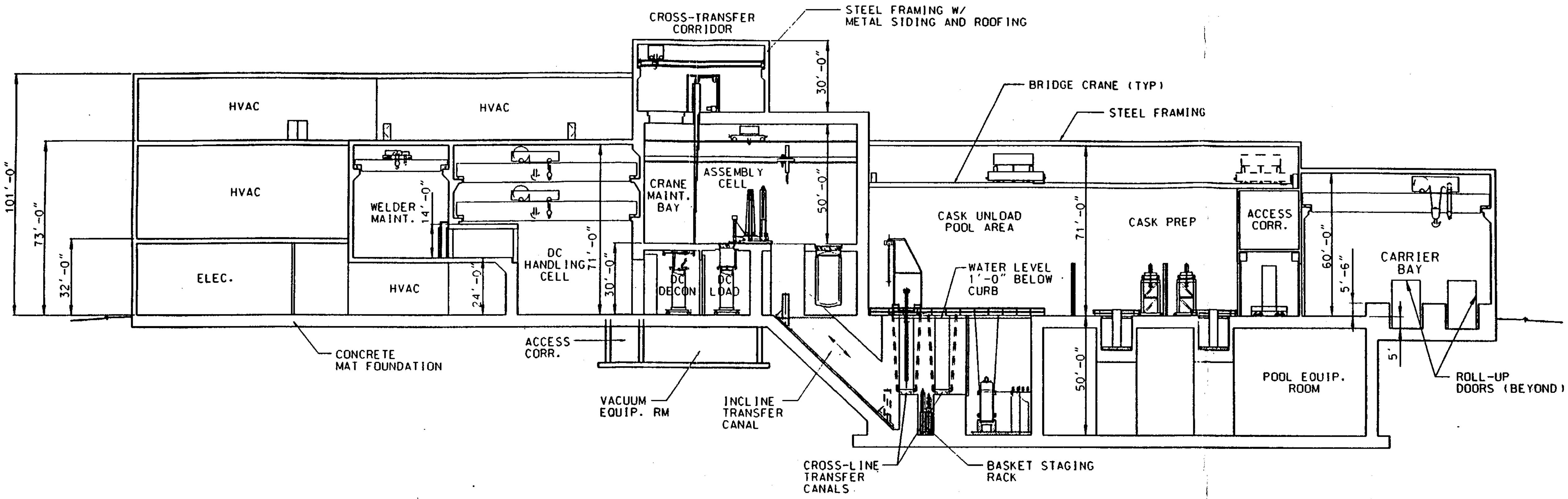
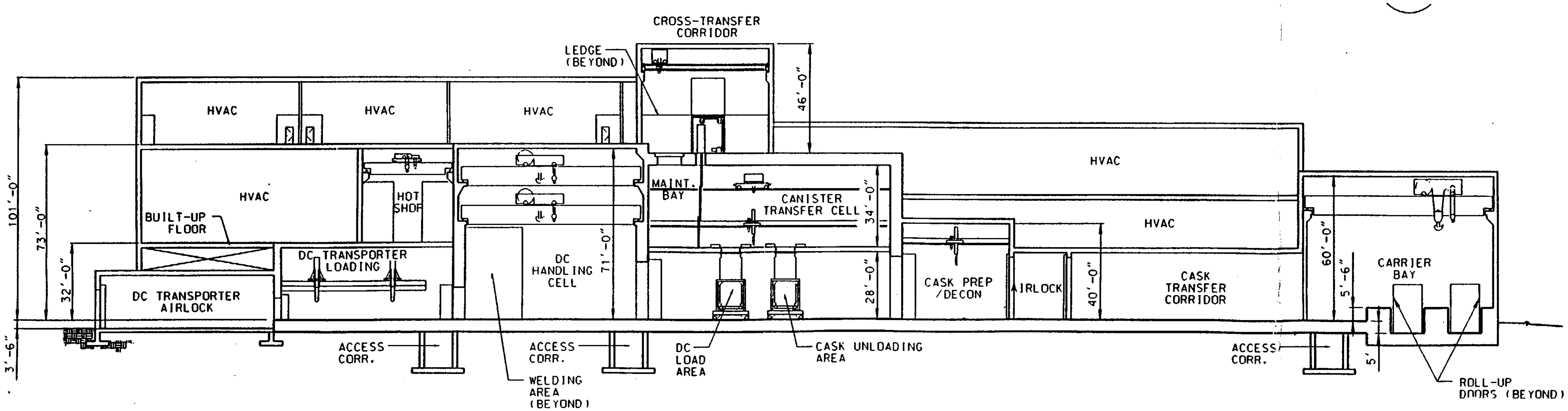


BUILDING SECTION - ASSEMBLY TRANSFER

A
I 36-43



BUILDING SECTION - CANISTER TRANSFER

B
I 36-43

GRAPHIC SCALE
0 8 16 24 32 40 48 FEET

FIGURE I-44
WASTE HANDLING/WASTE TREATMENT BLDG
BUILDING SECTIONS

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ATTACHMENT II

SYSTEM INFORMATION

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FIGURES

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TABLES

1. RADIOLOGICALLY CONTROLLED AREA

The Radiologically Controlled Area (RCA) facilities are dedicated to nuclear waste shipping, receiving, and transport operations within the RCA, including unloading nuclear waste from casks, storing the waste, loading waste into disposal containers (DCs), and loading underground transporters for emplacements. The primary RCA facilities include the Waste Handling Building (WHB), the Waste Treatment Building (WTB), the Carrier Preparation Building (CPB), the Transporter Maintenance Building (TMB), and the Airlock Building.

1.1 WASTE HANDLING BUILDING

The WHB provides the structures, controlled areas, and accesses required to house and operate the waste preparation systems, protect operating personnel, and maintain radiological confinement. Integral to the facility structure are the essential waste preparation systems (Carrier/Cask Handling System [CCHS], Assembly Transfer System [ATS], Canister Transfer System [CTS], and Disposal Container Handling System [DCHS] [see Figure I-1, Attachment I, this document), and the Waste Package Remediation System [WPRS]). The WHB waste handling operations are based on the Repository Surface Design mechanical from diagram overview (CRWMS M&O 1997c). The associated operating and equipment areas for these systems are described in subsequent sections. Essential support systems include the WHB Electrical, Fire Protection, Radiation Monitoring, and Ventilation Systems described herein. Ancillary support systems include security, communications, alarm and public address, potable and chilled water (CHW), sanitary waste, low-level waste (LLW), effluent, air and vacuum, waste handling pool, decontamination, facility monitoring and control, repair and calibration shop, office, and other support systems.

1.1.1 Assembly Transfer System

1.1.1.1 Functional Description

The design configuration for the ATS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2).

The two nearly identical ATS lines are provided in the WHB. The ATS lines include the fuel storage pool area and the nonstandard fuel pool room. Each line operates independently to handle the waste transfer throughput and to support maintenance operations. (CRWMS M&O 2000a, Summary)

The ATS receives, cools, and opens rail and truck transportation casks from the CCHS. Waste is received in various forms (see Figure I-2, Attachment I, this document). The system unloads commercial spent nuclear fuel (CSNF) consisting of bare assemblies and single element canisters, and dual-purpose canisters (DPCs) from the transportation casks. For casks containing a DPC, the system opens the DPC and then unloads the spent nuclear fuel (SNF). The system stages or stores the assemblies, loads them into a DC, temporarily fills the DC with inert gas and seals the DC, decontaminates the DC, and transfers the DC to the DCHS. The system repackages nonstandard fuel assemblies into acceptable packages. The system also prepares empty casks and DPC overpacks for offsite shipment.

Each ATS line consists of a cask unloading area and a hot cell area. The cask unloading area includes a cask preparation and decontamination area and a pool area. The pool area contains a cask unloading pool and an assembly staging pool. A single transfer canal connects the two pools. The hot cell area consists of an assembly handling cell, a DC loading cell, and a DC decontamination cell. An incline transfer canal is used to move the SNF from the staging pool to the assembly handling cell. The assembly handling cell is equipped with two drying stations, a DC loading port, an assembly transfer machine, a DC loading manipulator, an in-cell service crane, and a maintenance bay.

One of the ATS lines is specifically designed and equipped to handle shipments of nonstandard CSNF. The ATS line is connected to the nonstandard fuel handling room by an underwater transfer canal equipped with isolation gates and an SNF transfer cart. All the ATS pools and fuel storage pools have isolation gates to allow each pool to be segregated from the other pools, if necessary.

The ATS operating sequence begins with moving transportation casks to the cask preparation area. The cask preparation operations consist of remote cask cavity gas sampling, cask venting, cask cool-down, cask lid unbolting and removal, shield plug unbolting, and shield plug lifting fixture attachment. Casks containing bare SNF (no DPC) are filled with water in the cask preparation area and placed in the cask unloading pool. The shield plugs are removed underwater. For casks containing a DPC, the cask lid(s) is remotely removed, the DPC vent valves are opened, and the DPC cavity is sampled, vented, and cooled. A DPC lifting fixture is remotely attached and the cask is placed into the cask unloading pool. In the cask unloading pool, the DPC is removed from the cask and placed in a canister overpack where the DPC lid is severed and removed.

Assemblies are individually removed from either an open cask or DPC and loaded into assembly baskets positioned in the assembly staging pool or in the assembly basket transfer cart. The assembly baskets are then transferred to the fuel storage pool area. Two fuel basket transfer canals, each equipped with an assembly basket transfer cart, interconnect the ATS staging pools of both ATS lines with the fuel storage pool area. The fuel storage pool area consists of four storage pools.

The assembly baskets are transferred to the storage pools only when CSNF is loaded in the DC and is generating heat at a rate more than 11.8 kW. The assembly baskets are transferred from the storage pools only when CSNF loaded in the DC is generating heat at a rate less than 11.8 kW. It has been determined that approximately 12,000 SNF assemblies and 2,800 assembly baskets will accumulate in the storage pools during the emplacement period to satisfy the blending requirement (see Parameter 1.1.1.2.1.8). This amount of SNF can be held in four storage pools each sized to stage 1,250 metric tons uranium (MTU) or 750 fuel baskets (Assumption 1.1.1.2.2.11).

From the storage pools, assembly baskets are moved to a dry assembly handling cell and loaded into one of two SNF drying vessels. After drying, the assemblies are individually removed from the drying vessels and loaded into a DC positioned below the DC load port. After installation of a DC inner lid sealing device, the DC is transferred to the DC decontamination cell where the top area of the DC and the DC inner lid sealing device are decontaminated, and the DC is evacuated

and filled with nitrogen gas. The DC is then transferred to the DCHS for lid welding and inspection.

In the second cask preparation and decontamination area, lids are replaced on the empty transportation cask and DPC overpack, and the cask and DPC overpack are decontaminated, inspected, and transferred to the CCHS for shipment off site. Cask preparation equipment is designed to facilitate remote or manual operation, decontamination, and contact maintenance.

The ATS interfaces with the CCHS for incoming transportation casks and outgoing casks and DPC overpacks. The system also interfaces with the DCHS, which prepares the empty DC for loading and subsequently closes and seals the DC. The ATS also interfaces with the WHB System, the WHB Electrical System, and other WHB utility systems for operational support.

1.1.1.2 Design Parameters and Assumptions

1.1.1.2.1 Parameters

1.1.1.2.1.1 Two ATS lines with cask unloading and fuel staging pools are required to handle the waste throughput and support maintenance operations. (CRWMS M&O 2000af, Section 4.1.2.2.1)

1.1.1.2.1.2 Two cask preparation and decontamination rooms are required in each ATS line to meet throughput needs. (CRWMS M&O 2000af, Section 4.1.2.2.2)

1.1.1.2.1.3 Not used.

1.1.1.2.1.4 Not used.

1.1.1.2.1.5 Two fuel drying vessels are needed in each ATS line to provide the staging capacity for fuel drying. (CRWMS M&O 2000af, Section 4.1.2.2.3)

1.1.1.2.1.6 The pressurized water reactor (PWR) assembly baskets will each accommodate 4 PWR fuel assemblies. (CRWMS M&O 2000af, Section 4.1.2.2.4)

1.1.1.2.1.7 The boiling water reactor (BWR) assembly baskets will each accommodate 8 BWR fuel assemblies. (CRWMS M&O 2000af, Section 4.1.2.2.5)

1.1.1.2.1.8 Loaded DC maximum thermal output shall not exceed 11.8 kW. (CRWMS M&O 2000af, Section 4.1.2.2.6)

1.1.1.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.1.2.2.1 Approximately 11 ft of water will provide safe and adequate gamma and neutron shielding of spent fuel elements. The water will also shield and contain alpha and beta radiation contamination sources and prevent nearly all radioactive particulate

matter from becoming airborne. This is based on the proven nuclear power plant practice of using a pool for both a shield and a confinement for radionuclides.

Basis: *Remote Operations Design Guide* (CRWMS M&O 1997b, Section 4.3.6)

Used in: Section 1.1.1.3

1.1.1.2.2.2 It is assumed that ATS waste handling operations are as depicted on the Repository Surface Design mechanical flow diagram overview (CRWMS M&O 1997c).

Basis: *Repository Surface Design, MFD - Waste Handling Overview* (CRWMS M&O 1997c)

Used in: Section 1.1.1.4

1.1.1.2.2.3 The DC is equipped with standardized lifting and base-collars for handling purposes.

Basis: *Assembly Transfer System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000b, Section 5.6)

Used in: Section 1.1.1.4

1.1.1.2.2.4 An empty DC is fitted with a device to temporarily seal the inner lid of the DC before and after fuel assembly loading to prevent spread of contamination from the ATS to other systems.

Basis: *Assembly Transfer System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000b, Section 5.6)

Used in: Section 1.1.1.4

1.1.1.2.2.5 Adequate tools, spares, maintenance personnel, storage area, and equipment will be readily available to immediately repair failed system equipment. Since the ATS is used continuously, the system is continuously maintained over its operating life.

Basis: *Assembly Transfer System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000b, Section 5.8)

Used in: Section 1.1.1.3

1.1.1.2.2.6 The assembly basket staging racks in each ATS assembly staging pool provide capacity to stage 16 assembly baskets.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.2.3)

Used in: Section 1.1.1.3

1.1.1.2.2.7 The operating schedule for the ATS is 24 hrs per day, 120 hrs per week, and 50 weeks per year (6,000 hrs per year).

Basis: *Repository Waste Handling Integrated Model Development Report* (CRWMS M&O 1998g, Section 4.3.6.4)

Used in: Section 1.1.1.4

1.1.1.2.2.8 The ATS will provide the capability to safely and efficiently recover from a wide variety of equipment malfunctions and off-normal conditions.

Basis: *Waste Handling Facilities Recovery Analysis* (CRWMS M&O 1997f, Section 7.3.2.2)

Used in: Section 1.1.1.3

1.1.1.2.2.9 A segregated storage pool facility will be provided to process nonstandard fuel into disposable forms.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.2.2)

Used in: Section 1.1.1.4

1.1.1.2.2.10 CSNF assembly baskets will be staged and stored for fuel assembly heat output blending purposes.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.2.1)

Used in: Section 1.1.1.4

1.1.1.2.2.11 Four fuel pools, each sized to stage 1,250 MTU, or 750 fuel baskets, are needed to provide lag storage for blending.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.2.1)

Used in: Section 1.1.1.3

1.1.1.2.2.12 Two fuel basket transfer canals are needed to convey fuel baskets from the staging pools and to return fuel baskets to the ATS lines.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.2.6)

Used in: Section 1.1.1.3

1.1.1.3 System Description

The design configuration for the ATS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2).

Two nearly identical ATS lines are provided in the WHB (Parameter 1.1.1.2.1.1). Each line is operated concurrently to handle the waste throughput and to support maintenance operations. Each line consists of an airlock, a cask preparation and decontamination area, a cask unloading and staging pool area, and a hot cell area.

An airlock provides air confinement between the pool and the WHB Carrier Bay. The cask preparation and decontamination area consists of two cask preparation and decontamination rooms (Parameter 1.1.1.2.1.2). Each room contains a station for unloading and loading transportation casks from a cask transfer cart to and from a cask preparation pit for preparation of loaded casks or decontamination of empty casks and DPC overpacks. Each cask preparation pit is equipped with access platforms that are adjustable for the various cask diameters and a remotely operated gantry-mounted cask preparation manipulator and hoist that straddles the pit and access platforms. A variety of tools and accessories are available for the performance of remote preparation and decontamination activities using the cask preparation manipulator and hoist. Each ATS line is equipped with a large overhead bridge crane. The cask preparation area includes a crane maintenance bay for contact maintenance of the bridge crane.

The pool area contains a cask unloading pool and an assembly staging pool. The two pools are interconnected by a transfer canal. The assembly staging pool is connected to the dry assembly handling cell by an incline transfer canal. Two fuel basket transfer canals (Assumption 1.1.1.2.2.12), each equipped with a basket transfer cart, interconnect the staging pools of both ATS lines with the fuel basket storage pools. A third transfer canal connects the cask unloading pool and the nonstandard fuel pool.

The cask preparation and pool area equipment consists of the cask transfer carts, the cask unloading area bridge crane, and two gantry-mounted cask preparation manipulators with hoists. Cask and DPC lifting yokes, fixtures, remote tools, and accessories are also provided. The cask unloading and staging pools are equipped with pool-deck-mounted assembly transfer machines, wet assembly lifting grapples, DPC lid severing tools, DPC overpacks, assembly baskets, basket staging racks, two fuel storage pool transfer canal carts, and incline transfer canal carts.

The fuel storage pool area consists of four large water basins. Each basin is capable of storing 750 baskets of CSNF (Assumption 1.1.1.2.2.11). All four pools are interconnected using the two fuel basket transfer canals. A separate nonstandard fuel pool is provided for handling off-normal and damaged fuel assemblies in single-element canisters. The five pools are housed in an annex to the WHB. At all times, spent fuel and basket handing operations are conducted underwater, with 11 ft of water coverage over the fuel elements (Assumption 1.1.1.2.2.1).

From the time that the fuel is unloaded from the cask until the fuel is dried for loading into the DC, fuel is handled in standard size spent fuel baskets containing 4 PWR or 8 BWR assemblies (Parameter 1.1.1.2.1.6 and 1.1.1.2.1.7). A maximum of 16 fuel baskets may be staged in the ATS staging pool at any time (Assumption 1.1.1.2.2.6).

The hot cell area consists of an assembly handling cell, a DC load cell, and a DC decontamination cell. The assembly handling cell is interconnected to the pool area assembly staging pool by the incline transfer canal. The assembly handling cell contains two assembly drying vessels (Parameter 1.1.1.2.1.5), a DC load port, a dry assembly transfer machine, dry assembly lifting grapples, an assembly handling cell bridge crane, an assembly handling cell manipulator, a DC load port shield plug, an assembly drying vessel shield plug, an equipment maintenance bay, and recessed lid and shield plug storage areas. The DC load cell is located below the assembly handling cell and the DC decontamination cell is located below the assembly handling cell equipment maintenance bay.

The equipment maintenance bay, which is used to perform contact maintenance on the dry assembly transfer machine, the bridge crane, and the assembly handling cell manipulator, is separated from the assembly handling cell by a multi-segment isolation door. The maintenance bay is also interconnected to an overhead equipment transfer corridor by means of a shielded access hatch.

The DC load cell and the DC decontamination cell are serviced by a DC transfer cart which is used to transfer a DC between the DC handling cell, the DC decontamination cell, and the DC load cell. An isolation door is provided between the DC load cell and the DC decontamination cell and a shield door is provided between the DC decontamination cell and the DC handling cell. A DC load port mating device in the DC load cell provides a contamination barrier between the assembly handling cell, the DC load port, and the DC during SNF transfer operations. The DC decontamination cell is equipped with a bridge-mounted DC inerting manipulator, a bridge-mounted decontamination manipulator, a DC decontamination tool, and a DC contamination sample pass-through glove box. The pass-through glove box is used to transfer contamination survey samples into an adjacent operating gallery for counting.

All ATS remote operations are controlled from operating galleries adjacent to each hot cell. Strategically located closed-circuit television (CCTV) systems and shield windows support the remote operations. All hot cell area equipment is designed to facilitate remote operation and remote removal for contact decontamination and maintenance. Interchangeable components are provided where appropriate. The equipment is also designed to provide safe and efficient recovery from failures and malfunctions (Assumption 1.1.1.2.2.8).

1.1.1.4 Operational Description

Figures I-3, I-4, and I-5 (Attachment I, this document) depict the operations of the ATS. The following subsections describe the operational steps (see Assumption 1.1.1.2.2.2) for each ATS area in the WHB.

Airlock

The operational description for the airlock is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2.1).

A commercial SNF transportation cask is unloaded from its truck or rail carrier and is transferred into the ATS line from the CCHS using the carrier bay crane. The cask is upended on the carrier, lifted vertically, transferred to the ATS line cask transfer cart, and secured against overturning. The cask transfer cart is moved into the ATS line airlock. The airlock is provided with isolation doors at both ends to maintain a slightly negative air pressure in the ATS work areas compared to the carrier bay. The cask transfer cart is then used to move the cask to the cask preparation area.

Cask Preparation Area

The operational description for the cask preparation area is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2.1).

The casks are removed from the cask transfer cart using the dry cask lifting yoke and the cask unloading area bridge crane and placed into a cask preparation pit in one of the cask preparation and decontamination rooms. The access platforms are adjusted to accommodate the cask diameters. The cask preparation activities are performed by a combination of remote and contact operations, using the crane, manipulator, and associated tools. The cask preparation operations consist of remote cask cavity gas sampling, cask venting, gas and water cool-down, shield plug unbolting, and attachment of the shield plug lifting fixture. For casks containing fuel assemblies within a DPC, the cask outer lid is remotely or manually removed in the preparation pit, the DPC is remotely or manually sampled, vented, and cooled, and a DPC lifting fixture is remotely or manually attached. Following cask preparation operations, the bridge crane and lifting yoke are used to transfer the cask to the cask unloading pool for fuel and DPC unloading.

Cask Unloading and Staging Pools

The operational description for the cask unloading and staging pools is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2.1).

For casks containing bare fuel assemblies, the cask is placed in the cask unloading pool and the shield plug is removed underwater in the cask unloading pool. For casks containing a DPC, the DPC is removed from the cask and placed in the canister overpack using the bridge crane. The DPC lid is then severed and removed using the DPC lid severing tools and bridge crane.

Fuel assemblies are individually removed from either an open shipping cask or an open DPC by the wet assembly transfer machine and loaded into assembly baskets in the staging pool or the assembly basket transfer cart. The empty cask and the canister overpack, containing the empty DPC and the severed lid, are returned to the cask preparation and decontamination area where they are prepared for offsite shipment. Prior to shipment, lid installation, bolting, drying, contamination survey testing, and decontamination is performed, as required.

Fuel Storage Pools

The operational description for the fuel storage pools is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2.3).

When the assembly baskets in the staging pool are full, they are removed from the assembly basket staging rack by the wet assembly transfer machine and placed in one of the fuel basket transfer canal carts. The fuel basket transfer canal cart is then used to transfer the loaded fuel baskets to one of the storage pools for fuel blending and DC loading. CSNF blending (Assumption 1.1.1.2.2.10) requires that any loaded DC generate heat at a rate not exceeding 11.8 kW (Parameter 1.1.1.2.1.8). Loading of the DC is allowed only when the inventory of spent fuel in surface storage is sufficient to provide a mixture of fuel assemblies that average 562 watts for PWR fuel and 268 watts for BWR fuel. Unless sufficient quantities of fuel generating heat below these average values is available, a DC cannot be loaded until the heat generation is reduced by radioactive decay or cooler fuel arrives.

When a loaded fuel basket is selected from the storage pools for DC loading, the fuel basket is once again placed in one of the assembly basket transfer canal carts and transferred back to the ATS assembly staging pool. The loaded assembly basket is then removed from the cart by the wet assembly transfer machine and placed in an incline transfer canal cart. The incline transfer cart is used to transfer loaded assembly baskets up the incline transfer canal, out of the pool, and into the dry assembly handling cell.

Non-standard Fuel Handling Room

The operational description for the Non-standard Fuel Handling Room is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2.4).

The non-standard fuel handling room processes defective and nonstandard size SNF that does not meet the criteria for DC loading. To meet the DC loading criteria, nonstandard single-element canisters, consolidated SNF canisters, and over-size canisters are subjected to cutting, unloading, and repackaging operations (Assumption 1.1.1.2.2.9). All of these operations take place under water in the nonstandard fuel pool. The nonstandard fuel handling room is located in the storage pool area annex of the WHB. A transfer canal, with normally closed isolation gates at each end, connects one ATS cask unloading pool with the nonstandard fuel pool.

A cask containing nonstandard SNF is directed to the appropriate ATS line. After completion of the cask preparation operations, the cask is placed in the ATS cask unloading pool. The cask is opened and the isolation gates between the ATS cask unloading pool and the nonstandard fuel pool are opened. The ATS wet assembly transfer machine unloads the assemblies from the cask and places them in assembly baskets located into the nonstandard assembly basket transfer cart. The transfer cart is moved to the nonstandard fuel pool. Once the fuel unloading and transfer operation is completed, the isolation gates between the two pools are closed. Using an overhead bridge crane, the assembly baskets are removed from the nonstandard fuel transfer cart and placed into the nonstandard fuel pool basket-staging rack. After the fuel has been repackaged, it is loaded into the assembly basket again and sent back to the ATS cask unloading pool by

reversing the above operational sequences. Once in the ATS cask unloading pool, the loaded fuel baskets are directed either to the storage pools or to the assembly handling hot cell.

Assembly Handling Cell and DC Load Cell

The operational descriptions for the Assembly Handling Cell and DC Load Cell are based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.2).

In the assembly handling cell, the assembly basket is removed from the incline transfer canal cart by the dry assembly transfer machine and loaded into one of two assembly drying vessels. SNF assembly drying operations are performed to meet performance criteria (see Section 4.1.2.1). An empty DC, equipped with a lifting collar, a base collar (Assumption 1.1.1.2.2.3), and an inner lid sealing device (Assumption 1.1.1.2.2.4), is transferred into the DC load cell and mated with the DC load port. The dry assembly transfer machine is then used to remove the DC load port lid and the inner lid-sealing device from the DC. After the fuel assemblies are dry, the dry assembly transfer machine is used to remove fuel assemblies, one at a time, from the baskets in the drying vessel and load the assemblies into the DC positioned below the DC load port. The empty assembly baskets are returned to the storage pools, using the incline transfer canal and fuel basket transfer canal carts.

When the DC is filled with fuel assemblies, the DC inner lid sealing device and the load port lid are re-installed by the transfer machine. The DC is disengaged from the DC load port and transferred to the DC decontamination cell using the DC transfer cart. In the DC decontamination cell, the lid area of the DC and the DC inner lid sealing device are decontaminated. The DC is evacuated and filled with nitrogen gas to exclude oxygen using the DC inerting manipulator. The DC is then transferred using the DC transfer cart to the DCHS for lid welding, inspection, and subsequent emplacement in the repository subsurface.

Summary of Operations

To ensure that the ATS is capable of handling the throughput quantities specified in Section 1.2.1.5 of the *Assembly Transfer System Description Document* (CRWMS M&O 2000a), a waste handling simulation has been performed using the WITNESS computer program (CRWMS M&O 1998g, Section 7.1.3). The results of the simulation (CRWMS M&O 2000af, Sections 4.1.2.2 and 4.1.2.4) indicate that two ATS lines can receive, unload, handle, store, blend, and load fuel into the DCs by operating 6,000 hrs annually (Assumption 1.1.1.2.2.7). This assumption is based on timely response to ATS maintenance needs, equipment repair, and replacement (Assumption 1.1.1.2.2.5).

1.1.2 Canister Transfer System

1.1.2.1 Functional Description

The design configuration for the CTS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.3).

The CTS receives rail transportation casks from the CCHS as well as empty DCs from the DCHS. The system is located in the WHB. The system unloads the canisters from a cask, stages canisters (as required), loads canisters into the DC, and prepares the empty cask for offsite shipment. Cask unloading begins with cask inspection, gas sampling, and lid bolt removal operations. One or more cask lids are removed and the canisters are unloaded inside shielded hot cells. Small defense high-level waste (DHLW) or U.S. Department of Energy (DOE) spent nuclear fuel (DSNF) canisters are either loaded directly into a DC or are staged in the hot cell until enough canisters are available to fill a DC. Large DSNF canisters are loaded directly into a DC. Canisters that are damaged, contaminated, or received that do not meet acceptance specifications are considered off normal. Off-normal canisters are transferred to the off-normal canister handling cell for remedial processing. The system delivers a loaded DC to the DCHS. Empty transportation casks and associated components are decontaminated as required, closed, and delivered to the CCHS.

One CTS line is provided in the WHB. The line is configured to handle disposable DHLW and DSNF canisters (DOE 1999, Section 2.0) and load them into a DC. The CTS line contains an airlock, cask preparation and decontamination area, canister transfer cell, and an off-normal canister handling cell. The cask preparation and decontamination area includes a cask preparation station and a cask decontamination station. The canister transfer cell consists of canister transfer upper and lower rooms, a cask unloading port, a DC loading port, an off-normal canister transfer port, a small canister staging area, and a crane maintenance area. Canister staging is provided for the accumulation of small canisters in a shielded area.

All radioactive canister transfer operations are performed remotely in the shielded canister transfer or off-normal canister handling cells. The canisters are removed from a cask one at a time using in-cell remote equipment and placed in the DC, the canister staging area, or the off-normal canister port to be transported to the off-normal canister handling cell. The equipment in the off-normal canister handling cell is provided to receive, handle and, if necessary, repackage off-normal canisters prior to final disposal in the repository. Once a DC is loaded, it is transported to the DCHS. The empty cask is returned to the cask preparation and decontamination area and the CCHS for offsite shipment.

The CTS interfaces with the CCHS for incoming and outgoing transportation casks (CRWMS M&O 1998e, Section 8.4). The CTS also interfaces with the DCHS by receiving an empty DC prepared for loading and returning a loaded DC for sealing and eventual emplacement. The CTS also interfaces with the WHB System, the WHB Electrical System, and other WHB utility systems for operational support.

1.1.2.2 Parameters and Assumptions

1.1.2.2.1 Parameters

1.1.2.2.1.1 One CTS line is required to handle all expected DHLW and DSNF canister waste throughput and maintenance support operations. (CRWMS M&O 2000af, Section 6.2.1.3)

1.1.2.2.1.2 One CTS cask preparation station and decontamination station is required to meet expected DHLW and DSNF cask throughput and maintenance support operations. (CRWMS M&O 2000af, Section 6.2.1.3)

1.1.2.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.2.2.2.1 The canister transfer cell is divided into an upper and lower level to reduce the canister lift height (drop height) above the cell floor when moving a canister from a cask to a DC or to a canister staging position.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.2)

Used in: Section 1.1.2.3

1.1.2.2.2.2 One off-normal canister handling cell with a canister transfer cell tunnel is required to perform remedial processing for damaged, contaminated, or abnormal canisters and maintenance support operations.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.5)

Used in: Section 1.1.2.3

1.1.2.2.2.3 Not used.

1.1.2.2.2.4 Off-normal canisters that cannot be repaired (weld repair, crack repair, etc.) in the CTS off-normal canister handling cell will be placed in an overpack in the off-normal canister handling cell, welded closed, and returned to the canister transfer cell for loading into a DC. A DC will be configured with a special basket that will accept the overpack and a small canister.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.10)

Used in: Section 1.1.2.4

1.1.2.2.2.5 Due to the classified nature of some DSNF and the complexity and variety of DOE waste, the transfer and repackaging of DOE disposable canister waste is infeasible at the Monitored Geologic Repository (MGR). This approach is based on the assumption that solidified DHLW cannot be effectively removed from its canister and repackaged in a replacement canister. In addition, it is assumed that DSNF cannot be repackaged due to criticality concerns and the potential for extensive cell contamination during repackaging.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.3)

Used in: Section 1.1.2.4

1.1.2.2.2.6 During the life of the repository, several canisters will be classified as off normal and will require remedial processing before they are accepted for loading into a DC.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.1)

Used in: Section 1.1.2.4

1.1.2.2.2.7 Forty DHLW and DSNF canister staging area positions are required to provide in-process storage capacity for small canisters. Twenty positions are required for normal operations and twenty are required for off-normal waste handling operations.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.3.4)

Used in: Section 1.1.2.3

1.1.2.3 System Description

The design configuration for the CTS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.3).

One CTS line is provided in the WHB to handle canister waste transfer throughputs and to support CTS maintenance (Parameter 1.1.2.2.1.1). The CTS includes an airlock, a cask preparation and decontamination area, canister transfer cell, and an off-normal canister handling cell with a transfer tunnel connecting the two cells (Assumption 1.1.2.2.2.2).

Remote handling equipment in the cask preparation and decontamination area consists of a cask transfer cart, cask preparation manipulator, and tools required to perform cask unbolting, venting, lid removal, and decontamination.

The canister transfer cell is divided into a lower and an upper room (Assumption 1.1.2.2.2.1) with canister transfer ports employed to allow vertical canister lifts from the cask to the DC, staging area, or off-normal transfer tunnel. The upper room of the canister transfer cell includes a cask unloading port, a DC loading port, an off-normal canister transfer port, off-normal canister transfer tunnel, the staging area canister ports, and an in-cell maintenance bay. The canister transfer cell lower room includes a canister transfer station and a DC loading station. The lower room of the canister transfer cell also includes the canister staging area and the off-normal canister transfer tunnel. A canister staging rack is provided for the accumulation of 20

small canisters (Assumption 1.1.2.2.2.7). This arrangement reduces the potential canister drop height during the canister transfer operation (Assumption 1.1.2.2.2.1).

Remote handling equipment in the canister transfer cell includes a 65-ton overhead bridge crane (sized to handle the large naval canisters), an in-cell electromechanical manipulator, and a suite of small canister lifting fixtures. The remote equipment is designed to facilitate in-cell operations, maintenance, and recovery from off-normal events. A maintenance bay inside the canister transfer cell is used to perform contact maintenance operations. Interchangeable components are provided to support maintenance, repair, and replacement of equipment. Lay-down areas are included, as required for fixtures, tooling, and canister grapples. In the event of in-cell equipment failures, the crane and manipulator can be remotely withdrawn to the maintenance bay using off-normal and recovery operations.

A separate off-normal canister handling cell is located adjacent to the canister transfer cell and is interconnected to the transfer cell by means of the off-normal canister transfer tunnel (Assumption 1.1.2.2.2.3). The cell is equipped with a small overhead crane, a bridge-mounted electromechanical manipulator, and two overpack loading and welding stations (for canisters with different diameters and heights). The loading and welding stations are located in a pit to reduce the canister lift height above the cell floor when placing a canister into the overpack. Fixtures are used at the loading and welding stations to properly position, load, and weld the various-height overpacks. A robotic welding machine, positioned between the pits, performs remote welding of a loaded overpack in either station. The cell is also equipped with a canister transfer tunnel cart, storage racks for 20 small canisters (Assumption 1.1.2.2.2.7), a canister repair station, canister overpacks, remote handling fixtures, a decontamination station, and strategically located CCTV systems and shield windows.

The CTS interfaces with the CCHS to receive and transfer casks. The system interfaces with the DCHS to receive empty DCs for loading and to provide loaded DCs for welding. The WHB houses the equipment and provides the facility, utility, maintenance, safety, and auxiliary systems required to support operations, shield radioactive sources from workers, and confine contamination.

1.1.2.4 Operational Description

The operational description for the CTS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.3).

Figure I-6 (Attachment I, this document) provides a mechanical flow diagram for the operations of the CTS. The following subsections describe the operational steps in the diagram for each CTS area in the WHB.

<u>Airlock</u>

A DHLW or DSNF transportation cask (CRWMS M&O 1998e, Section 8.4) is unloaded from its rail carrier and is transferred into the CTS line from the CCHS using the carrier bay crane. The cask is upended on the rail carrier, lifted vertically, transferred to the CTS line cask transfer cart, and secured against overturning. The cask transfer cart is moved through a cask transfer corridor into the CTS line airlock. The airlock is provided with isolation doors at both ends to maintain a

slightly negative air pressure in the CTS work areas compared to the carrier bay. The cask transfer cart is then used to move the cask to the cask preparation area.

Cask Preparation and Decontamination Area

One cask preparation and one cask decontamination workstation, per CTS line, is required to meet all DHLW or DSNF transportation cask throughput and maintenance support operations (Parameter 1.1.2.2.1.2). The cask preparation operations consist of cask seal test port gas sampling, venting and purging, cask outer lid bolt de-tensioning and removal, and positioning the cask outer lid lifting fixture over the cask. The cask outer lid is removed and staged in the cask preparation area using a manipulator and hoist.

The cask preparation operations also include cask internal cavity gas sampling, cask venting and purging, cask inner lid bolt de-tensioning, positioning the cask inner lid lifting fixture over the cask, and securing the lifting fixture to the cask inner lid. For naval fuel casks, a naval fuel canister-lifting fixture is installed on the canister using the manipulator and hoist to secure the lifting fixture to the canister. The cask then is moved to the canister transfer cell using the cask transfer cart.

Once the DHLW and DSNF canisters are removed from the cask, empty cask preparation operations consist of moving the cask transfer cart to the cask decontamination area, removing the cask inner lid lifting fixture, and installing and tensioning the cask inner lid bolts.

For the naval fuel cask, the operations only include installing the cask outer lid, installing and tensioning the lid bolts, removing the cask outer lid lifting fixture, and performing decontamination operations on the empty cask.

The cask preparation area involves contact or remote operations using the cask preparation manipulator, hoist, and tooling. Remote operations will be performed when radiation exposure rates exceed as low as is reasonably achievable (ALARA) guidelines. Upon completion of cask preparation, decontamination, and radiation protection operations, the cask is move to the carrier bay for loading onto its rail carrier.

Canister Transfer and DC Loading

The canister transfer cell consists of an upper and lower shielded hot cell area. Casks are moved into the canister transfer cell lower level, one at a time, on the cask transfer cart. For casks containing small DHLW and DSNF canisters, the cask inner lid is removed and stored in the cask lid staging area in the canister transfer cell using an overhead bridge crane. Canisters are lifted vertically using the bridge crane, a grapple, and loading ports for unloading the cask and loading the DC. The bridge crane auxiliary hoist, canister grapple, and in-cell manipulator is used to grapple and lift the canister out of the cask, transfer the canister to a DC loading port position, and lower the canister directly into the DC. If canister staging is required prior to DC loading, the canisters are unloaded and transferred to staging rack positions located under ports in the floor over the canister lag storage area. The canisters staged are loaded into the next available DC to ensure lag storage empty locations.

An empty DC is moved into the canister transfer cell, one at a time, on a DC transfer cart. The empty DC is brought to the lower level of the canister transfer cell from the DCHS. The canister is loaded into the DC either directly from the cask or from the canister lag storage area. If the DC is loaded with a large naval canister, the in-cell crane and manipulator are used to unbolt, remove, and stage the canister-lifting fixture. If the cask is loaded with small DHLW or DSNF canisters, the cask inner lid and lifting fixture are reinstalled. The loaded DC is then moved to the DC handling cell for DC closure welding, inspection, and testing. The lifting fixture, cask, and cask cart are returned to the cask preparation area.

In the cask preparation area, the cask, fixtures, and cask cart are checked for contamination. Any decontamination operations required are performed before the cask is transferred to the CCHS for offsite shipment.

Small Canister Storage

If space in the DC will not accommodate all of the DHLW or DSNF canisters from the incoming cask, canisters are stored in the canister staging area for subsequent loading in the next available DC. It has been determined, by simulation analyses, that 20 canister storage positions are adequate to accommodate the canisters that require staging .

Off-normal Canister Handling

During the operating life of the repository, it is anticipated that several canisters will be classified as off-normal and handled in a manner described in this section (Assumptions 1.1.2.2.2.5 and 1.1.2.2.2.6). Only small DHLW and DSNF canisters are handled and remedial processing is limited to minor weld repairs, simple cutting operations, loading the canisters into disposable overpacks, and welding the overpack lid for subsurface disposal (Assumption 1.1.2.2.2.4).

When required, an off-normal canister is removed using the canister transfer cell overhead crane and transferred to the off-normal canister transfer tunnel port and transfer cart. The off-normal canister is then moved to the off-normal canister cell for repair or placement into an overpack. If the canister requires only weld repair or surface repair, the canister is placed in the cell weld station and the weld repair is performed using the electromechanical manipulator and a remote welding tool. If it is determined that the canister must be placed into an overpack; it is loaded into an overpack positioned in one of the welding pits (the appropriately sized empty overpack is placed in one of the welding pits prior to loading).

An overpack lid is installed and seal-welded using the remote manipulator and welder. After weld repairs to the canister or seal welding the overpack, the weld is inspected using the appropriate non-destructive examination (NDE) method. The canister or overpack is then placed in the decontamination station and decontamination operations are performed using the manipulator and the appropriate tooling. Off-normal canisters with a contamination level higher than is acceptable for DC loading are also decontaminated at the decontamination station. The repaired canisters or canister overpack is then returned to the CTS canister transfer cell using the off-normal canister transfer tunnel and cart and processed in the same manner as a standard canister.

1.1.3 Carrier/Cask Handling System

1.1.3.1 Functional Description

The design configuration for the CCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.1).

The CCHS receives rail and truck transportation cask carriers from the Carrier/Cask Transport System (CCTS), unloads casks from carriers, and loads empty casks onto carriers for offsite shipment. Loaded casks are transferred to the ATS or the CTS. Empty casks are received from the ATS and the CCTS for offsite shipment. The CCHS operates to handle the waste transfer throughput and to support maintenance operations.

The CCHS also receives empty canister DPC overpacks from the CCTS, unloads overpacks from carriers, transfers overpacks to the ATS, receives overpacks with empty DPCs from the ATS, and loads them onto carriers for offsite shipment.

CCHS operations begin when loaded truck or rail transportation casks are delivered to the WHB by the CCTS. The casks are unloaded from the carriers and placed on cask transfer carts that transport the casks to either an ATS or CTS line. After the cask waste contents are unloaded, the ATS and CTS return the empty casks to the CCHS. The CCHS receives the empty casks from the ATS and CTS and loads the casks onto cask carriers for offsite shipment. The CCHS also unloads empty DPC overpacks from truck carriers and transfers the overpacks to the ATS using a transfer cart. After the empty DPCs are loaded into the overpacks, the ATS returns the overpacks to the CCHS. The CCHS then loads the overpacks onto truck carriers for offsite shipment.

The CCHS interfaces with the CCTS that provides the rail and road system for the site prime movers (SPMs) (transport vehicles) to tow and haul rail and truck carrier systems to the CCHS (see Section 1.4 of this Attachment). The CCHS also interfaces with the ATS and the CTS for delivering loaded casks, shipping empty casks, receiving empty DPC overpacks, and shipping DPC overpacks off site. The WHB System houses the CCHS and provides the utility and safety systems required supporting maintenance and operations.

1.1.3.2 Parameters and Assumptions

1.1.3.2.1 Parameters

1.1.3.2.1.1 Two carrier transport lines are required to accommodate either truck or rail carriers in the WHB (CRWMS M&O 2000af, Section 4.1.2.1.2).

1.1.3.2.1.2 The transportation cask characteristics and parameters are defined in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 4.1.2.1.1).

1.1.3.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.3.2.2.1 Rail and truck carriers will be used to haul waste transportation casks. The carrier dimensional envelopes are based on existing and planned designs for the U.S. Nuclear Regulatory Commission (NRC)-docketed cask transportation systems. The following specific design assumptions are used:

- Rail carrier dimensions and overall dimensions are based on data provided in Parameter 1.1.3.2.1.2 for the largest transportation cask. Other dimensions are based on the cask characteristics.
- The legal-weight truck (LWT) carrier dimensions are based on data provided in Parameter 1.1.3.2.1.2 for the largest legal-weight transportation cask. Other dimensions are based on the cask characteristics.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.1.1)

Used in: Section 1.1.3.3

1.1.3.2.2.2 Adequate tools, spares, maintenance personnel, storage area, and equipment must be readily available to immediately repair failed system equipment. Since the CCHS is used continuously, the system must be regularly maintained over its operating life.

Basis: *Repository Waste Handling Integrated Model Development Report* (CRWMS M&O 1998g, Section 4.3.6.5)

Used in: Section 1.1.3.3

1.1.3.2.2.3 Cask unloading/loading in the CCHS will occur in a contact operation area using manual and remote handling equipment. Readily available remote/robotic technology in the nuclear industry will be used to support cask unloading/loading operations and ensure that radiation exposure rates for manual operation are ALARA.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.1.3)

Used in: Section 1.1.3.4

1.1.3.2.2.4 CCHS waste handling operations are based on the overview of the Repository Surface Design mechanical flow diagrams (CRWMS M&O 1997c).

Basis: *Repository Surface Design, MFD - Waste Handling Overview* (CRWMS M&O 1997c)

Used in: 1.1.3.4

1.1.3.3 System Description

The system description for the CCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.1).

The CCHS receives rail and truck transportation cask carriers from the CCTS, unloads casks from carriers, and loads empty casks onto carriers for offsite shipment. Loaded casks are transferred to the ATS or the CTS. Empty casks are received from the ATS and the CTS for offsite shipment. CCTS operations are described in Section 1.4 of this Attachment.

The CCHS also receives empty DPC overpacks from the CCTS, unloads overpacks from carriers, transfers overpacks to the ATS, receives overpacks with empty DPCs from the ATS, and loads them onto carriers for offsite shipment.

CCHS operations begin when loaded truck or rail transportation casks are delivered to the WHB by the CCTS. The truck and rail carrier configurations/dimensions are shown in Figures I-7 and I-8, Attachment I, this document (Assumption 1.1.3.2.2.1). The CCHS operates 120-hrs per week and 50 weeks per year to handle the waste transfer throughput and to support maintenance operations (CRWMS M&O 1998g, Section 4.3.6.4). Since the CCHS is used continuously, the system must be regularly maintained over its operating life. Adequate tools, spares, maintenance personnel, storage area, and equipment are assumed to be available to repair failed system equipment in a timely manner (Assumption 1.1.3.2.2.2).

Two carrier transport lanes (Parameter 1.1.3.2.1.1) enter and leave the WHB providing unloading/loading stations in the carrier bay, each of which can accommodate either truck or rail carriers (CRWMS M&O 1998b, Section 7.1.2.1). Truck carriers can enter and leave the carrier bay in one direction (one-way drive through) to minimize handling time in the carrier bay. Rail carriers enter and leave from the same end of the carrier bay. The truck or rail carrier is towed into the carrier bay unloading/loading area of the CCHS using an SPM as shown in Figures I-9 and I-10, Attachment I, this document.

The WHB carrier bay is configured and sized to accommodate two lanes, a carrier unloading area, a carrier loading area, three cask transfer carts, an overhead bridge crane, gantry-mounted manipulators, and other support equipment (Parameter 1.1.3.2.1.3). In the carrier bay unloading area, the overhead bridge crane is used to upright and transfer the cask to a cask transfer cart. The reverse operation is used to load an empty cask to the carrier. The carrier unloading/loading area is also equipped with support equipment such as cask lifting yokes, tooling, and maintenance equipment required to support normal and recovery activities.

The bridge crane is mounted on overhead rails in the carrier bay. The bridge crane consists of a double bridge-girder, trolley, main hoist, and auxiliary hoist. The crane main hoist/hook, rated for lifting a 160-ton load, is equipped with an electrically powered rotating hook to rotate the cask, if required. The crane main hoist is used in conjunction with the cask lifting yoke. The auxiliary hoist hook is used for lighter lifting operations. The cask lifting yoke is suspended from the crane hook and is equipped with two lifting arms designed to engage the cask trunnions. The cask lifting yoke facilitates tilting the cask to a vertical orientation and transfer of the cask to the transfer cart. The distance between the lifting arms is adjustable to accommodate the various diameters of the transportation casks. The lifting arm adjustment is accomplished by means of an electromechanical device incorporated into the lifting yoke. Multiple lifting yokes may be required to support the different cask designs.

The crane bridge and trolley coverage is a rectangular (X-Y coordinate) pattern inside the carrier bay loading/unloading area, the main hook rotates 360 degrees, and both the main and auxiliary hooks move in a vertical (Z coordinate) lifting motion. The crane is equipped with platforms for contact maintenance in the carrier bay.

A gantry-mounted manipulator is provided for each carrier transport lane to assist cask unloading/loading operations and allow partial remote handling to reduce radiation exposure. Each gantry-mounted manipulator consists of an electromechanical manipulator and a telescoping mast installed on a rail-mounted gantry and trolley system. The manipulator can be equipped with a variety of tools and accessories such as a robotic arm and hand assembly to assist in cask unloading and inspection operations.

1.1.3.4 Operational Description

The operational description for the CCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.1).

The CCHS is housed in the carrier bay of the WHB. Figure I-11, Attachment I, this document, provides a mechanical flow diagram for the system operations (Assumption 1.1.3.2.2.4). The operational steps in the diagram are described below.

The truck or rail carrier is towed into the carrier bay unloading/loading area of the CCHS using an SPM. The cask is lifted off of the carrier using the large carrier bay bridge crane and a lifting yoke. The overhead bridge crane is used to engage the cask trunnions with the cask lifting yolk and rotate the cask to an upright position (CRWMS M&O 1998b, Section 7.1.6.1). After the cask is in the upright position, the crane lifts the cask high enough to clear the carrier trunnion cradle and move the cask to a position for placement onto either an ATS or CTS cask transfer cart. The potential to drop a loaded cask during lifting exists. To minimize the lift height and the potential damage to the cask if a cask is accidentally dropped, the transport lanes are recessed below the carrier bay floor. If necessary, the cask will be rotated about its vertical axis and then placed onto the rail-mounted transfer carts. The transfer cart will be used to transfer the cask into the ATS or CTS lines. The system is configured and sized to accommodate the waste transportation and receiving schedules established for the repository (CRWMS M&O 2000c, Attachment I, Section 2; and CRWMS M&O 1998g, Section 7.2.3.1).

The cask unloading/loading procedure for the CCHS is a contact or remote operation using manual and remote equipment. To reduce radiation exposure rates for manual operation, operators will remotely operate the overhead bridge crane or the gantry-mounted manipulators (with the assistance of remote tools) from a safe distance by a radio control, a portable control console, or a crane overhead cab (Assumption 1.1.3.2.2.3).

1.1.4 Waste Package Remediation System

1.1.4.1 Functional Description

The design configuration for the WPRS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.5).

The WPRS performs remedial action on abnormal Waste Packages (WPs) and DCs. The system receives DCs and WPs from, and delivers them to, the DCHS. The system receives DCs and WPs that have failed the weld inspection processes of DCHS, and that are defective or abnormal. The system also delivers DCs and WPs to the DCHS that have been remediated and unsealed.

If inspections of the closure weld in the DCHS indicate an unacceptable, but repairable, welding defect, the DC is transferred to the WPRS for preparation for re-welding, if required. Correction of rejected closure welds will require removal of the weld material in such a way that the DCHS may resume and complete the closure welding process. If examinations indicate that the DC closure weld defect cannot be remediated, the DC is opened in the WPRS. If a WP is retrieved from the subsurface repository due to suspected damage, WP failure, it is also opened in the WPRS.

WP and DC opening will require closure weld remote cutting for each of the lids, removal and staging of the lids, collection and processing of cutting fines, cutting-waste removal and disposal, and installation of a temporary seal to confine contamination inside the DC/WP. SNF and high-level waste (HLW) removal from an opened WP and DC is facilitated by transferring the opened DC/WP to either the ATS or CTS (see Sections 1.1.1 and 1.1.2 of this Attachment).

All radioactive WP container remedial operations are performed remotely in a shielded WPRS hot cell located in the WHB. The cell is accessed directly from the DC handling system/cell. One package at a time can be handled in the WPRS cell. The DC/WP arrives on a DC transfer cart, is positioned at one of two workstations within the cell for remedial operations, and exits the cell without being removed from the cart. The system includes a wide variety of remotely operated equipment including an overhead bridge crane, an in-cell multi-purpose electromechanical manipulator, a lid cutting machine, and CCTV viewing systems. Specialized tools and remote controlled equipment are used to perform lid removal, temporary DC lid sealing, waste collection, decontamination, pressure measurement, gas sampling, and testing. All remotely operated equipment is designed to facilitate decontamination hot cell equipment maintenance, and replacement of interchangeable components, as required.

The WPRS interfaces with the DCHS for the receipt and delivery of WPs and DCs. The WHB System houses the system, and provides the facility, safety, and auxiliary systems required for supporting operations. The WPRS receives power from the WHB Electrical System. (CRWMS M&O 2000z, Summary)

1.1.4.2 Design Parameters and Assumptions

1.1.4.2.1 Parameters

1.1.4.2.1.1 The DCHS facilitates transport and transfer of retrieved WPs from the Waste Emplacement System to the WPRS (CRWMS M&O 2000af, Section 4.1.2.3.1).

1.1.4.2.1.2 The WPRS shall be capable of handling 9 DCs or WPs per year during the 40-year operational life of the system and 1 WP per year during the system's remaining years of operational life (CRWMS M&O 2000z, Section 1.2.1.9).

1.1.4.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.4.2.2.1 The DC/WP preparation, staging, repair, opening, and decontamination operations will be performed in a shielded hot cell using remote handling equipment. Remote/robotic technology readily available in the nuclear industry will be used to perform or support these operations to ensure that personnel radiation exposure rates are consistent with ALARA principles.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.2.5.2)

Used in: 1.1.4.2.4

1.1.4.2.2.2 The WPRS shall install temporary seals, evacuate gases, and back-fill open DCs with inert gas to prevent spread of contamination and exclude oxygen from SNF assemblies.

Basis: *Waste Package Remediation System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000aa, Section 5.3)

Used in: 1.1.4.2.4

1.1.4.2.2.3 The WPRS is one of the surface waste handling systems housed in the WHB (CRWMS M&O 2000af, Section 6.2.1.5). The WHB systems are designed for operation only during the MGR emplacement period with a design life of 40 years. Therefore, the maximum operational life of the WPRS is 40 years. If it is required that the operational capability of the WPRS extends beyond the MGR emplacement period (i.e., through the MGR caretaker period for a total of 300 years), the WHB would have to be modified and re-qualified (see Section 4.4.2.1 of this document). An alternative to an extended WHB design life could include construction of a new facility (prior to the end of the WHB 40-year life) with WPRS capabilities.

Basis: *Waste Package Remediation System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000aa, Section 5.3)

Used in: 1.1.4.2.4

1.1.4.2.3 System Description

The system description for the WPRS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.5).

The DCHS transports and transfers retrieved WPs from the Waste Emplacement System for delivery to the WPRS (Parameter 1.1.4.2.1.1). The WPRS is located inside a hot cell in the WHB and is directly connected to the DCHS. The WPRS performs remedial action on abnormal WPs and DCs. The system receives DCs and WPs from, and delivers them to, the DCHS. The system receives DCs and WPs that have failed the weld inspection processes of the DCHS, and that are defective or abnormal. The system also delivers DCs and WPs to the DCHS that have been remediated and unsealed. The WHB provides the facility, utility, maintenance, safety, and auxiliary systems to support the operations.

The DCs/WPs are delivered to the WPRS from the DCHS for remedial action only if failure or damage has been detected. The DC/WP arrives on a DC transfer cart that is remotely positioned within the cell for WPRS operations. The DC/WP enters and exits the cell without being removed from the cart.

The DC/WP remediation of rejected closure welds requires minor repair or removal of the weld in such a way that the DC closure re-welding can be performed in the DC handling cell weld station of the DCHS. If the examination of the DC closure weld indicates an irreparable welding defect, or suspected failure or damage to a retrieved WP, DC/WP opening operations will be required. The DC/WP opening is expected to be infrequent (Parameter 1.1.4.2.1.2), but requires the capability to unseal and vent. WP and DC opening will require closure weld remote cutting at each of the lids, removal and staging of the lids, collection and processing of cutting fines, cutting-waste removal and disposal, and installation of a temporary seal to confine contamination inside the DC/WP. Once open, the DC/WP is surveyed for contamination, decontaminated as required, and transferred to the ATS or CTS for fuel assembly or canister unloading operations.

The system includes a wide variety of remotely operated equipment including an overhead bridge crane, an in-cell multi-purpose electromechanical manipulator, a lid cutting machine, and CCTV viewing systems. Specialized tools and remotely controlled equipment are used to perform lid removal, temporary DC lid sealing, waste collection, decontamination, pressure measurement, gas sampling, and testing.

1.1.4.2.4 Operational Description

The operational description for the WPRS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.5).

Figure I-12, Attachment I, this document, provides a mechanical flow diagram for the operations of the WPRS. The operational steps in the diagram for the WPRS are described below.

One package at a time can be handled in the WPRS cell. The system operations are all performed remotely in a hot cell (Assumption 1.1.4.2.2.1). All remotely operated equipment is designed to facilitate decontamination, hot cell equipment maintenance, and replacement of interchangeable components, as required.

The DC/WP arrives on a transfer cart and enters the cell on rails for WPRS operations. A large shield door is opened to allow the transfer cart to enter. The DC/WP exits the cell after remedial operations without being removed from the cart. Two remote workstations are provided in the WPRS cell: one for DC/WP lid cutting, lid removal, and repairs; and one for DC inspection, examination, purging and back-fill of the DC interior with inert gas, temporary sealing, and decontamination (Assumption 1.1.4.2.2.2).

Following WPRS operations, the DC/WP is externally inspected for contamination and remotely decontaminated, as required. The DC/WP is then returned to the DCHS for re-welding or is transferred to the ATS for fuel assembly unloading or to the CTS for canister unloading (see Section 1.1.5). In either case, the empty DC is removed from the DC handling cell using the CTS line or the DCHS WP transporter loading line.

The system is designed for operation only during the MGR emplacement period with a design life of 40 years similar to other systems in the WHB. If the WPRS operational capability should be extended beyond the emplacement period (or a maximum period of 300 years), the WHB would have to be modified and re-qualified or all of the WPRS capabilities would have to be provided in a separate facility constructed prior to the end of the WHB 40-year life (Assumption 1.1.4.2.2.3).

1.1.5 Disposal Container Handling System

1.1.5.1 Functional Description

The design configuration for the DCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.4).

The empty DC is fabricated at a commercial supplier's facility and shipped with the inner and outer top lids to the repository WHB for loading. The DCHS receives and prepares the empty DC for loading, and delivers the empty DC to the ATS or CTS for loading. Once loaded, the DCHS receives the DC from the ATS or CTS and performs inner and outer lid closure welding, examination, and heat-treating. A DC that does not meet the weld examination criteria is transferred to the WPRS for repair or corrective action. The DCHS also stages the loaded DC, loads the WP onto the WP transporter, and transfers any DC/WP requiring remedial processing to the WPRS.

DCHS functions begin with empty DC preparation, which includes staging the DC, installing collars to lift and handle the DC, tilting the DC upright, configuring the DC for loading, and transferring it to the DC handling cell. DC handling cell operations include staging the DC lids at the weld stations, and transferring the DC to the ATS or CTS for loading. Once loaded, the DC is returned to the DC handling cell for welding. A number of DC welding stations are provided to receive loaded DCs from the ATS or CTS lines. The welding operations include mounting the DC on a turntable, removing lid seals, installing and welding the lids. The weld

process for each lid includes NDE. Following NDE and weld acceptance, the WP is either staged or transferred to a tilting station for transfer to the repository subsurface. At the tilting station, the WP is tilted to a horizontal orientation and transferred to the WP transporter-loading cell. The WP transporter loading operations include a contamination survey, WP decontamination, loading the WP onto a pallet, and transfer of the WP into the WP transporter.

The DCHS is contained within the WHB which includes areas for empty DC preparation, welding, loaded DC staging, WP transporter docking and loading, associated welder operating rooms, and required equipment maintenance areas. The areas operate concurrently to accommodate the DC/WP throughput rates and support DCHS maintenance.

The empty DC preparation area is located in an unshielded structure. The handling equipment includes a bridge crane, tilting station, and transfer carts. The DC handling cell includes several DC weld and NDE stations, a loaded DC staging area, and a DC tilting station. A robotic welding gantry and turntable supports each weld and NDE station. The WP transporter-loading cell includes equipment for WP transfer, lifting, inspection, and decontamination. The operations are supported by a remotely operated horizontal transfer cart, a horizontal lifting system, decontamination and inspection manipulators, and a decontamination system. All handling operations are supported by a suite of fixtures including yokes, lift beams, collars, and attachments. The remote equipment is designed to facilitate decontamination and maintenance, and interchangeable components are provided where appropriate. Set-aside areas are included as required for fixtures and tooling to support off-normal and recovery operations. Semi-automatic, manual, and backup control methods support normal, maintenance, and recovery operations.

The DCHS interfaces with the ATS and CTS to deliver empty DCs and receive loaded DCs, the Waste Emplacement and Waste Retrieval System for loading/unloading the WP transporter, and the WPRS for DC/WP repair and corrective action. The DCHS interfaces with the WHB System, the WHB Electrical System, and other WHB systems for operational support and radiation protection. The system also interfaces with each of the WP designs.

1.1.5.2 Parameters and Assumptions

1.1.5.2.1 Parameters

1.1.5.2.1.1 Eight welding stations are required to support the planned facility throughput. (CRWMS M&O 1998g, Section 7.2.3.4)

1.1.5.2.1.2 The DCHS must support the operation of two ATS lines and one CTS line. (CRWMS M&O 2000af, Section 4.1.2.5.2)

1.1.5.2.1.3 The DCHS supports transport and transfer of retrieved WPs from the Waste Emplacement System to the WPRS. (CRWMS M&O 2000j, Section 1.1.11)

1.1.5.2.1.4 The empty DC preparation area provides space for staging 20 DCs and associated hardware including lids, base collars, lifting collars, and temporary seal devices (CRWMS M&O 2000k, Section 7.1)

1.1.5.2.1.5 The loaded DC staging area provides staging capacity for 20 DCs. (CRWMS M&O 1998g, Section 7.2.3.4)

1.1.5.2.1.6 The DCHS shall remove temporary seals, evacuate gases, and back-fill the DC with inert gas to a combined concentration of less than or equal to 0.25 volume percent for O_2, CO_2, and CO. (CRWMS M&O 2000j, Section 1.2.1.7)

1.1.5.2.1.7 DCHS operations are based on a 120-hr workweek with three shifts per day and a 50-week annual work schedule. Equipment maintenance will be performed on a rotating outage basis. The DCHS is available for operations 6,000 hrs per year. (CRWMS M&O 1998g, Section 4.3.6.4)

1.1.5.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.5.2.2.1 DCHS operations are based on the overview of the Waste Handling System mechanical flow diagrams.

Basis: *Repository Surface Design, MFD - Waste Handling Overview* (CRWMS M&O 1997c)

Used in: Section 1.1.5.4

1.1.5.2.2.2 The DC is equipped with standardized lifting and base collars for handling purposes.

Basis: *Canister Transfer System Design Analysis* (CRWMS M&O 1997a, Figures 7.1-11 and 7.1-12)

Used in: Section 1.1.5.3

1.1.5.2.2.3 An empty DC is fitted with a device to temporarily seal the inner lid of the DC, before and after fuel assembly loading, to prevent spread of contamination from the ATS to other systems.

Basis: *Disposal Container Handling System Input to Support the Site Recommendation Phase* (CRWMS M&O 2000k, Figure 7.1-11)

Used in: Section 1.1.5.4

1.1.5.2.2.4 Individual WPs will not provide any additional shielding for personnel protection.

Basis: *Monitored Geologic Repository Project Description Document* (CRWMS M&O 1999p, CPA 019, Section I)

Used in: Section 1.1.5.3

1.1.5.2.2.5 The DCHS provides a two-week in-process loaded DC storage capacity to account for unavailability of the subsurface repository. The two-week period is based on a preliminary estimate of anticipated outages for the subsurface repository.

Basis: *Repository Waste Handling Integrated Model Development Report* (CRWMS M&O 1998g, Section 4.3.1)

Used in: Section 1.1.5.4

1.1.5.2.2.6 The DC handling cell is equipped with two remotely operated cranes to support continuous DCHS operating schedules during waste emplacement. Redundant cranes are considered prudent design contingencies against unplanned crane outages and extensive crane maintenance activities.

Basis: *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.4)

Used in: Sections 1.1.5.3 and 1.1.5.4

1.1.5.2.2.7 Adequate tools, spares, maintenance personnel, and equipment are readily available to immediately repair failed equipment. Since the DCHS is used continuously 50 weeks per year, the facility must also be continuously maintained over its operating life.

Basis: *Repository Waste Handling Integrated Model Development Report* (CRWMS M&O 1998g, Section 4.3.6.5)

Used in: Section 1.1.5.4

1.1.5.3 System Description

Unless noted, the system description for the DCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.4).

DC handling fixtures have been developed to reduce the number of operations during DC handling. A standard set of DC lifting collars and base collars for the different DC sizes are installed on each DC in the empty DC preparation area (Assumption 1.1.5.2.2.2). The collars facilitate remote handling operations in the hot cells with the DC handling cell cranes. The collars are attached and secured to the DC. The collars are equipped with trunnions for lifting, positioning, aligning, tilting, and securing the DC during handling operations. The benefits of using the collars include a standard lifting trunnion interface for all DCs, a quick and visually verifiable lift attachment, and a safe and proven concept for lifting, tilting, aligning, and securing heavy loads. The base collar is used to secure and protect the DC against tip-over when it is placed on carts, staging fixtures, welding station turntables, and when the DC is rotated during DC lid welding. The collars are also used to support and lift the DC when it is in a horizontal position. (CRWMS M&O 1997a, Figures 7.1-11 and 7.1-12)

The DCHS is located in the WHB and includes an unshielded empty DC preparation area and shielded hot cells for DC handling, welding, and transfer to the subsurface. Separate areas are provided for crane, welder, and manipulator maintenance bays. The areas operate concurrently 6,000 hrs per year to meet DCHS throughputs and to support maintenance (Parameter 1.1.5.2.1.7). The DCHS prepares empty DCs for loading, welds and stages DCs received from the ATS and CTS, and transfers them to the repository subsurface transporter for emplacement. The system also transports retrieved WPs and defective DCs to the WPRS.

Empty DC preparation includes unloading DCs from a carrier, staging empty DCs, tilting DCs for vertical handling, outfitting the empty DC with lids and fixtures, transferring the empty DC to a DC cart, and transferring it through an airlock to the DC handling cell. The DC handling cell provides DC staging capabilities, DC transfer carts connecting to the ATS and CTS, and a DC tilting station. DC handling cell operations include staging DC lids at the weld stations and transferring the empty DCs to the ATS or CTS for loading (Parameter 1.1.5.2.1.2).

The DCHS receives loaded and partially sealed DCs, then transfers them to a staging area or the DC welding stations. DC handling operations are supported by two remotely operated bridge cranes and hoists, as well as other peripheral equipment (Assumption 1.1.5.2.2.6). The operations include positioning the DCs, removing temporary sealing devices, purging the DC lid area with inert gases for welding, evacuating DC internal gases, back-filling the DC with helium prior to closure (Parameter 1.1.5.2.1.6), turning and welding the inner lid, installing the outer lid, and welding the outer lid. Each weld operation includes NDE. Following examination and weld certification, the DC is either staged or prepared for transfer to the subsurface. A loaded, closed, welded, and inspected DC is called a WP.

The final DC handling sequence involves repositioning the WP to a horizontal orientation, transferring the welded WP to a decontamination and subsurface transporter loading cell, remotely conducting final decontamination, final inspection, tagging and recording WP data, and loading the WP on the subsurface transporter. These operations are performed using one of two DC handling cell overhead cranes, a WP tilting station for changing the WP orientation, a transfer cart, a WP horizontal lifting machine, a remotely operated WP decontamination system, and the subsurface WP transporter. Once the WP is loaded onto the WP transporter pallet and rail car, the transporter operator will retract the rail car into the shielded transporter, undock the WP transporter from the transporter loading cell, and close the WP transporter shield doors prior to hauling the WP into the subsurface repository.

DCHS equipment is designed to facilitate manual decontamination, maintenance, and component replacement, when feasible. All handling operations are supported by a variety of remote handling fixtures including DC lifting and base collars, lifting trunnions, lifting yokes, lifting beams, tilting fixtures, staging fixtures, and DC lid sealing devices. A crane maintenance bay is provided at the far end of the DC handling cell to allow for contact maintenance and inspection of the DC handling cell cranes.

A remotely controlled robotic gantry is used to setup, prepare, weld, inert, and inspect the DC closure operations. The robotic gantry and its associated equipment are remotely removed from the DC handling cell into a welder maintenance bay for service, maintenance, and retooling.

Lay-down areas are included as required for lids, fixtures, welder, NDE, tooling, and robotic end-effectors to support normal, off-normal, and recovery operations.

The system interfaces with the ATS and CTS to deliver empty DCs and receive loaded DCs. The system interfaces with the Waste Emplacement System during DC loading of the subsurface WP transporter. The system also interfaces with the WPRS for DC repair, inspection, and performance confirmation of retrieved WPs (Parameter 1.1.5.2.1.3). The WHB interface provides the facility, utility, maintenance, safety, and auxiliary systems required supporting operations and radiation protection activities.

1.1.5.4 Operational Description

Figure I-13, Attachment I, this document, provides a mechanical flow diagram for the operations of the DCHS. The following subsections describe the operational steps (Assumption 1.1.5.2.2.1) in the diagram for each DCHS area in the WHB.

The design configuration for the DCHS is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1.4). The design has been modified to accommodate design changes to the WP and the WHB. However, the DC handling operations, system configuration, and design for the DCHS has been modified only slightly since the Viability Assessment (VA) design. The operations performed in these areas are as follows:

Empty DC Preparation Area

In this area, an empty DC will be received, inspected, fitted with handling collars, oriented in a vertical position, and prepared for loading by installing fuel assembly spacers, inner and outer lids, and the inner lid seal ring. The empty DC preparation area provides adequate space for staging 20 empty DCs and their lids, handling collars, and inner lid seal rings (Parameter 1.1.5.2.1.4). The DC is then placed on the empty DC transfer cart in preparation for transfer into the DC handling cell.

The DCHS is configured so that empty DCs can be brought into the DC handling cell ready for handling and loading. This permits manual preparation of each DC prior to transfer into the DC handling cell. The empty DC preparation area is designed to implement this handling strategy as follows:

- The empty DC carrier will be received at the empty DC preparation area. The empty DC will be lifted in the horizontal orientation, using a lifting beam and a service crane, onto a support cradle area and the DC handling collars installed.
- The DC will be lifted again in the horizontal orientation, using a lifting beam and a service crane, onto a tilting stand that engages the DC base collar trunnions.
- The DC will be upended to the vertical orientation using the collars, trunnions, a yoke, and the service crane. The DC will then be lifted in the vertical orientation and placed on a DC transfer cart where it is prepared for loading by installing fuel assembly spacers, the inner lid, the inner lid seal ring, and the outer lid (Assumption 1.1.5.2.2.3).

- During empty DC preparation, the DC will be secured to the transfer cart using the trunnions on the base collar. The empty DC and cart will then be remotely transferred through the empty DC cell airlock into the DC handling cell.

Empty DC Preparation Airlock

The airlock consists of a shielded room through which the empty DC is transferred into the DC handling cell. The purpose of the airlock is to prevent transfer of any contamination that may be present in the DC handling cell into the empty DC preparation area. The shield walls and doors at the airlock also provide radiation protection from radioactive sources inside the DC handling cell.

DC Handling Cell

The DC handling cell is a large shielded structure containing areas for welding stations, loaded DC staging, transfer cart operations, tilting the DC to a horizontal position, and maintenance of the overhead cranes. DC handling operations are supported by two remotely operated bridge cranes and hoists, as well as other peripheral equipment (Assumption 1.1.5.2.2.6). An empty DC is lifted using one of the DC handling cell cranes and is either staged or directly transferred to a DC transfer cart servicing one the three ATS or CTS lines. The inner and outer lids are staged near the weld stations for later installation in a similar manner. The empty DC is taken into the ATS or the CTS for loading. When loaded, the DC is returned from either the ATS or the CTS and is taken to the staging area or one of eight welding stations. The DC is placed on a turntable, the inner and outer DC lids are installed, and the turntable is used to rotate the DC while the DC lids are welded, inspected, and heat-treated.

The DC handling cell crane will be used to lift and transfer a loaded DC to one of eight independent DC lid weld stations (Parameter 1.1.5.2.1.1). The weld station operations include securing the DC to the weld station turntable, removing temporary sealing devices, purging the DC lid area with inert gases for welding, back-filling the DC with helium prior to closure, turning the DC, welding the inner lid, installing the outer lids, and welding the outer lids. Welding of the DC lids will be performed using automatic welders deployed from a robotic gantry system that can be remotely removed from the cell for retooling, testing, and adjustments. This feature eliminates the need for personnel to enter the DC handling cell. The robotic gantry is withdrawn into a welder service bay where a number of contact change-out and service operations can be performed. The welder service bay is directly adjacent to the DC handling cell.

Each weld operation includes NDE. If a weld failure is detected, the DC is taken to another DC cart for transfer to the WPRS. Following examination and weld certification, the DC is either staged or prepared for transfer to the subsurface. A completed WP is moved to either the loaded DC staging area or the WP tilting area where the WP is rotated to a horizontal position onto the WP transfer cart. This cart transfers the WP to the transporter-loading cell.

Loaded DC Staging Area

The loaded DC staging area is used to stage loaded DCs or WPs waiting transfer to the WP transporter loading cell (Assumption 1.1.5.2.2.5). Waste handling simulations have shown that a two-week interruption in subsurface emplacement operations can be accommodated by staging 20 loaded DCs in the DC handling cell (Parameter 1.1.5.2.1.5).

To reduce crane maintenance bay radiation levels, loaded DCs will be staged in a separate area inside the DC handling cell with partial walls and an access door to facilitate DC transfers to and from staging locations. The partial walls will provide shadow shielding for the main portion of the cell and the maintenance bay. The design configuration incorporates both distance and shielding by isolating radiation sources to one area of the hot cell and by adding a wall separating the staged DCs from the welding, handling, and crane maintenance areas. This will significantly reduce radiation doses to equipment during normal operation, and radiation levels during manned entry into the cell for periodic maintenance and test operations.

WP Transporter Loading Cell

The last set of operations involve transferring the welded WP to a decontamination and WP loading hot cell where final decontamination, final inspection, certification, tagging, and WP loading on the WP transporter occurs. These operations are performed using a horizontal transfer cart, a WP horizontal lifting machine, a decontamination system, and the underground WP transporter. Only one line is available for the final decontamination, inspection, WP transfer, and loading onto the WP transporter. Once the WP is loaded onto the WP transporter pallet, the transporter operator will retract the pallet into the shielded transporter, close the transporter shield doors, and undock the WP transporter from the airlock dock prior to hauling the WP into the subsurface repository.

The WP is lifted off the horizontal transfer cart using the collars and the horizontal-lifting machine. While suspended, the WP is decontaminated, inspected, certified, and tagged. The WP transporter pallet is transferred into the cell and the WP is lowered onto the pallet. The collars will be remotely removed and taken out of the DC cell for reuse. Any contamination picked up during DC loading will be manually removed prior to reuse of the collars in the empty DC preparation area. The final operation occurs when the WP is pulled into the WP transporter to be taken into the repository subsurface.

Waste Package Transporter Airlock

The function of this cell is to provide an airlock where the WP transporter vehicle may be docked for loading. The airlock prevents movement of air between the WP transporter loading cell and the outside atmosphere.

Welder Airlocks

The function of these airlocks (one room for each of the eight welders) is to provide access to the robotic welding gantry, welder, NDE equipment, and post-weld heat treating equipment. Access and service work on the equipment is possible in these rooms without exposing the workers to the atmosphere and radiation in the DC handling cell.

Welder Maintenance Bay

The welder maintenance bay is provided as an area where equipment change-out, repair, replacements, and testing may be performed on any robotic welding gantry, welder, NDE equipment, and post-weld heat treating equipment that has been removed from the DC handling cell (Assumption 1.1.5.2.2.7). Prompt maintenance and repair of failed or malfunctioning equipment is required to support a 24-hr per day operation 50-weeks per year.

1.1.6 Architecture and Structure

1.1.6.1 Functional Description

The WHB System provides the space, layout, structures, and embedded subsystems that support the waste handling operations. The WHB is located on the surface within the protected area of the MGR site. The WHB System provides space and layout to support waste handling operations, staging of WPs, and storage of empty DCs. The WHB System also helps maintain a suitable environment for personnel and equipment that supports the waste handling operations; protects the systems within the WHB from natural and induced environments; confines contaminants; provides radiological protection to personnel; and provides space and layout for industrial and radiological safety systems, operations control and monitoring, safeguards and security (S&S) systems, fire protection systems, ventilation systems, and utilities systems. The WHB also provides the required space and layout for maintenance, tool storage, and personnel administrative and support facilities. (CRWMS M&O 2000af, Section 6.2.1)

The WHB System integrates waste handling systems within its protective structure to support the throughput rates established for waste emplacement (CRWMS M&O 2000x, Summary). The system also provides shielding, layout, and other design features to help limit personnel radiation exposure to levels that are ALARA.

The WHB System requires interface with MGR systems that perform or support waste handling operations. This system interfaces with the following systems:

- Carrier/Cask Transport System
- Waste Emplacement/Retrieval System
- Site Communications System
- Site Water System
- Emergency Response System
- Monitored Geologic Repository Site Layout System
- Health Safety System
- Monitored Geologic Repository Operations Monitoring and Control System
- Safeguards and Security System
- Site Generated Radiological Waste Handling System
- Site Generated Hazardous, Non-hazardous, and Sanitary Waste Disposal System
- Pool Water Treatment and Cooling System
- Canister Transfer System
- Assembly Transfer System
- Disposal Container Handling System

- Waste Package Remediation System
- Waste Handling Building Ventilation System
- Waste Handling Building Radiological Monitoring System
- Waste Handling Building Electrical System
- Waste Handling Building Fire Protection System
- Carrier/Cask Handling System

1.1.6.2 Parameters and Assumptions

1.1.6.2.1 Design Parameters

Parameters are from the conclusions of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 4.1.1). There is no new analysis in this document.

1.1.6.2.2 Assumptions

Assumptions regarding the WHB layout and WHB room sizes are from the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 5.1 and Section 5.4). There is no new analysis in this document.

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.6.3 System Description – Waste Handling Building (Architecture)

1.1.6.3.1 Primary Areas

Five primary systems are required to receive, lift, unload, handle, load, package, remediate waste package defects, and deliver HLW forms to the subsurface repository:

- Carrier/Cask Handling System
- Assembly Transfer System
- Canister Transfer System
- Disposal Container Handling System
- Waste Package Remediation System

The combined space requirements for waste handling, radiation protection, safety, shielding, ventilation, maintenance, decontamination, recovery from off-normal events, retrieval of a waste package from the subsurface, and waste storage are incorporated into the total WHB System.

The method used to perform the space allocation analysis followed a standard approach for facility design and layout. This included use of material handling dimensional outlines and maximum equipment envelopes. For each system area the net space (length, width, and height) required to house the system and the support equipment is defined. Plan and/or section sketches for each primary area were prepared that illustrate the arrangement of the waste handling systems, pools, hot cells, and transfer lines. These sketches include space for airlocks, waste ingress and egress paths, doors, workstations, viewing windows, maintenance bays, and

space-intensive support equipment. Additional space allowances for in-process storage, equipment lay-down, staging, waste handling aisles, and operating stations is provided. (CRWMS M&O 2000af, Section 6.2.1)

In the subsections to follow, each of the five primary systems is described based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.1).

Carrier/Cask Handling System

The layout of the WHB CCHS carrier bay is shown in Attachment I, Figure I-13 of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). The length of the carrier bay is dictated by the width of the two ATS lines and the one CTS line. The rail carrier dimensions are 11 ft by 72 ft by 10 ft 7 in. A minimum length of 196 ft is provided. The layout is based on two large rail carriers in line, each 72-ft long with 26 ft of clearance for handling. The width of the carrier bay must accommodate two rail or truck carrier lines. There is clearance for two gantry-mounted manipulators straddling each carrier line, and five-cask transfer carts used for cask transport to the ATS and CTS. The interior width of the carrier bay is 80 ft. The width will accommodate two 11-ft wide carriers and the 15-ft long carts. An additional width of 13 ft is provided for wall clearance, gantry clearance, and cask handling aisle clearance. The height of the carrier bay is determined by the large rail carrier dimensions, the tallest shipping cask, the height of the cask yoke, and the size of the carrier bay crane. The interior height of the carrier bay is 60 ft.

The minimum floor space required in the WHB for the CCHS is 15,680 sq ft.

Assembly Transfer System

The layout of the WHB ATS airlock and cask preparation area is shown in Attachment I, Figure I-15, of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). The minimum required floor space for the two ATS lines is 83,634 sq ft.

Canister Transfer System

The layout of the WHB CTS airlock and cask preparation area is shown in Attachment I, Figure I-24, of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). The minimum required floor space for the CTS line is 15,202 sq ft.

Disposal Container Handling System

The layout of the DC handling cell is shown in Attachment I, Figure I-31, of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af).

The minimum floor space required in the WHB for the DCHS is 51,216 sq ft based on Attachment I, Figure I-36, of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). This floor space includes 1,140 sq ft for the empty DC preparation airlock; 15,480 sq ft for the empty DC preparation area; 15,900 sq ft for the DC handling cell; 2,208 sq ft for the DC welders; 7,056 sq ft for the loaded DC staging area; 4,248 sq ft for one DC

handling crane maintenance bay; 2,592 sq ft for the DC transporter loading cell; and 2,592 sq ft for the DC transporter airlock.

Waste Package Remediation System

The layout of the WP remediation, multi-purpose cell is shown in Attachment I, Figure I-37 of *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). The minimum floor space required in the WHB for the WP remediation cell is 1,998 sq ft.

1.1.6.3.2 Primary Support Areas

Operating Galleries

The primary waste handling areas include different hot cells where remote operations are used exclusively. Operator viewing and controlling stations must be strategically located outside these hot cells to meet functional and safety requirements. The operator stations are placed in operating galleries adjacent to each hot cell window or viewing port. The operating galleries are nominally 15-ft wide and 16-ft high to accommodate remote equipment controls, observation locations, CCTV displays, operator consoles, and through-the-wall manipulator workstations. A high ceiling is provided to allow space for cell wall penetrations, instrumentation, cable, utilities, and ducting to run overhead. A wide aisle is also provided in the operating gallery outside the cells for replacement and maintenance of through-the-wall manipulators.

The following operating gallery dimensions result from estimates in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.2.1): (These dimensions refer to one ATS line and are duplicated for the second ATS line.)

ATS Cask Prep:	Length: 2@ 14 ft	Width: 20 ft	Height: 28 ft
ATS Line:	Length: 1@ 69 ft	Width: 20 ft	Height: 16 ft
ATS Line:	Length: 1@ 85 ft	Width: 20 ft	Height: 16 ft
Off-normal CTS:	Length: 102 ft	Width: 30 ft	Height: 16 ft
ATS and CTS:	Length: 2@ 127 ft	Width: 20 ft	Height: 16 ft
DCHS Welding #1:	Length: 27 ft	Width: 16 ft	Height: 12 ft
DCHS Welding #2:	Length: 27 ft	Width: 16 ft	Height: 12 ft
DCHS Welding #3:	Length: 27 ft	Width: 16 ft	Height: 12 ft
DCHS Welding #4:	Length: 27 ft	Width: 16 ft	Height: 12 ft
DCHS Welding #5:	Length: 32 ft	Width: 35 ft	Height: 12 ft
DCHS Loading Cell:	Length: 2 @ 148 ft	Width: 15 ft	Height: 16 ft
WPRS:	Length: 2 @ 230 ft	Width: 15 ft	Height: 22 ft

The minimum space required for the above operating galleries is 24,438 sq ft. The location of each operating gallery or operating gallery section must be integrated in the overall WHB

arrangement. These operating galleries provide access to the waste handling remote workstations, hot cells, and valuable wall space adjacent to the primary waste handling areas.

Equipment Transfer Corridors

Two equipment transfer corridors are required to provide access to the primary area hot cells where maintenance bays are used to provide equipment repair, replacement, and recovery operations. These corridors are identified in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.2.2). The first corridor traverses the ATS and CTS lines and passes directly over their respective maintenance bays. The second corridor traverses the DCHS and WPRS hot cells and passes directly over the DC handling cell maintenance bay and the multi-purpose remediation work cell. The purpose of the equipment transfer corridors is to facilitate equipment movement in and out of the maintenance bays and adjacent hot cells; the following equipment transfer corridor spaces are required in the WHB:

ATS and CTS Transfer Corridor:

Length: 218 ft   Width: 48 ft   Height: 36 ft

DC Handling and WP Remediation System Equipment Transfer Corridor:

Length: 57 ft   Width: 142 ft   Height: 28 ft

The minimum space required for the above transfer corridors is 18,558 sq ft. The minimum height for each corridor is 28 ft based on the size of a 50-ton overhead bridge crane. The crane clearance would be 10 ft and the vertical space for handling large equipment items would be 18 ft. This height would permit most in-cell equipment items to be removed through hot cell hatches to the contaminated equipment rooms without partial disassembly in the hot cell maintenance bays. The location and dimensions of each equipment transfer corridor must be integrated into the overall WHB arrangement.

Contaminated Equipment Rooms

Two contaminated equipment rooms are required to interface with the equipment transfer corridors discussed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.2.3). The ATS and CTS transfer corridor connects to the first contaminated equipment room, 42-ft long and 45-ft wide. The DCHS and WPRS equipment transfer corridor connects to the second contaminated equipment room, 45-ft long and 57-ft wide. These rooms are located directly below two hatchways leading to the equipment transfer corridors. The room interiors are 27-ft high, as limited by the height of the DC handling cell maintenance bay. The minimum space required for the contaminated equipment rooms is 4,455 sq ft. Adjacent to the second room, a 4,692 sq ft. staging area is provided for personnel and forklift access, step-off areas for radiation and contamination control, work areas for maintenance personnel, equipment removal and installation, and handling of low-level radioactive waste from the contaminated equipment rooms. The total combined minimum space required for contaminated equipment is 9,027 sq ft.

Maintenance Equipment Storage

A maintenance equipment room is provided adjacent to the contaminated equipment rooms to support equipment removal, repair, and maintenance activities. The room is 35-ft wide by 78-ft long and 16-ft high. The minimum space required for maintenance equipment is 3,000 sq ft. The area contains space for storage, staging, and handling of replacement parts, components, and equipment installed in the WHB. The area does not provide permanent warehousing or storage for WHB equipment and spare parts, but spare parts and equipment are received in this area from central stores and warehouse facilities. (CRWMS M&O 2000af, Section 6.2.2.5)

LLW Collection and Packaging

Solid and liquid LLW is generated in the geologic repository operation area (GROA), the majority of this waste being generated in the WHB. There will be no liquid LLW discharge from the MGR. Various LLW forms are collected and packaged in the WHB. Other LLW forms are transferred through the LLW process systems from the WHB to the WTB. In the WTB, the LLW is processed, packaged, and prepared for offsite disposal The waste streams include LLW in solid and liquid forms. Liquid LLW is segregated into two streams at the WHB: recyclable and non-recyclable. The non-recyclable stream can contain detergents or other non-hazardous cleaning agents. The recyclable stream is treated in the WTB and a large portion of the water is recycled for re-use in the WHB. This greatly reduces the amount of waste the WTB systems must process for disposal. WHB generated solid LLW will consist of wet solids such as ion exchange resins and filter cartridges, as well as dry waste such as tools, clothing, plastic bags, etc. These solids are sorted and transported to the WTB where they are volume reduced and packaged for shipment. The minimum area required for the LLW collection and packaging is 700 sq ft.

Welder Materials Storage Rooms

The Welder Materials Storage Room is the local source for the consumable materials for DC inner and outer lid welds. Consumable materials are electrodes, weld wire, and miscellaneous weld material supplies. Weld and inerting gases are supplied from a compressed gas storage area located outside the WHB. Weld gas materials include argon/helium shield gas and argon trail gas.

A minimum of 1,100 sq ft is required for weld material storage. The storage area would include 600 sq ft for storage of 100 spools of weld wire, 200 sq ft for weld electrode and miscellaneous weld material storage, and 200 sq ft for access and material handling aisles. (CRWMS M&O 2000af, Section 6.2.2.6)

Welder Maintenance Bay

The Welder Maintenance Bay is located across an access corridor from the welders and their adjacent operating galleries. The Welder Maintenance Bay supports the welders, operating galleries, and welder maintenance hot shop, and is accessed from a vestibule that is connected to the welder materials storage. The minimum area required is 6,970 sq ft.

Maintenance Shop

This shop services equipment that is used in the RCA of the WHB facility. The shop is equipped with a complement of hand and machine tools to allow repair of most items. These include a small lathe, milling machine, band saw, etc. It also contains a basic array of electrical tools to permit the measurement of voltage, current, power, and waveform to facilitate electrical repairs as well. The minimum recommended area for the maintenance shop is 1,000 sq ft. (CRWMS M&O 2000af, Section 6.2.2.7)

Tool Storage

The CCHS, the ATS, and the CTS utilize a number of special tools, underwater tools, and portable hand tools to support the carrier unloading, cask unloading, cask preparation, cask de-lidding, cask handling, canister handling, and canister opening operations. Adjacent to the carrier bay in the WHB, a tool room is provided to support these activities. The area contains space for storage of remote tools, hand tools, and special tools unique to the different carriers, casks, and canisters scheduled to be handled. The minimum space required for the tool room is 2,000 sq ft. (CRWMS M&O 2000af, Section 6.2.2.8)

Forklift Staging and Servicing Rooms

The WHB facility needs a variety of forklifts to handle dock receipt of supplies and parts, pallets of 55-gal drums, and waste handling-related hardware. The following forklift inventory was outlined in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.2.9):

Truck receiving dock:	1 @ 2 tons capacity
Hot support area:	1 @ 2 tons, 1 @ 5 tons
Cold support area:	1 @ 2 tons, 1 @ 5 tons
Carrier bay:	1 @ 20 tons

Dimensions of forklifts vary by mode of power (battery vs. gas), model, design, etc. The dimensions required to space and park 2- or 5-ton forklifts are 6-ft wide, 16-ft long (including forks), and 13-ft high. The 20-ton capacity lift is assumed to be 7-ft wide, 20-ft long and 15-ft high. An additional 3 ft are added to the length to allow for electrical connections during battery charging. The combined floor area of all seven lifts is 737 sq ft.

To allow for circulation and maneuvering, the minimum recommended area is 2,000 sq ft with the minimum dimension being at least 30 ft.

Waste Handling Operations Center

The Operations Center/Main Control Room monitors and controls the primary activities and systems of the WHB. This room is able to observe key process areas throughout the facility and to monitor or control automatic process systems including feed material and product data collection. These support systems include power; heating, ventilation, and air-conditioning (HVAC); communications; fire; process monitoring; radiological monitoring; environmental monitoring; security; process water; and process gases.

The minimum recommended area considered adequate for a supervisor and two operator/controllers to achieve an ergonomic layout is 1,000 sq ft. (CRWMS M&O 2000af, Section 6.2.2.12)

1.1.6.3.3 Pool Support Areas

Space is required within the facility for Pool Support (CRWMS M&O 2000af, Section 6.2.3). These include rooms for pool treatment equipment, vacuum pumps, and heat exchangers. A minimum combined area of 16,660 sq ft is required.

1.1.6.3.4 Facility Support Areas

The WHB contains areas within the facility required for support of the primary systems operations. These areas include Radiation Protection, Security, Operations, Administration, and Maintenance. Circulation of personnel and equipment throughout the facility is also required. The floor area requirements in this section are based primarily on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.4).

Radiation Protection

Radiation Protection includes space that houses Health Physics Technicians (HPTs) and provides for the protection of personnel entering potentially contaminated areas of the WHB. These areas are situated within the facility to provide direct access to the areas for which personal protective equipment is required. These areas include all Primary Areas and specific spaces within the Primary Support Area, including transfer corridors, decontamination rooms, and the equipment maintenance shop.

- **Regulated Change Room**

  The change room is required for the donning of personnel protective clothing for male and female workers requiring access to areas of the building that may be radioactively contaminated. The room is located to provide access to potentially contaminated areas without entrance to non-contaminated areas. The required minimum room height is 9 ft, and the required minimum floor area is 500 sq ft.

  In addition to the primary Change Room, several minor ancillary change rooms are needed at each crane maintenance area (3 total) to provide for the donning of personnel protective clothing. An assumption of a 5-person crew plus 100 sq ft of area for protective clothing storage is needed. The minimum space provided for each ancillary change area is 200 sq ft.

The combined minimum space provided is 900 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.1)

- **Radiation Protection Portal**

  The Radiation Protection Portal step-off pad is required for removal of personnel protective clothing on a progressive step-off pad. The portal has direct access to the Regulated Change Room. The area has a required minimum floor area is 400 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.2)

- **Personnel Decontamination Room**

  The Personnel Decontamination Room is required for radiological decontamination of personnel. The room is located adjacent to areas of potential sources of contamination, with access from the Radiation Protection Portal. The required minimum floor area is 225 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.3)

- **Personal Radiation Protection Equipment Storage**

  Personal Radiation Protection Equipment Storage is required for storage of radiation protection equipment such as dosimetry, masks, and air equipment. Protective equipment is issued by the HPTs. The room is adjacent to the Health Physics Office and located for convenient equipment issue to workers. The amount of equipment stored is provided to supply one shift of workers. The room has a required minimum floor area of 225 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.4)

- **Health Physics Office**

  The Health Physics Office is required for the HPT staff. The office is located for easy access to all Radiation Protection Area spaces. The required minimum floor area is 200 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.5)

- **Protective Clothing Storage**

  Protective Clothing Storage is required for storage of clean and dirty protective clothing. The storage area is located adjacent to the Regulated Change Room with easy access to the low specific activity (LSA) Packaging and Shipping area. The required minimum floor area for each room is 100 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.6)

- **Calibration Shop**

  The Calibration Shop is required for calibration and operational testing of radiation detection and other alarm system equipment. The shop provides testing for instruments located within the WHB and other surface nuclear facilities. It is located to provide access from the Radiation Protection Portal, to the Personal Radiation Equipment Storage room, and to shipping/receiving from other facilities. The required minimum floor area is 600 sq ft. (CRWMS M&O 2000af, Section 6.2.4.1.7)

- **Circulation**

  Circulation is required for movement of personnel and equipment among the Radiation Protection Area spaces. Sizing of corridors is in accordance with circulation area factors identified in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.4.1.8).

  The total minimum area required for circulation is 584 sq ft.

<u>Security</u>

Security includes spaces housing the security functions within the WHB. The area also provides for the central security alarm station. The area is located at the main entry to the facility with the second portal located at the secondary entry for equipment/material shipping and receiving. Spaces include two security portals, a security alarm station, and two offices as described in the following paragraphs. (CRWMS M&O 2000af, Section 6.2.4.2)

- **Security Portals**

  The portals provide access control points to very high radiation and also provide a secondary access control point for vital areas and material access. A portal is located at entrances into radiation areas and includes area for one security officer and two personnel radiation counters. At this time two portals are anticipated, one at the main entry and one at the contaminated material shipping/receiving area. The required minimum floor area is 200 sq ft for each portal, 400 sq ft for both portals. (CRWMS M&O 2000af, Section 6.2.4.2.1)

- **Security Alarm Station- For Monitoring of Security Alarms**

  The alarm station provides adequate space for alarm console panels as a secondary security alarm station. The required minimum floor area is 410 sq ft. (CRWMS M&O 2000af, Section 6.2.4.2.2)

- **Offices**

  Offices are required in the Security area for security personnel. One shift office is provided for each portal and will be located adjacent to the portal, for a total of two offices. The minimum required floor area for both offices is 300 sq ft. (CRWMS M&O 2000af, Section 6.2.4.2.3)

- **Circulation**

  Circulation is required for movement of personnel within the Security area. The sizing of corridors is in accordance with circulation area factors identified in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.4.2.4).

  The total minimum area required for circulation is 278 sq ft.

Operations

Operations includes spaces that provide for support of Primary, Primary Support, and Pool Support Area activities and associated support personnel. The Operations area is located adjacent to the main entry and is accessible to the areas supported within the facility. The area includes a health physics and analytical laboratory with associated storage, first aid facilities, men's and women's change rooms for non-radiological coverall worker clothing with shower facilities and restrooms, coverall storage, a lunchroom, and a janitor closet as described in the following paragraphs. (CRWMS M&O 2000af, Section 6.2.4.3)

- **Health Physics Laboratories**

  Health Physics Laboratories are required to analyze radiological and chemical samples taken within the surface nuclear facilities. It is assumed two labs are required to perform this task, with staffing of two technicians for each laboratory per shift. If needed, additional laboratories for the overall site are located at another facility. The laboratories are located within the facility to provide access to the WHB primary areas and health physics office, and to retrieve samples from other surface nuclear facilities. The required minimum floor area is 1,200 sq ft for both laboratories. (CRWMS M&O 2000af, Section 6.2.4.3.1)

- **Laboratory Technician Offices**

  Laboratory Technician Offices are required for health physics laboratory technicians. The technician offices provide workstations for the laboratory technicians. The offices are located directly adjacent to the laboratories. Four offices are provided (two for each laboratory), and sized to accommodate three workstations each (one for each shift). The minimum required floor area is 900 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.2)

- **Laboratory Material Storage**

  Laboratory Material Storage is required for storage of health physics laboratory materials. Laboratory storage is for both flammable and non-flammable materials required for sample analysis. Gas bottles are stored exterior to the WHB. The storage is located adjacent to the laboratories. The minimum required floor area is 200 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.3)

- **First Aid Room and Office**

  The First Aid Room is required for minor first aid care. The first aid room provides a satellite first aid station for a nurse to perform minor first aid for personnel working the WHB and adjacent facilities. An office is provided for one nurse located directly adjacent to the first aid room. The first aid room is located for easy access from all areas of the WHB and from other adjacent facilities. The minimum combined required floor area for the first aid room and office is 200 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.4)

- **Change Rooms**

Change rooms with associated showers and restroom facilities are provided for both male and female operational and maintenance employees working within the WHB for changing into worker coveralls. The change rooms are located for direct personnel access to the primary and primary support areas of the facility and are accessible from the maintenance areas. The required minimum floor area is 1,757 sq ft for both change rooms combined. (CRWMS M&O 2000af, Section 6.2.4.3.5)

- **Coverall Storage**

Two rooms are provided for storage of clean and dirty coverall clothing. The storage areas are located adjacent to the change rooms, with easy access from the shipping/receiving area. The space is sized to accommodate coverall storage for the anticipated number of workers using the change rooms. The required combined minimum floor area is 244 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.6)

- **Operations Lunchroom**

The Operations Lunchroom is provided for operations and maintenance staff assigned to the WHB. A lunchroom is provided for minimal food preparation and storage, eating, and space for vending equipment. Food preparation includes heating of precooked food and food storage includes refrigeration. The required minimum floor area is 1,355 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.7)

- **Janitor Closet**

A Janitor Closet is provided for storage of janitorial supplies. This janitor closet is used for all operational areas and provides the main janitorial supply storage for the WHB. The required minimum floor area is 200 sq ft. (CRWMS M&O 2000af, Section 6.2.4.3.8)

- **Circulation**

Circulation is required for movement of personnel within the Operations area. (CRWMS M&O 2000af, Section 6.2.4.3.9)

The total minimum area required for circulation is 1,514 sq ft.

<u>**Administration**</u>

Administration includes spaces that house various management and support functions for the WHB. These spaces include supervisor and plant operation offices, DOE offices, staff offices, and support spaces such as conference, copy, lunch, document control, storage, and restrooms. The administrative area is located adjacent to the main entry to the facility and allows reasonable separation from facility operations so as not to disrupt efficient circulation of personnel. (CRWMS M&O 2000af, Section 6.2.4.4)

- **Entry Lobby**

  The lobby is located at the main entry to the facility and is sized to accommodate 10 people awaiting entry. It is located adjacent to the main entry security portal. The required minimum floor area is 180 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.1)

- **Supervisor Offices**

  Supervisor Offices are provided for operation and maintenance personnel supervision. Four offices are provided to accommodate three supervisors per office. This configuration allows each supervisor to have an individual office per shift. The required minimum floor area is 1,000 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.2)

- **Operations Offices**

  Operations Offices are provided for the plant operations manager, quality assurance (QA)/quality control (QC) personnel, operations staff, and staff support. Eleven offices are provided for operations. The plant operations manager has an individual office. The QA/QC personnel are provided with two offices, each with space for three persons. Operations staff is accommodated in four offices, with three offices providing three workstations and the fourth provides two workstations. Staff support is accommodated in four offices, including two offices for one secretary each, one office for two clerk workstations, and one office for four office systems staff personnel. The required minimum square footage, not including circulation, is 2,408 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.3)

- **DOE Offices**

  Nine offices for DOE management, staff, and staff support are provided within the administrative area. Two managers, four staff persons, and two staff support have individual offices. The remaining two staff support persons share one office. The required minimum floor area for the DOE offices, not including circulation, is 1,359 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.4)

- **Conference Room**

  A conference room is provided and is sized to accommodate 50 percent of the total WHB support staff on the maximum shift. The required minimum floor area is 600 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.5)

- **Document Control**

  Document Control is provided for central storage of controlled documents in a secured environment. The required minimum floor area is 140 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.6)

- **Copy and Storage Room**

  A Copy and Storage Room is provided for general office copying and supply storage. A minimum combined space of 150 sq ft for a copy machine, fax machine, and general office supply storage is required. (CRWMS M&O 2000af, Section 6.2.4.4.7)

- **Restrooms**

  Restrooms are provided for male and female administrative staff. The restroom size is determined by the maximum staff during one shift. The required minimum floor area is 340 sq ft for both restrooms combined. (CRWMS M&O 2000af, Section 6.2.4.4.8)

- **Lunchroom**

  A lunchroom is provided for administrative staff assigned to the WHB with space for minimal food preparation and storage, eating, and space for vending equipment. Food preparation includes heating of precooked food, and food storage includes refrigeration. The room accommodates the maximum shift staff. The required minimum floor area is 750 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.9)

- **Janitor Closet**

  A Janitor Closet is provided for storage of janitor supplies for administrative areas only. The required minimum floor area is 100 sq ft. (CRWMS M&O 2000af, Section 6.2.4.4.10)

- **Circulation**

  Circulation is required for movement of personnel within the administrative area. (CRWMS M&O 2000af, Section 6.2.4.4.11)

  The total area required for circulation is 1,582 sq ft.

<u>Maintenance</u>

Maintenance includes spaces that provide equipment maintenance and shipping/receiving within the non-contaminated areas of the WHB. (Central maintenance shops are provided at the balance of plant area.) This area is located for access to areas requiring maintenance activities and supply of materials to the operations and administrative areas. The area includes equipment and instrument maintenance shops, tool and material storage, high-efficiency particulate air (HEPA) filter storage, waste staging, gas bottle storage, and shipping/receiving. (CRWMS M&O 2000af, Section 6.2.4.5)

- **Equipment Maintenance Shop**

  An Equipment Maintenance Shop provides space to maintain and perform minor repair to building support system equipment within the WHB and other nuclear surface facilities. (Other equipment repair and maintenance activities are performed at the balance of plant). The shop is located with access to the shipping/receiving area for use by other facilities and movement of shop equipment. Basic machine shop equipment (grinder, drill press, saw) and

electrical repair equipment are provided, along with a cutting station and storage for flammable liquids and materials. The required minimum floor area, including circulation, is 1,954 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.1)

- **Instrument Maintenance Shop**

  The Instrument Maintenance Shop is required for repair of building support system instrumentation systems, including security alarms and to test/maintain emergency alarms, communications equipment, and other alarming. The shop should have access to shipping/receiving or be provided with an individual access to the exterior for acceptance and return of instrumentation equipment. It is also located within the WHB to provide access to areas containing alarming and other instrumentation. The required minimum floor area is 1,342 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.2)

- **Tool Storage**

  Tool Storage provides space for tools required for maintenance of non-contaminated areas within the WHB, and for storage and assignment of maintenance tools. Tool storage is located for access to the non-contaminated areas of the facility and adjacent to maintenance material storage. The required minimum floor area, including circulation, is 240 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.3)

- **Maintenance Material Storage**

  Maintenance Material Storage provides space for materials required for maintenance of the non-contaminated areas of the WHB and for staging of maintenance materials to be used in the WHB such as air handler filters, chemicals, and miscellaneous hardware. The room is located for access to the non-contaminated areas of the facility and shipping/receiving, and is adjacent to the tool storage room. The required minimum floor area, including circulation, is 400 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.4)

- **HEPA Filter Storage**

  Separate HEPA Filter Storage spaces are provided for clean and contaminated HEPA filter storage and spacing. One room is for clean filters and is located adjacent to the maintenance material storage room. The other room is located adjacent to LSA packaging/shipping, and is for changed out filters, which are contaminated. The rooms are sized to accommodate 10 percent storage capacity in either clean or contaminated HEPA filter rooms. The required floor area is 760 sq ft for both storage rooms. (CRWMS M&O 2000af, Section 6.2.4.5.5)

- **Janitor Closet**

  A Janitor Closet is provided for storage of janitor supplies for the maintenance area. The required minimum floor area is 100 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.6)

- **Shipping and Receiving**

  The shipping and receiving area provides a loading dock and staging area for materials to be used in the non-contaminated areas on the WHB. Materials may include laboratory supplies, first aid supplies, coverall storage, administrative supplies, janitorial supplies, maintenance/repair shop equipment and supplies, clean HEPA filters, and maintenance supplies. The area is located for access from site shipping and movement of materials within the facility. The required minimum floor area is 8,554 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.7)

- **Waste Staging**

  The waste staging area provides space to accommodate paper from security, operations, administrative, and maintenance activities. The area is located adjacent to shipping/receiving. The required minimum floor area is 200 sq ft. (CRWMS M&O 2000af, Section 6.2.4.5.8)

- **Gas Bottle Storage**

  Gas Bottle Storage is provided for laboratory and shop activities. Gas bottle storage is located to provide exterior access, with bottles entering the facility from shipping/staging. Storage of these gases will be in accordance with NFPA 55, 1998 Edition, *Standard for Storage Use and Handling of Compressed and Liquified Gases in Portable Cylinders*, Chapter 2. The required minimum floor area is 50 sq ft. (paragraph from CRWMS M&O 2000af, Section 6.2.4.5.9)

- **Circulation**

  Circulation is required for movement of personnel and equipment within the maintenance area. (CRWMS M&O 2000af, Section 6.2.4.5.10)

  The total area required is 1,442 sq ft.

<u>**Building Circulation**</u>

Circulation within the individual facility areas is included with the floor area analysis for those individual support areas. Additional circulation is needed within the WHB for access of personnel and equipment to the primary, primary support, and the building support areas. The circulation pathways also provide fire egress to meet the requirements of NFPA 101, *Life Safety Code* (Section 5.1). Both horizontal and vertical circulation is provided. The circulation floor areas is 96,600 sq ft. (CRWMS M&O 2000af, Section 6.2.4.6)

1.1.6.3.5 Heating, Ventilation, and Air Conditioning Equipment Areas

Sizing of the HVAC equipment and the configuration of the HVAC equipment room for the WHB is based on preliminary calculations using conservative air change rates for the identified building spaces performed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Table 6-1).

The HEPA housings, being the largest HVAC component, are arranged to fit within a room column spacing not to exceed a reasonable 24-ft by 24-ft column grid. The remaining associated HVAC equipment (e.g., air handling units [AHUs] and fans) are then sized and located. (CRWMS M&O 2000af, Section 6.2.5.1)

The equipment room for ventilation systems dedicated for contamination confinement shall be provided with a clear height of 24 ft, similar to many existing nuclear facilities. The remaining industrial grade ventilation systems (Cold Support and Carrier Bay) shall be provided with a clear ceiling height of 15 ft. An estimated space shall be provided for ductwork and utilities such as hot and chilled water (CHW) piping, fire protection piping, instrumentation, electrical, and lighting. It should be noted that the engineering for these utilities has not yet been performed, so it is assumed that a 48-in. clear contingency space below the ceiling is sufficient for the rooms housing contamination confinement equipment and a 24-in. clear contingency space for the industrial systems to allow for crossovers of main runs. Space is also included for circulation aisles, in-place testing and maintenance, replacement operations, and space for floor-mounted electrical motor controllers (MCCs) in the HVAC equipment room. (CRWMS M&O 2000af, Section 6.2.5.1)

The emergency ventilation equipment for safety related systems will be located in a separate hardened room. The HEPA plenums shall be designed to have six filters wide by three filters high banks to facilitate shipping, handling, testing, and maintenance. The AHUs and fans shall be off-the-shelf industrial grade units. (CRWMS M&O 2000af, Section 6.2.5.1)

The requirements for a protective ventilation system for the Control Room/Emergency Response areas will be completed during License Application (LA).

Air Flow Estimate

The development of the airflow estimate for the WHB is as shown in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Table 6.-1).

HEPA Housings Configuration

The standard HEPA filter element has nominal dimensions of 24 in. by 24 in. by 12 in. deep (2 ft by 2 ft by 1 ft). (CRWMS M&O 2000af, Section 6.2.5.3)

Exhaust and Recirculation HEPA Housing

The nominal capacity for the HEPA housing is 18,000 cfm. The exhaust and recirculation HEPA housing are configured for 18 filter elements arranged 6 filters wide by 3 filters high (Width = 14 ft 4 in.; Height = 8 ft; Length = 26 ft). (CRWMS M&O 2000af, Section 6.2.5.3.1)

Outside Air Intake AHU Configuration

Sizing basis:

- Standardization of components is preferred.

- Use velocity through coils that precludes moisture carryover (450 fpm).
- Face area = cfm/450 fpm.
- Equipment section sizes allow service personnel entry.
- The nominal capacities for the AHUs are selected at 30,000 cfm for large systems and 18,000 cfm for smaller systems. These sizes are normally available off-the-shelf. (CRWMS M&O 2000af, Section 6.2.5.4)
- 30,000 cfm AHU: Width = 13 ft; Height = 9 ft 4 in.; Length = 17 ft
- 18,000 cfm AHU (w/fan): Width = 9 ft; Height = 7 ft 6 in.; Length = 20 ft

Fans Configuration

The nominal capacity for the largest fan considered in this evaluation is 30,000 cfm. The estimated fan size is very preliminary because system pressure drop is not known, so a conservative selection as a space keeper is used. (CRWMS M&O 2000af, Section 6.2.5.5)

Footprint required:	= 10 ft x 10 ft	= 100 sq ft
Height (w/base):	= 8 ft + 1 ft	= 9 ft

WHB HVAC Equipment Rooms Configuration

The intention is to keep the cleaner outside air intake separated from the exhaust equipment, and to keep the exhaust stack downwind from the air intakes. The room for the emergency exhaust HEPA with fans is intended to be a safety class hardened enclosure. The space for the MCCs serving HVAC equipment motors shall be provided on the basis of one MCC each per large motor and an additional allowance of 10 percent for unaccounted small motors. The normal MCC set size is approximately 20 ft by 20 ft, and requires 48-in. service clearance in front. A system of this size may have about 70 large horsepower motors dedicated for the supply, re-circulation, and exhaust air. (CRWMS M&O 2000af, Section 6.2.5.6)

WHB HVAC Equipment Rooms Space Summary

The estimated allocated space represents a composite of the equipment space and maintenance and circulation aisles. (CRWMS M&O 2000af, Table 6-2)

Primary/Secondary Confinement Supply HVAC Space Requirement (H-300)	= 27,559 sq ft
Secondary Confinement Exhaust Air Space Requirement (H-400)	= 34,400 sq ft
Primary Confinement Exhaust Air Space Requirement (H-400A)	= 7,678 sq ft
Emergency Confinement Exhaust Air Space Requirement (H-400 B)	= 7,068 sq ft
Emergency Confinement Exhaust Air Space Requirement (H-400 C)	= 7,638 sq ft
Tertiary Confinement Exhaust Air Space Requirement (H-171)	= 25,434 sq ft
Tertiary Confinement Re-circulating Space Requirement (H-201)	= 29,058 sq ft
Tertiary Confinement Supply Space Requirement (H-200)	= 39,040 sq ft
Pool Storage HVAC Space Requirement Supply (H-383 A)	= 16,672 sq ft
Pool Storage HVAC Space Requirement Exhaust (H-383 B)	= 17,484 sq ft
Emergency Supply Space Requirement (H-308 B & C)	= 16,512 sq ft
Electrical Distribution HVAC Room (H-171A)	= 2,200 sq ft
Stack Monitor Rooms (H-171 B & C)	= 200 sq ft
Hydronic Equipment Room Space Requirement (H-204)	= 6,313 sq ft
Cold Support HVAC Room (H-157)	= 4,000 sq ft

The space required for the WHB HVAC Equipment Area is: = 241,256 sq ft

The WHB HVAC equipment rooms are shown in Figures I-47 through I-53 of Attachment I of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af). The following are some of the factors considered in developing the HVAC equipment space requirements.

- As a general rule, air handling equipment that process outdoor air are considered contaminant-free and are grouped into rooms separate from equipment handling potentially contaminated particulate. An example of potentially contaminated air handling equipment is the HEPA filtration system exhausting air from the contaminated areas of the facility.

- Refrigeration equipment has the potential refrigerant gas contamination and is located in a separate room.

- Safety Class equipment, if required, is enclosed in safety-related barriers so that its operation is not jeopardized by any failure of the non-safety class system or component.

- Space for removal and replacement of components such as cooling and heating coils, electric motors, pumps, heat exchangers, etc.

- Maintenance aisles to permit transport of replacement components to and from the equipment room, and including maintenance equipment.

- Space allowance for MCCs that support the HVAC operation. It is estimated that about 70 sizeable motors requiring controllers of approximately 20 in. by 20 in. with a minimum of 48-in. frontal clearance recommended by the controller manufacturer. An additional 10 percent space allowance for unaccounted smaller motors is included.

- Space for accessibility to above-the-floor components to perform inspection, maintenance, or removal/replacement of such components.

1.1.6.3.6 Miscellaneous Building Support Areas

The WHB contains miscellaneous systems required for support of the building as a whole. These systems include fire protection, electrical, and communication systems. The following is based on the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af).

Fire Protection

The WHB is provided with fire suppression and alarm systems meeting the requirements of the applicable codes and standards in the *Waste Handling Building Fire Protection System Description Document* (CRWMS M&O 2000v, Section 1.2.6). Adequate area is provided for sprinkler system risers. Twelve risers are provided to service the building. The maximum square footage of protection for each riser is 52,000 sq ft, per NFPA 13, 1999 (Section 5.2). A fire alarm annunciation panel is located within the vestibule at the main entry to the facility.

The required fire riser area is located either in a separate room or within a general area that does not detract from the function of the space. Each riser requires area for the riser piping, valves, backflow preventer, and associated alarm annunciation. The riser space may be open to the building structure above. The minimum required floor area for each riser is 100 sq ft, based on a 10 ft by 10 ft floor area, and the total area for 12 risers is 1,200 sq ft. (CRWMS M&O 2000af, Section 6.2.6.1)

The fire alarm annunciation panel required is located on the wall of the main entry vestibule. No additional floor area is required.

Electrical

The WHB is provided with normal and emergency power with uninterruptible power provided to critical safety systems. Safety class of systems, with associated requirements for emergency and uninterruptible power, has not been determined. Equipment with associated floor area for these systems has sizes in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS

M&O 2000af, Section 6.2.6.2). All emergency power required by the facility is provided at the WHB.

Electrical power is supplied from normal backup electrical rooms (including uninterruptible power), electrical switchgear rooms, and an emergency generator room. Required minimum floor areas for these spaces are 7,600 sq ft for normal electrical power distribution equipment, 1,080 sq ft for emergency power distribution equipment, and 2,160 sq ft for the emergency diesel generator. (CRWMS M&O 2000af, Section 6.2.6.2)

<u>**Communication**</u>

A Communication room is provided for telephone, radio, computer networking, and building/site alarm system equipment. A floor area of 480 sq ft is provided for communications systems that are yet to be defined. (CRWMS M&O 2000af, Section 6.2.6.3)

1.1.6.4 System Description – Waste Handling Building Structure and Foundation

The WHB site is located on the North Portal that was constructed for the Exploratory Studies Facility (ESF).

The North Portal Pad is located along the western margin of Midway Valley, at the eastern base of Exile Hill. It is an area of approximately 800 to 1,200 ft by 600 to 700 ft of man-made fill sloping roughly 2 degrees to the east, and is situated at approximately 3,670- to 3,683-ft elevation. ESF tunnel muck piles along the eastern side of the North Portal Pad rise to approximately 3,700-ft elevation. The eastern part of the WHB footprint is in the area of the present muck piles. (CRWMS M&O 2000af, Section 6.2.7)

The preliminary building design is shown on the General Arrangement figures in Attachment I (I-36 through I-44), this document. The WHB will be designed and constructed as a safety related structure, system, and component (SSC) in accordance with the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Section 1.2.2). The WHB is about 600-ft wide and 700-ft long with finished floor elevation at 3,681.5 ft. The grades around the WHB will be approximately 3,681-ft elevation from the northwest corner to the southeast corner of the building, will vary from approximately 3,681- to 3,680-ft elevation along the west side of the building, and will vary from approximately 3,680- to 3,679-ft elevation along the south side of the building. While most of the WHB has no floor area below the finished floor elevation, the base of the mat for the pools and pool treatment equipment room is over 50 ft below finished floor elevation. (CRWMS M&O 2000af, Section 6.2.7)

Preliminary wall thickness is from the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.7) as follows:

- Approximately 5-ft thick in areas where DCs will be handled from the operating floor to 30 ft above the operating floor
- Approximately 1.5-ft thick from 30 ft above the operating floor to the rooftop
- Approximately 3-ft thick concrete walls where filled WPs/DC will be handled

- Approximately 1.5-ft thick walls above the 10-ft elevation in the horizontal loadout area.

Secondary factors that impact the size of the structural system and the resulting foundation are the concentrated loads on the operating floor due to heavy duty overhead cranes wtih capacities of up to 125 tons, and 90 to 140 ton concentrated loads on the operating floor from casks and DCs on the transfer carts. These concentrated loads can extend over most of the operating floor of the building. (CRWMS M&O 2000af, Section 6.2.7)

The column spacing would likely be in the range from 16 to 30 ft, resulting in steel columns supporting elevated equipment floors and roof slabs. (CRWMS M&O 2000af, Section 6.2.7)

The potential WHB structure will be supported on a 5-ft thick reinforced-concrete slab. (CRWMS M&O 2000af, Section 6.2.7.1.2) Although the locations where the estimated loads would be applied have not been provided, based on wall/roof loading of 50 kips per foot of 5-ft thick wall and the load distribution attributed to the 5-ft thick slab-on-grade, it is estimated that the load transmitted from the slab to the soil will be on the order of 3 kips per square foot, including 0.75 ksf for the mass of the 5-ft thick slab-on-grade. (CRWMS M&O 2000af, Section 6.2.7)

Pool Storage Building (PSB) modules will be constructed east of and adjacent to the WHB, near the ATS line unloading pools, and will be connected via underwater transfer canals. (CRWMS M&O 2000af, Section 6.2.7)

The outside plan dimensions of a PSB module is 280-ft long by 194-ft wide, with common water-cooling and purification equipment located between the pools. The internal dimensions of the storage pool are 36.5-ft wide by 160-ft long and 50-ft deep. The PSB superstructure modules will be steel-framed buildings with metal clad siding. The clear space of 38 ft above the pool deck is required for operations. A floor above the pool area will house the HVAC equipment. The total height of the steel frame structure will be approximately 70 ft above the ground. The structure is considered safety-related and will require design to preclude collapse during a design basis event following NRC criteria for nuclear facilities. (CRWMS M&O 2000af, Section 6.2.7)

The PSB foundation will be a mat foundation with the 50-ft deep pools. The water pools will require thick concrete walls lined with stainless steel plates to ensure no loss of water. Wall thickness will be determined by lateral loads from earthquakes, hydrodynamic forces from sloshing water during earthquake ground motion, potential cask drops, and other possible accidents. The stainless steel liners will be the primary containment with leak detection systems. The concrete walls of the water pools will serve as secondary containment. (CRWMS M&O 2000af, Section 6.2.7)

The WHB is separated from the WTB, located to the north, to prevent structural interaction during earthquake events. The cold support facility (not safety related) will also be separated from the potential WHB to avoid interaction in an earthquake. The DC preparation building (not safety-related) also be separated from the WHB to avoid interaction in an earthquake. (CRWMS M&O 2000af, Section 6.2.7)

1.1.6.4.1 North Portal Construction Records

Specifications

Common Fill for the North Portal pad was required to have a 30-in. maximum size and contain no debris. There were no other material requirements. The specifications required that the Common Fill be placed in layers that were as thick as the maximum particle size plus 6 in. (consequently, up to 36-in. lift thickness). Common Fill that had less than 30 percent of its particles retained on the 3/4-in. sieve was required to be compacted to at least 95 percent of the maximum dry density and to at least 90 percent in the deeper fill. If the Common Fill had more than 30 percent of its particles retained on the 3/4-in. sieve, it was to be compacted by five complete passes of a 10-ton (minimum) vibratory sheepsfoot roller or a 35-ton (minimum) non-vibratory sheepsfoot roller. The water content of the fill was required to be not more than two percentage points above the optimum water content of the material (CRWMS M&O 1999r).

The WHB would be located in the fill pad that was constructed for the ESF North Portal Surface Facility (ESF-NPSF). The ESF-NPSF grading operations are described in field data forms and are largely undocumented from a geotechnical-engineering point of view. The fill pad at the ESF-NPSF consists of material from at least three sources. The initial fill was obtained from a bench cut into the colluvium and shallow bedrock at the location of the North Portal of the ESF tunnel. Additional fill was obtained from borrow pits at Forty Mile Wash and Fran Ridge. Laboratory tests of material from SFS-TP-3 are presented in Table II-1 of the *Preliminary Geotechnical Investigation for Waste Handling Building, Yucca Mountain Site Characterization Project* (CRWMS M&O 1999r). Soil engineering properties of the additional fill material from Borrow Pit #3 are presented in Table II-2 of *Preliminary Geotechnical Investigation for Waste Handling Building, Yucca Mountain Site Characterization Project* (CRWMS M&O 1999r).

Finally, as the ESF tunnel was being excavated, tunnel muck was placed on and/or adjacent to the fill, extending the pad to its present size using muck from initial ESF tunneling. Some of the common fill failed to meet the 95 percent minimum relative compaction requirement and had to be reworked and retested, sometimes several times, before a passing retest was obtained. (CRWMS M&O 1999r, Section 3.7)

Discussion

For a potential mat foundation alternative, the WHB should be founded on a competent engineered fill. Review of the construction records lead to the conclusion that the North Portal Pad should not be considered engineered fill. Obviously, the same is true of the adjacent muck piles onto which the WHB would extend, for which even less documentation exists.

The following tables (Tables II-1 and II-2 of this document) are based on previous investigations of *Preliminary Geotechnical Investigation for Waste Handling Building, Yucca Mountain Site Characterization Project* (CRWMS M&O 1999r) and are not necessarily applicable to the potential WHB foundation design.

Table II-1. Values Recommended for Design and Estimating Calculations

Engineering Property	Value
Bearing Capacity (after compaction)	6,000 psf
California Bearing Ratio	35 percent
R-Value	65 percent
Modulus of Soils Reaction	400 pci

(CRWMS M&O 1999r, Section 3.0)

Table II-2. Summary of Soil Engineering Properties at ESF Test Pit ESF-3

Property	Values
Young's Modulus Poisson's Ratio Modulus of Subgrade Reaction	0.71-1.4 GPa (10,000-20,000 psi) 0.30-0.35 55-83 MPa or 5,536-8,304 g/cm^3 (200-300 pci)
Shear Strength Internal Friction Angle Cohesion - Non-cemented Soil - Cemented Soil	 33°-37° 0 psf 0.02 MPa (500 psf)
Allowable Bearing Pressure Non-cemented Soil Cemented Soil	 0.29 MPa (6 ksf) 0.48 MPa (10 ksf)
Permanent Slopes in Cut Cemented Soil Non-cemented Soil Fill Slopes	Horizontal : Vertical 1.5:1 2:1 2:1
Natural Moisture Content	7.2 percent
Absorption	7.9 percent
in situ Density	1.62-1.79 g/cm^3
Maximum Dry Density	1.62-1.79 g/cm^3 (101-112 pcf)
Specific Gravity of Soil Solids	2.43 g/cm^3
Void Ratio	0.37
Optimum Moisture Content at Maximum Dry Density	12.0-14.7 percent
Conversion Factors:	1 psi = 6.89×10^{-6}GPa 1 psf = 4.79×10^{-5}MPa 1 pci = 2.71×10^{-1}MPa/m 1 ksf = 4.79×10^{-2}MPa

* Bearing pressures are subject to verification that settlements are tolerable in the case of large structures; the minimum loading width should be 2 ft.

(CRWMS M&O 1999r, Section 3.0)

1.1.6.4.2 Foundation Systems

Based on the subsurface conditions and the potential WHB characteristics, two types of foundation systems were considered to be potentially feasible: a mat foundation and a drilled shaft foundation (CRWMS M&O 1999r, Section 7.3).

The mat foundation alternative is predicated on removing the non-engineered fill (North Portal Pad and muck piles) that has been placed at the potential WHB site. The non-engineered fill should be removed because their geotechnical properties cannot be ascertained with the existing data and cannot be adequately ascertained even with additional exploration and testing. The removal should include all fill underlying the mat foundation and lying within a horizontal distance beyond the edges of the mat foundation that is equal to the difference in the elevations of the base of the mat and the base of the non-engineered fill. From this limit, either temporary shoring or an inclined cut slope may be constructed.

For the drilled shaft foundation alternative, the non-engineered fill would not necessarily have to be removed. However, the cost of removing the non-engineered fill might be partially or entirely offset by potential savings due to increased resistance to lateral loading from engineered fill relative to non-engineered fill, which could result in smaller drilled shafts.

Because the mat foundation is expected to be significantly more economical than a drilled shaft foundation, only the mat foundation alternative is being considered. (CRWMS M&O 1999r, Section 7.3)

1.1.6.4.3 Engineered Fill

Engineered fill will be required to achieve the final grades shown (Figure I-21, Attachment I, this document) and to replace the non-engineered fill. Relative to the grades of the North Portal Pad (excluding muck piles), about 2 ft of fill is required along the west side of the potential WHB and about 20 to 30 ft along the east side. Relative to the pre-North Portal Pad grade (original grade), about 10 to 15 ft of fill are required along the west side of the potential WHB and about 20 to 30 ft along the east side. It is recommended that the engineered fill consist of alluvial/colluvial sand and gravel from the potential WHB excavations[1] or other local alluvial/colluvial sources. A preferred borrow source should be identified, and a geotechnical investigation of the borrow source should be performed prior to construction. The characteristics of borrow material, and particularly the coarseness of its particle-size distribution, will determine the modalities of fill control during construction and affect the construction specifications (CRWMS M&O 1999r, Section 7.4).

If the engineered fill material is mainly sand and fine gravel, the fill control can be by relative compaction or relative density. Then, the fill should be compacted to a predetermined degree, such as at least 95 percent of its maximum dry unit weight or at least 75 percent relative density.

[1] Some of the material from the WHB excavations may consist of tuff that was placed in the North Portal Pad and muck piles. Although little is known about the compaction characteristics of the tuff, this material may be suitable to use as engineered fill.

1.1.6.4.4 Mat Foundation

Bearing Capacity and Settlement

The design of the WHB mat foundation is expected to be limited by settlement rather than bearing capacity (CRWMS M&O 1999r, Section 7.5).

Because loading data were unavailable for settlement calculations, it is estimated that the building loads could be approximated by a uniform load of 3,000 lbs/ft^2 acting at the base of the main mat (elevation 3,676.5 ft). For this calculation, the 3,000 lbs/ft^2 was treated as a uniform net load. This means that in the deeper parts of the WHB, the 3,000 lbs/ft^2 is the increase in load over the existing vertical stress; however, the settlement associated with reloading, which is expected to be small, was neglected. The engineered fill placed at the site also represents a load that will result in settlement at the potential WHB site. Whether that settlement affects the potential WHB depends on whether the engineered fill is placed before the WHB is constructed or after. At this time it has been assumed that the engineered fill will be placed before the WHB is constructed, which will result in the WHB experiencing smaller total settlements. The presence of other loads, such as might be imposed by any adjacent structures such as the WTB, was not considered. (CRWMS M&O 1999r, Section 7.5.1)

The typical soil profile at the WHB will consist of engineered fill overlying alluvium/colluvium deposits, which in turn overlie tuffaceous bedrock. The alluvium/colluvium deposits at the WHB site consist of silty sand to well-graded gravel with sand. It is assumed for the time being that the engineered fill to be placed at the WHB site will be similar to the alluvium/colluvium material and will be compacted to at least 95 percent of the maximum dry unit weight. (CRWMS M&O 1999r, Section 7.5.1)

Because of the granular nature of the soil and its location above the water table, it is expected that the majority of settlements will occur "instantaneously"; that is, as the load is applied or within one month of the end of loading. Creep is expected to be small and was not considered. (CRWMS M&O 1999r, Section 7.5.1)

For the uniform 3,000 lbs/ft^2 load, it is estimated that immediate settlements will be about 0.25 in. or less along the perimeter of the potential WHB and about 0.5 in. or less in interior areas. Along the building perimeter, lower settlements are expected to occur at the salient corners and higher settlements at re-entrant corners. (CRWMS M&O 1999r, Section 7.5.1)

As mentioned above, it has been assumed that the engineered fill will be placed before the WHB is constructed. However, it may be worthwhile in future investigations to examine other construction sequence scenarios, which may have the effect of increasing total settlement in some areas, but decreasing differential settlement across the structure. Also, it may be preferred to construct the deep basement areas (pool areas) after excavating the non-engineered fill and before placing the engineered fill above about 3,660-ft elevation in order to reduce the height of the temporary excavation. (CRWMS M&O 1999r, Section 7.5.1)

Modulus of Subgrade Reaction

The modulus of subgrade reaction for a one-foot square plate, k_{v1}, is expected to range from 300 to 2,000 tons/ft^3 for the main mat bearing at elevation 3,676.5 ft, and from 800 to 6,000 tons/ft^3 for the lower mat bearing at elevation 3,626.5 ft to 3,628.5 ft. (CRWMS M&O 1999r, Section 7.5.2).

Vapor Barrier

It is desirable to install impervious sheeting under the WHB mats to act as a vapor barrier. The purpose of a vapor barrier would be to prevent migration of water into and through the mats. Such water vapor may contain soluble salts, such as sulfates, leached from the soil. Some of these salts may affect the reinforced concrete mat. In addition, when the migrating water evaporates inside the building, the salts remain as an encrustation (efflorescence) that can affect floor coverings. This condition can occur even when standing water is not observed on the floor. Vapor barriers can also be helpful in reducing the entry of gases, such as radon, into buildings. If impervious sheeting is used, it should be placed on and covered by 2-in. thick layers of clean sand. (CRWMS M&O 1999r, Section 7.5.3)

Lateral Earth Pressures

The recommended value for the permanent static total lateral earth pressures, on subsurface walls of the WHB, were estimated to be 4,367 lbs/ft^2. (CRWMS M&O 1999r, Section 7.5.4) These are residual (permanent) static lateral earth pressures at a depth of 100 ft; they are the stresses that will be felt after construction is completed. The permanent static lateral earth pressures at any depth can be linearly interpolated.

The back-fill friction angle was taken as 42 degrees and the back-fill unit weight was taken as 132 lbs pcf. It is assumed that the groundwater table is so deep that it will not be included. For the calculation of residual (permanent) static lateral earth pressure, it is assumed that the basement walls are constructed before the fill is placed. It is also assumed that the basement walls are restrained against deflection under static conditions, such that active earth pressures cannot develop. (CRWMS M&O 1999r, Section 7.5.4)

It is assumed that the back-fill is compacted with a single self-propelled compactor operated within a distance from the walls no less than 0.5 ft. (CRWMS M&O 1999r, Section 7.5.4) Lateral earth pressures will also result from surcharge loads placed near the walls. If a surcharge load, q_s, acts over a large area, the corresponding lateral earth pressure distribution can be estimated as a uniform horizontal pressure of magnitude $0.33*q_s$ acting on the subsurface wall and sides of the mat. However, to the extent that the lateral earth pressure due to the surcharge is less than the excess of the compactor-induced lateral earth pressure over the at-rest lateral earth pressure, the lateral earth pressure due to the surcharge is reduced.

Dynamic lateral pressures imposed on the walls due to design-level seismic shaking have been evaluated by the Seed-Whitman approach. (CRWMS M&O 1999r, Section 7.5.4) The increment of lateral earth pressure due to seismic loading may be estimated as a horizontal pressure distribution that varies linearly from the top to the bottom of the below-grade wall. This horizontal pressure distribution is equivalent to a horizontal force per lineal foot of wall that acts

at a distance above the base of the wall equal to 60 percent of the wall's below-grade height and has a horizontal magnitude of:

$$P_{AE,h} \text{ (in lbs/ft)} = 66 \text{ lbs/ft}^3 * (a_{h,peak} - 0.29)*H^2$$
$$\text{for } 0.5 \leq a_{h,peak} \leq 1.0$$

where $a_{h,peak}$ is the design peak horizontal ground acceleration normalized to the acceleration of gravity and H is the height of the wall in ft.

Depth of Frost Penetration

The depth of frost penetration for the WHB foundation design is estimated to be 15 in. (CRWMS M&O 1999r, Section 7.5.6)

1.1.7 Waste Handling Building Ventilation System

1.1.7.1 Functional Description

The ventilation system provides HVAC to the contaminated, potentially contaminated, and uncontaminated areas of the WHB. The ventilation system maintains the proper environmental conditions for equipment operation as well as provides for the comfort, health, and safety of the operating personnel in these areas. The ventilation system limits the release of radioactive or other airborne contaminants in the effluents from the facility for protection of the public and the environment. (CRWMS M&O 2000y, Section 1.1)

The ventilation system minimizes the spread of airborne radioactive and hazardous contamination by successively directing the flow of air from uncontaminated areas to areas of greater potential for contamination by maintaining pressure differential control between the areas. (CRWMS M&O 2000y, Section 1.1)

The ventilation system serving the WHB will remain operational, as required (Assumption 1.1.7.2.2.1), to perform its safety functions during normal and off-normal operating modes and during and after credible design basis events (DBEs). (CRWMS M&O 2000y, Section 1.1)

1.1.7.2 Parameters and Assumptions

1.1.7.2.1 Parameters

The ventilation confinement zoning classification, area occupancy, room air change frequency, calculated air quantities, ventilation system type, and the HVAC equipment description are as listed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.5).

1.1.7.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

The principal assumptions that were used to develop the ventilation system design concept and/or design features are summarized below.

1.1.7.2.2.1 The ventilation system maintenance will be conducted using a preventative maintenance approach. Since the WHB Ventilation System operates continually, the system will be provided with enough redundancy so that maintenance can be performed without shutting the system down.

Basis: *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.2.2.1)

Used in: Section 1.1.7.1

1.1.7.2.2.2 Bare spent fuel assemblies (SFAs) handling and drying operations are always performed in contamination confinement cells.

Basis: Section 1.1.1.1 of this Attachment

Used in: Section 1.1.7.3.1

1.1.7.2.2.3 The pool water treatment and cooling system maintains proper water quality, temperature, and provides continual treatment to remove radioactive constituents in order to minimize potential for airborne contamination due to open surface water evaporation.

Basis: Section 1.1.8 of this Attachment

Used in: Section 1.1.7.3.1

1.1.7.3 System Description

The ventilation for the WHB includes the ventilation system serving contaminated and potentially contaminated areas designated as contamination confinement areas and a system serving uncontaminated areas designated as non-confinement areas. The contamination confinement areas are served by an independent confinement ventilation system. The non-confinement areas are served by an independent conventional quality (CQ) ventilation system. Example of a confinement ventilation system is depicted in the WHB HVAC Flow Diagram, Confinement Area, Figure I-25, Attachment I, this document. Example of a non-confinement ventilation system is depicted in WHB HVAC Flow Diagram, Non-Confinement Area, Figure I-26, Attachment I, this document.

The ventilation equipment is housed in designated equipment rooms and configured so that the supply air (outside air) side equipment is located on one side of the building while the exhaust air side equipment, which handles the potentially contaminated air, is on the opposite side. Equipment for safety class systems, if required, are located in a separate safety class hardened enclosure. Equipment for the non-confinement area ventilation systems, which are considered free of contamination, are located so that recycling of any exhaust air is prevented.

The size of the various HVAC equipment rooms allows sufficient space for the ventilation system components plus space required for utilities, and space to perform service or maintenance as shown in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.5).

The rooms' ventilation confinement zoning classification, area occupancy, room air change frequency, calculated air quantities, ventilation system type, and the HVAC equipment description are as listed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.2.5)

The indoor and outdoor design conditions are as described in the *Waste Handling Building Ventilation System Description Document* (CRWMS M&O 2000y, Section 1.2.1, Tables 1, 2, and 3; Section 1.2.3)

1.1.7.3.1 Confinement Ventilation System

The confinement ventilation system in conjunction with the facility physical barriers includes the confinement system for the WHB. Effective confinement control is accomplished by properly compartmentalizing the facility into required confinement zones based on the level of potential for airborne radioactive contamination. Three confinement ventilation zones are used which may suit the most restrictive hazard anticipated for the WHB based on consideration of the type, quantity, physical and chemical form, and packaging of the material handled in the facility (Assumptions 1.1.7.2.2.2 and 1.1.7.2.2.3). The confinement ventilation zones are depicted in Figures I-23 and I-24, Attachment I, this document, and are classified as follows:

- Primary Confinement Ventilation Zone – This zone is maintained at the lowest negative pressure differential relative to the secondary confinement zone. This zone is considered normally contaminated.

- Secondary Confinement Ventilation Zone – This zone is maintained at a lower negative pressure differential relative to the outside environment. This zone is considered to have high potential for contamination.

- Tertiary Confinement Ventilation Zone – This zone is maintained at a lower negative pressure differential relative to the outside environment, but with a higher ventilation pressure than the secondary confinement. This zone is considered to have low potential for contamination.

The confinement ventilation zones' pressure differential shall be maintained during normal and off-normal operational modes. The ventilation system is provided with features to ensure its capability to maintain the desired airflow direction between ventilation zones based primarily on the areas' potential for airborne contamination. (CRWMS M&O 2000y, Sections 1.2.1.4, 1.2.1.7, and 1.2.1.12)

The confinement ventilation system provides once-through ventilation in areas of the WHB that are normally contaminated as well as for areas with high potential for airborne radioactive contamination. (CRWMS M&O 2000y, Sections 1.2.1.6 and 1.2.1.9) The confinement

ventilation zone system provided with recycled air shall include at least one stage of HEPA filtration. (CRWMS M&O 2000y, Sections 1.2.1.10, 1.2.1.11, and 1.2.1.12)

The ventilation system consists of several operating supplies and exhaust subsystems configured such that when any one component fails or is shutdown for maintenance, the remaining components can still provide the required function. This HVAC system configuration provides higher degree of system reliability. (CRWMS M&O 2000y, Section 1.2.1)

The supply air subsystem includes several AHUs, supply fans, and supply ductwork distribution system. Each air-handling unit consists of pre-filter, final filters, heating coils, cooling coils, and humidifier (if needed). (CRWMS M&O 2000y, Sections 1.2.6.3 and 1.2.6.4)

The exhaust air subsystem consists of several HEPA filtration units, exhaust fans, associated exhaust ductwork system, and exhaust stack. Each HEPA filtration unit consists of pre-filters (moisture eliminators) and HEPA filters arranged in banks with adequate space suitable for the monitoring, testing, and maintenance of the unit. (CRWMS M&O 2000y, Sections 1.2.6.3, 1.2.6.4, and 1.2.1.8)

The ventilation system provides suitable air volumes for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, and for the provision of fresh air for the health and safety of the operating personnel. (CRWMS M&O 2000y, Sections 1.2.1.5 and 1.2.2.2.2)

The ventilation system for the secondary and tertiary confinement areas is provided with air cleaning units equipped with 90 percent (minimum) pre-filters and at least one stage of 99.97 percent HEPA filters in series. The primary confinement areas are exhausted through two stages of 99.97 percent HEPA filters. However, the number of stages of HEPA filtration necessary for the removal of airborne radioactive contaminants, as required to meet the quantity and concentration that may be released to the environment, is to be determined by safety analysis. In the absence of such analysis, a two-stage HEPA filtration system is provided. (CRWMS M&O 2000y, Section 1.2.1.10, 1.2.6.3, and 1.2.6.4)

The re-circulation system for the normally clean confinement areas is provided with at least one stage of HEPA filtration. (CRWMS M&O 2000y, Section 1.2.1.11)

The filtered exhaust air is discharged to the environment through a stack of sufficient height to allow adequate dispersion. Effluent air from the confinement areas is continuously monitored for radioactive contamination at the exhaust stack, prior to being exhausted to the outside environment during normal and off-normal conditions. (CRWMS M&O 2000y, Sections 1.2.1.8, 1.2.1.13, and 1.2.4.2)

The ventilation system for the confinement areas of the WHB is classified as Quality Level 2 (QL-2). (CRWMS M&O 2000y, Appendix B, Table 9)

The confinement ventilation SSCs essential to perform confinement functions are designed to ensure that a single failure does not result in the loss of its capability to accomplish its required safety functions. To protect against single failures, the ventilation system includes appropriate redundancy and diversity to minimize the possibility of concurrent common-mode failures. The ventilation system's SSCs are designed with emergency power to ensure continuous operation

during a loss of primary power, redundancy and protection features to withstand or mitigate the consequences of internal and external missile impacts, and features to withstand the seismic events as assigned. (CRWMS M&O 2000y, Section 1.2.2)

The emergency back-up ventilation system is a safety-class system designed to perform the function of the failed system to prevent the spread of radioactive contaminants to adjacent zones under both normal and abnormal operating conditions, up to and including the Design Basis Accidents and loss of power. The emergency back-up system is provided with the same components including the normal ventilation system. (CRWMS M&O 2000y, Section 1.2.2)

1.1.7.3.2 Non-Confinement Ventilation System

The ventilation system for the non-confinement areas of the WHB utilizes a CQ HVAC system based on requirement commensurate with ventilation system for non-confinement areas. (CRWMS M&O 2000y, Appendix B, Table 9)

The ventilation system for the non-confinement areas is designed to provide no less than the minimum quantity of outside air required for the safety and health of the personnel in the normally occupied areas. (CRWMS M&O 2000y, Section 1.2.1.5)

The ventilation system for the non-confinement areas is designed to have the capability for filtering any adverse elements in the outside air before introduction into the occupied areas, as necessary for protection of the health of the occupants. (CRWMS M&O 2000y, Section 1.2.2.2.2)

The ventilation system for rooms requiring close control of their environmental conditions such as computer and control rooms is designed to remain operational during normal as well as during off-normal conditions. (CRWMS M&O 2000y, Section 1.2.1, Tables 1 and 2; and CRWMS M&O 2000y, Section 1.2.3, Table 7)

The non-confinement areas ventilation system shall maintain the non-confinement areas at a pressure differential positive to the pressure requirement of the confinement areas shown in the *WHB Ventilation System Description Document*. (CRWMS M&O 2000y, Section 1.2.1.4, Table 4)

1.1.7.4 Operational Description

1.1.7.4.1 Confinement Ventilation System

Outside air will be introduced into the confinement area ventilation system through a special-designed wall intake structure to withstand the effects of high winds, rain, tornado, snow, wind-blown dust and sand, debris, and wind-blown missiles. The intake ductwork system will be provided with air dampers for isolation and volume control, tornado protection (if required), and bird screens. The supply AHUs will filter and condition the air before distribution to the confinement areas through mechanical fans and associated ductwork. The supply to each room will be provided with reheat and pressure control.

The confinement area exhaust air will be picked up at strategic locations of the rooms for efficient removal of any potential airborne contaminants. The exhaust system will be provided with exhaust ductwork, HEPA filters, exhaust fans, pressure control dampers, isolation dampers, tornado dampers (if required), and an exhaust stack.

Pressure differential will be provided between different confinement areas to maintain an airflow pattern from areas of lesser potential of contamination to areas of greater potential of contamination.

The exhaust stack, at least 12 ft higher than the WHB and any adjacent structure, is provided with a continuous air emission monitoring system. The stack is designed to withstand maximum predicted wind loads and including the DBEs it is required to withstand. (CRWMS M&O 2000y, Section 1.2.1.8)

During power failure, the emergency confinement ventilation system is energized to provide the safety function of the failed system. The exhaust air from the safety class areas is diverted to the emergency confinement ventilation system including HEPA filtration units and exhaust fans. It assures adequate inward ventilation flow and maintains the desired negative pressure differentials. (CRWMS M&O 2000y, Section 1.2.1.12)

In the event of a fire in the confinement areas served by an air re-circulation system, the system will go to once-through ventilation by closing the normally open re-circulation air damper and opening the normally-closed isolation damper via interlocks at the discretion of the WHB Fire Protection System. (CRWMS M&O 2000y, Section 1.2.4.3)

The monitoring and control of the ventilation system operations is provided with audible and/or visual alarms for off-normal conditions and equipment failures. The system shall interface with the MGR Operations Monitoring and Control System and with the Site Radiological Monitoring System (SRM). (CRWMS M&O 2000y, Sections 1.2.1.13, 1.2.1.14, 1.2.1.15, 1.2.2.2.3, 1.2.4.2, and 1.2.4.5)

The cooling and heating function is accomplished by the site utility chilled and heating water (HW) system through their associated flow modulation control valves. (CRWMS M&O 2000y, Section 1.2.4.1)

1.1.7.4.2 Non-Confinement Ventilation System

Outside air will be introduced into the ventilation system through an outside air intake structure and mixed with the recycled air. The air-handling unit filters, conditions, and supplies the mixed air to each thermal area. The rooms' thermal conditions are achieved with terminal reheat coils and controlled by local thermostats. Exhaust air from the non-confinement areas will be discharged to the outside environment by exhaust fans and associated ductwork.

The ventilation system will be designed to have the capability to filter adverse elements present in the outside air to minimize their introduction into the occupied areas for the protection of the health of the occupants. (CRWMS M&O 2000y, Section 1.2.2.2.2)

The cooling and heating function is accomplished by the site utility chilled and HW system through their associated flow modulating control valves. (CRWMS M&O 2000y, Section 1.2.4.1)

Auditory and visual alarms are provided to alert personnel to conditions that have the potential to result in equipment damage, or affect system performance. (CRWMS M&O 2000y, Section 1.2.2.2.3)

1.1.8 Waste Handling Building Pool Water Treatment and Cooling System

The Pool Water Treatment and Cooling System is used to maintain proper water quality and characteristics for the pools and transfer canals used in the handling of fuel in the ATS. In this performance, the Pool Water Treatment and Cooling System accomplishes the following functions: (CRWMS M&O 2000p)

- Management of pool water temperature
- Management of pool water quality, clarity, and radiological activity
- Operation of the pool(s) leak detection system(s)
- Management of pool water level (including water makeup)

QA classification has been performed and the QLs assigned are: Pool Water Treatment – QL-2; Pool Water Cooling – CQ; Pool Water Makeup – QL-3; Pool Water Level Control – QL-3; and, Pool Water Leak Detection – QL-3 (Reference Table 1 of *Classification of the MGR Pool Water Treatment and Cooling System*, CRWMS M&O 1999d).

The functional and design criteria for the Pool Water Treatment and Cooling System are as identified in *Pool Water Treatment and Cooling System Description Document* (CRWMS M&O 2000p).

1.1.8.1 Pool Water Cooling

1.1.8.1.1 Functional Description

The function of the pool water cooling system(s) is to remove heat from the pool water. This heat is the result of SFA decay heat continuously being transferred to the pool water. The removal of decay heat allows the pools to operate at a reduced temperature (e.g., 60°F). This low temperature minimizes the amount of water being continuously evaporated from the pools, minimizes corrosion to pool components and fuel assemblies, and minimizes the occurrence of algal bloom within the pool, thereby facilitating the maintenance of pool water clarity (CRWMS M&O 2000p).

1.1.8.1.2 Design Parameters and Assumptions

1.1.8.1.2.1 Parameters

1.1.8.1.2.1.1 Two ATS lines with cask unloading and fuel staging pools are required to handle the waste throughput and support maintenance operations. (CRWMS M&O 2000af, Section 4.1.2.2.1)

1.1.8.1.2.1.2 Four spent fuel pools, each sized to stage 1,250 MTU, or 3,000 SNF assemblies, are needed to provide lag storage for blending. (CRWMS M&O 2000af, Section 6.2.1.2)

1.1.8.1.2.1.3 One non-standard fuel line is required to handle non-standard fuel passing through the ATS. (CRWMS M&O 2000af, Section 5.2.2.2)

1.1.8.1.2.1.4 The system and equipment utilized for maintaining pool water quality (water treatment) and the system and equipment utilized for maintaining pool water temperature (water cooling) are separate and independent per the guidance of ANSI/ANS 57.7-1988 *Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)*.

1.1.8.1.2.1.5 Due to the potential of alpha contamination from the handling of non-standard fuel assemblies, the pool water treatment and cooling system functions for the off-normal handling pools is totally isolated from those systems serving other pool waters. (CRWMS M&O 2000af, Section 5.2.2.2)

1.1.8.1.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.1.8.1.2.2.1 It is assumed that the pool water treatment and cooling equipment will be similar in design concept to that presented in Appendix A of ANSI/ANS 57.7-1988 and that is identified there.

Basis: It is believed to be reasonably bounding, for the purposes of this analysis, to assume that the pool water treatment and cooling system design will be similar to the concept identified in the ANS standard.

Used: Section 1.1.8.1.3

1.1.8.1.3 System Description

The temperature of pool and transfer canal water is monitored and controlled on a continuous basis, to maintain design temperature and to remove excess assembly decay heat. Pool and canal water-cooling systems are automatically controlled. When the water temperature rises to a set point, due to excess heat input, water is pumped through a heat exchanger to cool the water and return that cooled water to the source. The heat rejected by the pool water is transferred to an independent CHW loop. The CHW loop, in turn, rejects the heat to a refrigerant system, which ultimately discharges the heat to the environment by means of air-cooled heat exchangers. The working fluid used in the refrigeration chiller is environmentally acceptable chlorofluorocarbon. The pressure on the chilled-water side of the heat exchangers is maintained above the pressure of the pool water being cooled. This reduces the possibility of the closed-loop-CHW being contaminated in the event of a heat exchanger failure (Assumption 1.1.8.1.2.2.1). Figure II-1 presents a simplified flow diagram for pool water-cooling. (ANSI/ANS-57.7-1988, Section 4.3 and Appendix A-4)

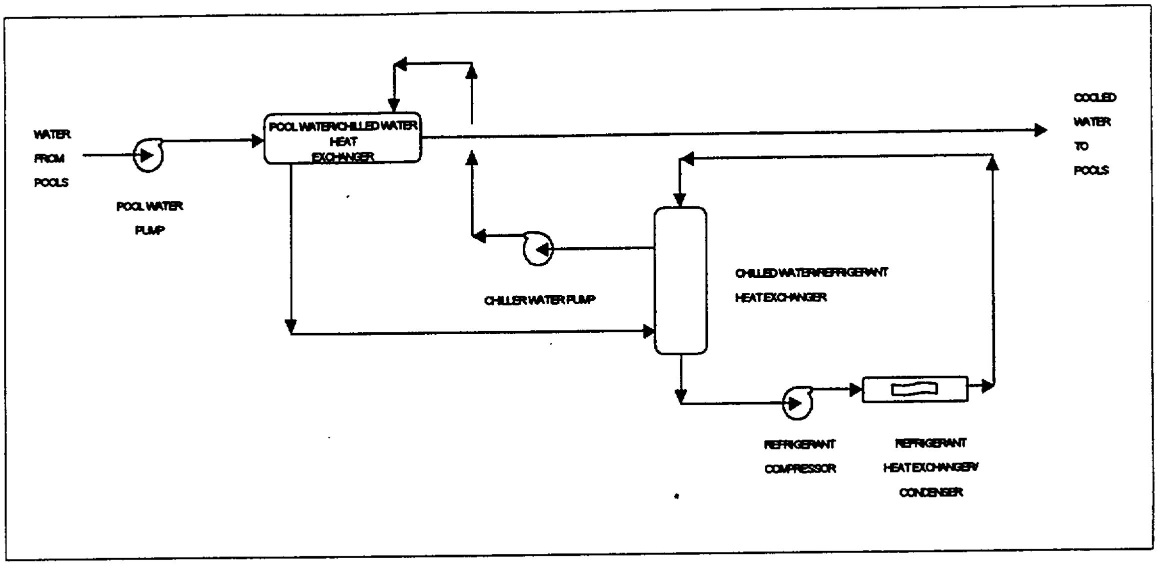

Figure II-1. Pool Water Cooling Flow Diagram

To minimize the possibility of loss of pool water due to siphoning, all piping enters the pools at a point at or above the minimum acceptable water level.

1.1.8.1.4 Operational Description

The pool water cooling system(s) is operated under computer control. The system utilizes redundant pumps and chillers to ensure cooling is accomplished in the event of rotating equipment failure. (CRWMS M&O 2000ab, Section 7.3.2)

1.1.8.2 Pool Water Treatment

1.1.8.2.1 Functional Description

The function of the Pool Water Treatment System is to continuously filter and purify pool and canal water.

1.1.8.2.2 Design Parameters and Assumptions

See Section 1.1.8.1.2.

1.1.8.2.2.1 System Description

Pool and canal water is subject to continuous contamination from the processing and storage of SFAs. To ensure that sufficient shielding for ALARA purposes is provided by the pool water, this pool water must be continuously treated to remove radioactive constituents. Additionally, crud particles can spall off the assemblies during assembly movement; these particles must be removed from both the water and pool liner surfaces for both ALARA and pool water clarity purposes. Pool water clarity can also be adversely impacted by algal bloom. Pool water is

therefore treated to minimize the amount of algae in the water. (CRWMS M&O 2000ab, Section 7.4) Water turnover is a minimum of once every 72 hrs.

Pool and canal water is continuously pumped through the treatment system(s). The water is initially passed through a filtration step to remove particulate materials. After filtration, the water passes through a mixed (cation and anion) bed ion exchange system to remove dissolved constituents. After ion exchange, the water is passed through a polishing filter to remove any ion exchange resin carried with the water. Finally, the water is passed through an ultra violet sterilization system to destroy algae. The water is then returned to the pool system. (CRWMS M&O 2000ab, Section 7.4)

Debris floating on the surface of pool water is removed by weirs. A manually operated pool vacuum system is provided for the purpose of removal of accumulated debris on pool wall and floor surfaces. Water collected in these cleaning operations is passed through roughing filters for large particle removal before passing through the continuous water treatment system. Figure II-2 shows a simplified process flow scheme for the pool water treatment system. (CRWMS M&O 2000ab, Figure III-2)

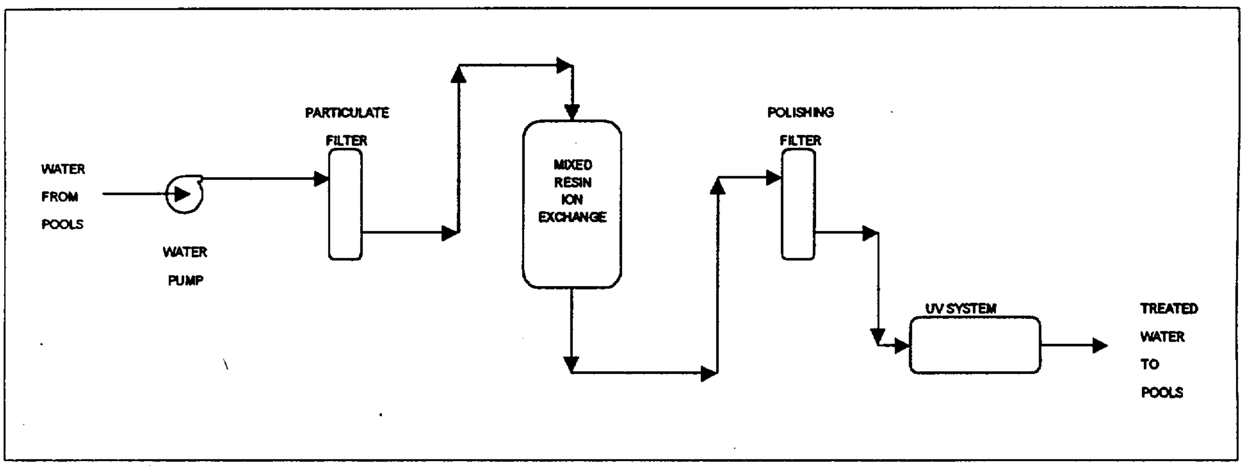

Figure II-2. Pool Water Treatment Process Flow Sketch

To minimize the possibility of loss of pool water due to siphoning, all piping enters the pools at a point at or above the minimum acceptable water level.

1.1.8.2.2.2 Operational Description

The pool water treatment system(s) is operated under computer control. The system utilizes redundant pumps, filters, and ion exchange beds to ensure treatment is accomplished in the event of rotating equipment failure, or change out of filters or ion exchange beds. (CRWMS M&O 2000ab, Section 7.4)

1.1.8.3 Pool Leak Detection

1.1.8.3.1 Functional Description

The function of the Pool Leak Detection System is to monitor for pool leaks and to alert operational personnel if a leak occurs.

1.1.8.3.2 Design Parameters and Assumptions

See Section 1.1.8.1.2.

1.1.8.3.3 System Description

A leak detection system is employed to identify, locate, and quantify any leakage between pool liners and outer pool concrete walls. Water collected from leak detection system(s) is collected into sumps located below pool bottom elevation. Collected water is sampled, analyzed, and then appropriately disposed as liquid LLW (either recyclable or non-recyclable) or transuranic liquid waste. (CRWMS M&O 2000ab, Section 7.5)

1.1.8.3.4 Operational Description

Detection of pool leaks is an automatic function with alarms to alert operational personnel of a potential leak condition. Sampling of water collected in leak detection sumps and the disposition of that water is under operator control. (CRWMS M&O 2000ab, Section 7.5)

1.1.8.4 Pool Water Level Control

1.1.8.4.1 Functional Description

The function of the Pool Water Level Management System is to manage pool water level within design parameters. This is necessary to ensure that the pool water provides sufficient shielding for ALARA purposes.

1.1.8.4.2 Design Parameters and Assumptions

See Section 1.1.8.1.2.

1.1.8.4.3 System Description

Overflow weirs are used on the ATS Transfer Pools to control the maximum pool water level during cask handling and unloading operations. Minimum water level is controlled through an automatic system that pumps (redundant pumps are provided) water into the pools if the water level is reduced below a control set point. Overflow water from the weirs is collected in a sump and then reused to maintain pool water level; if necessary, de-ionized water from the site de-ionized water system is used for pool water make-up. (CRWMS M&O 2000ab, Section 7.6)

1.1.8.4.4 Operational Description

The pool water level control system is under computer control. If water level passes through a pre-determined low-level set point, operational personnel are alerted. Operational personnel can provide additional make-up water from the site de-ionized water system through manual valves. (CRWMS M&O 2000ab, Section 7.6)

1.1.8.5 Pool Makeup Water

1.1.8.5.1 Functional Description

The function of the Pool Makeup Water System is to provide water to ensure proper water level is maintained and to compensate for evaporation and drag-out from the pools. Makeup water from the site de-ionized water system is provided. (CRWMS M&O 1998j, Section 7.1.6)

1.1.8.5.2 Design Parameters and Assumptions

See Section 1.1.8.1.2 of this document.

1.1.8.5.3 System Description

Makeup water for the pools is provided from the site de-ionized water system. (CRWMS M&O 1998j, Section 7.1.6)

1.1.8.5.4 Operational Description

This section to be completed during the License Application design phase.

1.1.9 Waste Handling Building Fire Protection System

1.1.9.1 Functional Description

The WHB Fire Protection System is classified as QL-2 in accordance with *Classification of the MGR Waste Handling Building Fire Protection System* (CRWMS M&O 1999j, Section 7.1).

The WHB is divided into several functional areas in relation to tasks required to be performed. They are the Primary, Primary Support, Pool Support, Facility Support, HVAC Equipment, Miscellaneous Building Support areas, and the Building Structure. The Fire Hazard Descriptions follow the same general breakdown by combining several rooms of the same functional relationship together. The reason is that fire area separations are not required normally between areas or rooms of similar type hazard. (CRWMS M&O 1999x, Section 8.2.4)

Classifications of hazard types are taken from the fire hazard description of building spaces. Exterior building areas are not evaluated (i.e., yard transformers, exterior diesel fuel tanks) due to a lack of specific location on any site drawing and available hazard definition. Areas are identified by system function and consist of one or more rooms. Rooms are shown with H-identifiers per the WHB space planning drawings (CRWMS M&O 1999x, Section 8.2.4).

"The Primary Areas consist of the CCHS, ATS, CTS, DCHS, and the WPRS. The HVAC confinement system in these areas is either primary or secondary. These primary confinement areas are not normally occupied and the secondary areas are either never occupied, or occupied on a very intermittent basis. [See CRWMS M&O 1999x, Table 8-1, for room by room classifications.] These F-2 and H-7 occupancies are as defined by the Uniform Building Code (UBC). The fire hazards in these areas are low to moderate and are classified as an "Ordinary Hazard Group 1" automatic sprinkler occupancy per NFPA 13. Fire hazards are expected to be from electrical wiring, cable, and motors. Two exits and a maximum travel distance of 200 ft shall be maintained in any occupied area. All penetrations to these areas will require fire rated penetration seals." (CRWMS M&O 1999x, Section 8.2.5)

"The Primary Support Areas consist of the Operating Galleries, Equipment Transfer Corridors, Contaminated Equipment Rooms, LLW Collection and Packaging, Maintenance Equipment Rooms, Weld Material Storage, Maintenance Shop, Forklift Staging and Servicing Rooms, and the Waste Handling Operations Center. The HVAC confinement system in these areas is either tertiary or none. These areas are normally occupied and may contain potentially radioactive contaminated materials. [See CRWMS M&O 1999x, Table 8-2, for room by room classifications.] These are B or F-2 occupancies as defined by the UBC. The fire hazards in these areas are defined as moderate and are classified as an "Ordinary Hazard Group 2" automatic sprinkler occupancy per NFPA 13. Fire hazards are expected to be from ordinary combustible materials used in operation and maintenance. Two exits and a maximum travel distance of 200 ft shall be maintained in any occupied area. All penetrations from areas of greater hazard will require fire rated penetrations." (CRWMS M&O 1999x, Section 8.2.6)

"The Pool Support Area consists of the Pool Treatment Equipment Room that houses the equipment to maintain water temperature, quality, and remove contamination from the pool. The HVAC confinement system in the area is secondary. The room is normally occupied and may contain radioactively contaminated materials. [See CRWMS M&O 1999x, Table 8-3, for individual room classifications.] The fire hazards in the area are defined as low to moderate and the sprinkler system occupancy classification is "Ordinary Hazard Group 1." The area is classified as F-2 by the UBC. Fire hazards are expected to be from ordinary combustible materials used during operation and maintenance activities. Two stairway exits are provided from this area. All penetrations into this area are required to be fire rated penetrations." (CRWMS M&O 1999x, Section 8.2.7)

"The Facility Support Areas consist of the Radiation Protection, Security, Operations, Administration, Maintenance, and Building Circulation areas. These areas support the primary systems areas in the WHB. The HVAC confinement in these areas is either tertiary or none. The areas are normally occupied and some of the areas may contain radioactively contaminated equipment. [See CRWMS M&O 1999x, Table 8-4, for individual room classifications.] The fire hazard in the area is defined as medium and the sprinkler system classification is "Ordinary Hazard Group 1 or Group 2" occupancy. The areas are classified as B or F Occupancies by the UBC. The area is classified as industrial by NFPA 101. Two exits and a maximum travel distance of 200 ft are required from each area. All penetrations to the area from areas of greater hazard require fire rated penetrations." (CRWMS M&O 1999x, Section 8.2.8).

"The HVAC Equipment Areas consist of the HVAC equipment rooms and the associated equipment. These rooms contain the HVAC equipment that provides the confinement for the Primary, Secondary, and Tertiary exhaust systems. The HVAC confinement in these areas is tertiary. This area is normally occupied and may contain some radioactively contaminated equipment. [See CRWMS M&O 1999x, Table 8-5, for individual room classifications.] The areas are classified as F-2 by the UBC. The fire hazard in the area is low to medium and the areas are classified as an "Ordinary Hazard Group 1" sprinkler occupancy. The areas are classified as industrial by NFPA 101. Two exits and a maximum travel distance of 200 ft are required from each area. All penetrations into the area are required to be fire rated penetrations." (CRWMS M&O 1999x, Section 8.2.9)

"The Miscellaneous Building Support Areas consist of the Fire Protection, Electrical Equipment, and Communication Equipment Rooms. The rooms do not require a HVAC confinement system. The rooms are normally unoccupied and contain a medium to high fire hazard. [See Table 8-6, CRWMS M&O 1999x, for individual room classifications.] The areas are classified as F-2 or H-3 by the UBC and as an industrial occupancy by NFPA 101. The areas are classified as an "Ordinary Hazard Group 2" sprinkler system occupancy. Two exits and a maximum travel distance of 200 ft are required from each area. All penetrations into the area from an area of greater hazard require a fire rated penetration. The Fire Protection Alarm System monitors all fire alarm and suppression devices in the facility and displays the alarm conditions on an annunciator panel in the main entry vestibule." (CRWMS M&O 1999x, Section 8.2.10)

"The WHB is a non-combustible structure as defined by the UBC. The building is designed to withstand a design basis earthquake, extreme wind/tornado winds, and any potential tornado wind missiles. Based on these building design features, the external structure of the building shell will provide adequate protection from external fire events." (CRWMS M&O 1999x, Section 8.2.11)

1.1.9.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.1.9.3 System Description

Fire protection design considerations shall comply with "Facility Safety" (DOE Order 420.1) and "Implementation Guide for use with DOE Orders 420.1 and 440.1, Fire Safety Program." For requirements governed by both the NRC and DOE Order 420.1, NRC requirements take precedence. (CRWMS M&O 2000v, Section 1.2.6.3)

"Fire and explosion detection and alarm systems are required in SSCs ITS (CRWMS M&O 1998j, Section 4.2.29). A fire alarm system shall be installed in the WHB to warn occupants of a fire, to activate the automatic fire protection systems, and to alert the fire response personnel." (CRWMS M&O 1998j, Section 4.2.34)

1.1.9.4 Operational Description

The fire alarm systems in the WHB will sound in the building and be transmitted to the fire station by a radio system or over dedicated telecommunications copper-based loops.

Suppression includes the fire fighters and response equipment that respond to detected fires (CRWMS M&O 1998l, Section 7.1.1.4).

The site fire alarm annunciation and monitoring system shall receive automatic fire detection and suppressions signals from the WHB. (CRWMS M&O 1998l, Section 7.2)

1.1.10 Waste Handling Building Electrical System

1.1.10.1 Functional Description

The WHB Electrical System performs the function of receiving, distributing, transforming, monitoring, and controlling AC and DC power to all WHB electrical loads. The system generates emergency power for important to radiological safety loads. (CRWMS M&O 2000u, Summary, Section 1.2.2.1.7) The system also distributes standby power for essential loads from the site electrical power system. The system provides the capability to transfer between site and emergency power. Designated ITS electrical equipment will be designed to operate during and after DBEs. (CRWMS M&O 2000u, Summary, Section 1.2.2.1.8) The system also provides lighting, grounding, and lightning protection for the WHB. (CRWMS M&O 2000u, Summary)

1.1.10.2 Parameters and Assumptions

1.1.10.2.1 Parameters

This section to be completed during the License Application design phase.

1.1.10.2.2 Assumptions

This section to be completed during the License Application design phase.

1.1.10.3 System Description

The WHB emergency power source and associated power distribution system is classified as QL-2 and the normal power source and associated distribution system is classified as CQ. (CRWMS M&O 1999i, Section 7.1) The electrical system consists of a diesel generator, power distribution cables, transformers, switch gear, MCC, power panel boards, lighting panel boards, lighting equipment, lightning protection equipment, control cabling, and grounding system. Emergency power is generated with a diesel generator. The WHB Electrical System distributes and controls primary power to acceptable industry standards, and with dependability compatible with WHB reliability objectives for non-safety electrical loads. (CRWMS M&O 2000u, Summary)

The WHB normal electrical supply will be fed from an offsite source that will provide power to all the WHB electrical loads (CRWMS M&O 1998i, Section 4.3.4). The portion of the electrical system dedicated to supporting the designated ITS loads will be separated from the non-safety electrical loads. (CRWMS M&O 2000u, Section 1.2.2.1.11) These ITS electrical loads will have an emergency power supply provided by a single diesel generator, an uninterruptible power supply, or battery system with sufficient capacity to supply the designated ITS electrical loads

when the normal electrical supply is not available. (CRWMS M&O 2000u, Sections 1.2.2.1.5, 1.2.2.1.6, and 1.2.2.1.7 and CRWMS M&O 1998n, Section 7.2.4)

A grounding grid is provided around the WHB, as appropriate for the site soil resistivity. The building ground system will be interconnected to the switchyard substation ground. All major electrical equipment, including the power panel boards, lighting panel boards, and motors, is connected to the building ground. A separate instrument ground is provided for the control system equipment, which is tied to the building ground mat. (CRWMS M&O 1998n, Section 7.2.4)

Lightning protection, including lightning arrestors, static wire, and grounding systems, will be provided for the WHB. (CRWMS M&O 1998n, Section 4.2.3.3)

Interior lighting for office areas consists of commercial-type fluorescent luminaries with high power factor and energy efficient ballast. High intensity discharge luminaries are used in high bay areas (CRWMS M&O 2000ae, Section 5.5.5).

1.1.10.4 Operational Description

During normal operations, power for the WHB initiates from switchgear circuit breakers located in the North Portal Switchgear Building, which is capable of distributing normal power to all ITS and non-safety loads. (CRWMS M&O 2000ae, Section 5.4)

Whenever offsite power is lost, the system generates and distributes emergency power to designated QL-2 loads using a dedicated diesel generator, and an uninterruptible power supply or battery system located within the WHB. This system is designed to distribute emergency power, via redundant and physically separated distribution systems, to ITS process and instrumentation and control (I&C) loads. The emergency power distribution system is configured with the capability of switching between offsite and emergency power if loss of offsite power occurs. (CRWMS M&O 2000ae, Section 5.4).

The WHB Electrical System design is depicted in the WHB Electrical System One-Line Diagrams (Figures I-30 and I-31, Attachment I, this document). (CRWMS M&O 2000ae, Section 6).

The inherent availability for the WHB electrical system shall be greater than 0.9883. (CRWMS M&O 2000u, Section 1.2.5.1)

The diesel generator shall have the capability to be tested either during operation of the facility or while the facility is shut down. (CRWMS M&O 2000u, Section 1.2.5.2)

The system design shall separate ITS loads (AC and DC) into redundant load groups. (CRWMS M&O 2000u, Section 1.2.2.1.2)

The system shall provide a connection to the normal power source and to the emergency power source for each ITS AC load group. (CRWMS M&O 2000u, Section 1.2.2.1.3)

1.1.11 Waste Handling Building Instrumentation and Control System

1.1.11.1 Functional Description

A Central Control Center (CCC) will be provided in the WHB for specific WHB operations (CRWMS M&O 2000m, Section 5.4). Operations such as material control and accountability, WHB utility functions, and radiation containment door control are some of the activities that will be handled from this control center.

A CCC will also be located in the Computer Center in the Administration Building (CRWMS M&O 2000m, Section 5.4). This center will provide the automatic control and monitoring of the MGR surface operations as well as providing monitoring and limited emergency control functions for the WHB.

A redundant emergency control panel may be provided in the WHB to provide a backup control center for the WHB CCC (CRWMS M&O 2000m, Section 4.0). The control panel will perform emergency operations normally provided by the control consoles in the WHB CCC. The emergency control panel will provide the control capability to bring the WHB systems important to a safe operating or shutdown condition. The emergency control panel will interface only with the equipment required for orderly safe operation or shutdown of the systems. The emergency control panel will normally be in a power off unused mode of operation. The emergency control panel will only be operated if the WHB CCC system is unavailable. The emergency control panel will have the capability to transfer control of the safety related control systems from both the WHB CCC and WHB local control systems.

1.1.11.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.1.11.3 System Description

The conceptual design of the CCC in the computer center is to monitor and control the activities, status, and alarms of the MGR facilities. The CCC will also monitor and provide limited control capability for the WHB CCC. Limited emergency response capability, such as public address (PA) announcements, and mobilization of personnel to respond to off-normal events are some of the activities envisioned from the CCC. The WHB CCC will in turn have the capability to perform limited emergency functions, such as PA announcements, and radio communications for the CCC in the event the CCC becomes inoperable. In addition to the WHB CCC, there are local control consoles located in the WHB operating galleries. The purpose of the local control consoles is to control the waste handling operations from operating galleries where operators will have direct line of sight viewing of the nuclear operations. The WHB CCC will monitor the operation and status of the local control consoles and will provide limited emergency response to local off-normal events. The WHB CCC will not normally perform emergency response control functions in the event of local controller malfunction. However, the WHB CCC has the capability to perform those functions if control from the local control consoles is not possible (e.g., the operating gallery becomes uninhabitable). Communications between local console operators and the WHB CCC operators will be performed by secured communication lines.

Operator headsets or console speakers are some of the design options to be considered. (CRWMS M&O 2000m, Section 4.0)

1.1.11.4 Operational Description

The I&C monitoring and control operations may be performed from the WHB CCC, the local control console (LCC) located in the operating galleries, and from the computer center CCC for limited emergency control operations. (CRWMS M&O 2000m, Section 4.0)

1.1.11.4.1 Waste Handling Building Central Control Center

The WHB CCC performs monitoring and limited control of WHB operations. Operations such as door control and access to various parts of the WHB may be controlled and monitored from the CCC. (CRWMS M&O 2000m, Section 4.0)

Shift operators in the CCC may perform operations such as daily reports, shift operating logs, and administrative time keeping activities.

Door and access control may be operated from control consoles with the aid of CCTV monitors.

Intrusion and fire alarm monitoring are also functions that may be monitored from the WHB CCC.

The WHB CCC will contain the PA system and communications equipment to make WHB announcements and to afford communications to the LCC operators and operators in the Computer Building CCC. The WHB CCC may have the capability to perform limited emergency functions such as PA announcements and radio communications for the computer center CCC in the event the computer center CCC becomes inoperable. The CCCs will monitor the operation and status of the LCC and will provide emergency response to local off-normal events. (CRWMS M&O 2000m, Section 4.0)

1.1.11.4.2 Waste Handling Building Operating Galleries

The primary control functions of waste handling operations will be handled from the operating galleries where operating personnel will have direct line of sight of the waste handling operations.

Local control console operators will control and monitor waste handling operations from consoles located in front of viewing windows. CCTV monitors will also be provided to allow operators close up views of intricate operations. Local control of mechanical systems (e.g., overhead cranes and manipulators), with control consoles located in the operating galleries, provides operators the opportunity to view hot cell operations through strategically located windows. Many operations will be designed for operation from the local operator consoles only. Both CCTV and visual observation from the operating gallery windows will be required for remote operations (CRWMS M&O 2000m, Section 5.1). In emergency response situations, control of safety systems normally operated from LCC may be transferred to the WHB CCC. When control is transferred to the WHB CCC (by LCC generated manual control signals)

audible and visual alarms will be generated at the LCC and at the WHB CCC (CRWMS M&O 2000m, Section 5.1).

Ergonomically designed operator consoles with emphasis on Human Factors Engineering (HFE) will provide operators with control consoles that will emphasize rapid response to off-normal operations (CRWMS M&O 2000m, Section 5.1).

1.1.12 Waste Handling Building Utility Systems

The WHB requires various piped utility systems (i.e., liquids, gases, and vacuum), to perform its function of receiving and repackaging of SNF/HLW materials. This section discusses those various utility systems. The classification of the WHB piped utility systems are CQ (CRWMS M&O 1999k, Section 7). The functional and design criteria for the WHB utility systems are as identified in appropriate sections of the *Waste Handling Building System Description Document* (CRWMS M&O 2000x, Sections 1.1 and 1.2)

1.1.12.1 Potable Water

1.1.12.1.1 Functional Description

The function of the potable water piping is to provide potable water to those areas within the WHB requiring potable water service. (CRWMS M&O 1998j, Section 4.2.1.1)

1.1.12.1.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

Per the requirements identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.1), potable water service shall meet the following criteria:

- Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6 (Energy Policy Act of 1992. 42 U.S.C. 13201 et seq).
- The potable water system shall be designed and installed to comply with Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

1.1.12.1.3 System Description

Cold potable water is provided to the WHB from the central potable water system. The cold potable water is distributed through Type L copper tubing to the men's and women's change rooms, operations lunchroom, personnel decontamination room, men's and women's restrooms, lunchroom, janitor closets, and drinking fountains. (CRWMS M&O 1998n, Section 7.2.1.1)

Cold potable water is routed to a glass-lined electric water heater. The hot water tank is stamped in accordance with American Society of Mechanical Engineers (ASME), Section IV, and includes pressure and temperature relief valves. The hot water system includes a pressurized

diaphragm hot water expansion tank, temperature gauge, and low water cutout. Hot sanitary water is distributed to the same areas as the cold sanitary water, excluding the drinking fountains. The hot water system includes recirculation to ensure hot water will be continuously available at all hot water fixtures. (CRWMS M&O 1998n, Section 7.2.1.1)

Hot and cold potable water routed to the personnel decontamination room is protected by a reduced-pressure principle backflow prevention device. The hot water to this area is not recirculated because this area is potentially contaminated. (CRWMS M&O 1998n, Section 7.2.1.1)

1.1.12.1.4 Operational Description

Water is available at outlets through the opening of local manual valves.

1.1.12.2 Sanitary Sewer

1.1.12.2.1 Functional Description

The function of the WHB sanitary sewer system is to collect and transfer sanitary sewage to the MGR site sanitary sewer mains.

1.1.12.2.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

An environmentally acceptable method for disposal of sanitary wastes is required to support operations within the WHB. The sanitary waste system shall be designed and installed per the criteria identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.3):

- The design, construction, and operation of sanitary sewage handling and disposal systems shall be permitted in accordance with the Clean Water Act of 1972, as amended (CWA), 33 USC 1251 et. seq. Section 1345, and applicable State laws.

1.1.12.2.3 System Description

The sanitary sewer lines are consolidated and gravity drained to the existing site sanitary sewer system. Sanitary sewage from the operations lunchroom, janitor closets, men's and women's restrooms, lunchroom, outside air intake rooms, and the drinking fountains is drained and connected to a sanitary vent system that extends through the roof of the WHB. Groups of fixtures vent piping are consolidated, where possible, using a central vent stack.

The sanitary sewer from the men and women's change rooms is consolidated and gravity drained to a sump that is equipped with a duplex sewage pump system in accordance with the Uniform Plumbing Code (UPC). The system is Class 1, Division 1, in accordance with the National Electric Code (NFPA 70) Article 501-10 and is Underwriters' Laboratory (UL) listed. (paragraph from CRWMS M&O 1998n, Section 7.2.1.2)

No sanitary sewer will be provided at eye wash stations, combination safety showers/eye washes, or in the personnel decontamination room decontamination shower. This provides isolation of the sanitary sewer lines from these potentially contaminated areas. Liquids from these systems will be collected locally, sampled, and analyzed, and then the liquids disposed of appropriately. (CRWMS M&O 1998n, Section 7.2.1.2)

1.1.12.2.4 Operational Description

The sanitary sewer system is gravity drained. Clean-outs are provided per UPC guidance for maintenance purposes.

1.1.12.3 Safety Shower Water

1.1.12.3.1 Functional Description

The function of the Safety Shower Water piping system is to provide potable water for safety showers and eye wash stations within the WTB.

1.1.12.3.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

Potable water service is provided to the WHB and piped as necessary for consumption under the following criteria (CRWMS M&O 1998j, Section 4.2.1.1):

- Where the possibility exists for the eyes or body of any person to be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the immediate work area for emergency use.

1.1.12.3.3 System Description

A copper water line is extended from the cold sanitary water supply. The line is tied into the cold sanitary water supply line upstream of the main building shut-off valve. The safety shower water system has a locked open isolation valve and reduced-pressure principle backflow prevention device installed at the branch connection. Safety shower water is extended to an eye wash station at each laboratory, a combination safety shower/eye wash station located in the corridor between the laboratories, to the pool treatment equipment rooms, and one for each separate emergency generator. The combination safety shower/eye wash stations for the emergency generators are heat-traced and insulated to prevent freezing during operation of the generators. The combination safety shower/eye wash stations are identified with a highly visible sign and will be well lighted. Eye washes and safety showers comply with ANSI Z358.1 for flow, pressure, installation, and testing requirements. (CRWMS M&O 1998n, Section 7.2.1.3)

1.1.12.3.4 Operational Description

Water to safety showers and eyewashes is hard piped. Valves are locked in the open position. Maintenance activities are administratively controlled under lock and tag procedures.

1.1.12.4 De-Ionized Water

1.1.12.4.1 Functional Description

The function of the de-ionized water distribution piping is to provide de-ionized water to the ATS pools and to the assembly lag storage pools. De-ionized water is also required to supplement recycled water used for decontamination activities. The Pool Water Makeup SSC is classified as QL-3, minor safety significance or of occupational exposure significance. (CRWMS M&O 1999d, Section 7, Table 1)

1.1.12.4.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

1.1.12.4.3 System Description

De-ionized water is supplied from the site de-ionized water system to points of consumption within the WHB. (CRWMS M&O 1998n, Section 7.2.1.4) The site de-ionized water system is connected to back-up power to ensure water availability in the event of a power outage. (CRWMS M&O 1998j, Section 7.1.6.2)

1.1.12.4.4 Operational Description

De-ionized water is hard piped to points of consumption. Water flow for manual decontamination activities is controlled with manual valves. Maintenance activities are administratively controlled under lock and tag procedures for those valves normally locked open.

1.1.12.5 Recycled Water

1.1.12.5.1 Functional Description

The function of the Recycled Water Distribution System is to provide recycled water for selected decontamination activities within the WHB. (CRWMS M&O 1999t, Section 7.2.1)

1.1.12.5.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

1.1.12.5.3 System Description

Recycled water is distributed within radiological controlled areas within the WHB for utilization in decontamination activities.

1.1.12.5.4 Operational Description

Recycled water is hard piped to points of consumption. Water flow for manual decontamination activities is controlled with manual valves. Maintenance activities are administratively controlled under lock and tag procedures for those valves normally locked open.

1.1.12.6 Softened Utility Water

1.1.12.6.1 Functional Description

The function of the Softened Utility Water Distribution System is to provide utility water for activities such as facility cleaning in non-radiological controlled areas of the WHB.

1.1.12.6.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1)

1.1.12.6.3 System Description

Softened utility water is distributed from the main softened utility water supply system to those areas within the WHB where this water is utilized for facility wash down and housekeeping. (CRWMS M&O 1998j, Section 7.1.5)

1.1.12.6.4 Operational Description

Flow of water at points of consumption is controlled with manual valves.

1.1.12.7 Breathing Air

1.1.12.7.1 Functional Description

The function of the Breathing Air Distribution System is to provide breathing air through hose connections in the WTB for the purposes of allowing personnel access into the cell areas for the performance of non-routine maintenance and/or to correct off-normal occurrences.

1.1.12.7.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1.7)

The breathing air system will be designed as discussed in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.2.1).

The following are additional considerations for breathing air systems:

- When it is not practicable to apply process or other engineering controls in restricted areas to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the repository shall, consistent with

maintaining the total EDE ALARA, have the capability to increase monitoring and limit intakes by one or more of the following: control of access, limitation of exposure times, use of respiratory protection equipment, and other controls.

- Each utility service system (i.e., fire protection water, potable water for safety showers and eye washes, and breathing air) that is ITS shall be designed so that essential safety functions can be performed under both normal and accident conditions.

1.1.12.7.3 System Description

Breathing air is piped from the site breathing air system to points of consumption within the WHB. Branch lines are routed to each of the airlock rooms, to the pool treatment equipment rooms, the DCHS airlock room, the welder maintenance bay room, and outside the operating gallery room in the access corridor. Each branch line will end at a breathing air station consisting of a pressure regulator, a filter, pressure gauge, and quick-disconnect check-valve units for air hose connection. The breathing air quick-disconnect check-valves are not compatible with any other quick disconnects used within the WHB. "The breathing air system complies with ANSI Z88.2 and 29 CFR 1910.134 for air quality, maintenance, testing, and training programs" (CRWMS M&O 1998n, Section 7.2.1.7).

1.1.12.7.4 Operational Description

Breathing air service is controlled with manual valves locked in the open position. Maintenance activities are performed under administrative control using lock and tag procedures.

1.1.12.8 Instrument and Shop Air

1.1.12.8.1 Functional Description

The function of the Compressed Instrument and Shop Air Distribution System is to provide compressed air for I&C functions and actuators within the WHB. Compressed air is also required for use with pneumatic tools used in maintenance operations.

1.1.12.8.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2.1.6)

1.1.12.8.3 System Description

Instrument and shop air is provided by the site instrument and shop air system and piped to required locations within the WHB. A back-up air compressor with a refrigerated air dryer, pre-filter, and final filter is installed to provide compressed air if the site compressed air system fails or is high use. Compressed air is provided to each cask preparation area room, each laboratory, forklift staging and servicing area, and the maintenance shop room. Air from this system also provides instrument air for pneumatic control systems. The instrument air supply

includes a refrigerated air dryer, pre-filter, and final filter. (CRWMS M&O 1998n, Section 7.2.1.6)

1.1.12.8.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities. Switchover to the backup compressor is a manual operation.

1.1.12.9 Nitrogen

1.1.12.9.1 Functional Description

The function of Nitrogen Distribution Piping is to provide nitrogen service utilized in cask purging and sampling operations, purging of the assembly drying system, initial purging of the WP after fuel loading, and various other purging operations.

1.1.12.9.2 Design Parameters

Nitrogen gas piping will be extended to the WHB from the storage system located at the WHB. (CRWMS M&O 1998n, Section 7.2.1.8)

1.1.12.9.3 System Description

Nitrogen is supplied to the WHB from a liquefied nitrogen storage vessel. Liquefied nitrogen is supplied to the storage vessel by truck from an offsite source. (CRWMS M&O 1998j, Section 7.3.1) Gaseous nitrogen is piped through welded, seamless, stainless steel pipe to user areas within the WHB.

1.1.12.9.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities.

1.1.12.10 Helium

1.1.12.10.1 Functional Description

The function of the Helium Distribution Piping is to provide helium for use as the final inerting and heat transfer gas within the WP.

1.1.12.10.2 Design Parameters

Helium gas piping will be extended to the WHB from the storage system located at the WHB. (CRWMS M&O 1998n, Section 7.2.1.9)

1.1.12.10.3 System Description

Helium is supplied from helium tube trailers located near the WHB. Compressed helium is supplied by truck from offsite sources. Helium is routed through welded, seamless, stainless steel piping and tubing to each of the welding stations. (CRWMS M&O 1998n, Section 7.2.1.9)

1.1.12.10.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities.

1.1.12.11 Argon

1.1.12.11.1 Functional Description

The function of the Argon Distribution Piping is to provide argon gas to support welding of WP inner and outer lids.

1.1.12.11.2 Design Parameters

Argon gas services will be extended to the WHB from the storage located at the WHB. (CRWMS M&O 1998n, Section 7.2.1.10).

1.1.12.11.3 System Description

Argon is supplied from argon tube trailers located near the WHB. Compressed argon is supplied by truck from offsite sources. Argon is routed through welded, seamless, stainless steel piping and tubing to each of the welding stations. (CRWMS M&O 1998n, Section 7.2.1.10) Argon is also piped to maintenance shop areas for use in welding of stainless steel.

1.1.12.11.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities.

1.1.12.12 Argon/Helium Blend

1.1.12.12.1 Functional Description

The function of the Argon/Helium Gas Blend (25 percent and 75 percent, respectively) Distribution Piping is to provide argon/helium blend to support welding of WP lids. (CRWMS M&O 1998n, Section 7.2.1.11)

1.1.12.12.2 Design Parameters

Argon/helium blend gas will be extended to the WHB from the storage located at the WHB. (CRWMS M&O 1998n, Section 7.2.1.11)

1.1.12.12.3 System Description

Argon and helium gases are supplied to the WHB in high-pressure, trailer-mounted, tubes. A mixer is used to prepare the proper mixture before the gas blend enters the WHB. The argon/helium blend is then distributed through seamless welded stainless steel piping to the DC welding area and to the WP remediation area. (CRWMS M&O 1998n, Section 7.2.1.11)

1.1.12.12.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities.

1.1.12.13 Vacuum Systems

1.1.12.13.1 Functional Description

The function of the Vacuum System Piping is to provide vacuum required for collection of vacuum air samples at radiological laboratory hoods, for radiological area air monitoring, and for collection of gas samples from cask sampling activities.

1.1.12.13.2 Design Parameters

Vacuum service will be extended to those areas within the WHB from the vacuum pumps located in the WHB. (CRWMS M&O 1998n, Section 7.2.1.12)

1.1.12.13.3 System Description

The WHB's central vacuum system consists of a receiving tank, roots type vacuum pumps with standby capabilities, and I&Cs for system operation. The discharge piping from the vacuum pumps is connected to an activated carbon filtration system upstream of the primary confinement HEPA-filtered exhaust system. Seamless welded stainless steel vacuum piping supplies the following areas within the WHB (CRWMS M&O 1998n, Section 7.2.1.12):

- Lines are routed to the DC Handling Cell and the WP decontamination cell in the ATS to provide vacuum for evacuation of the WPs prior to inerting the WP with nitrogen or helium. Each of the eight welding stations will also have vacuum connections.
- A vacuum line is provided to the WP remediation cell for evacuating WP.
- A line is routed to laboratories to provide vacuum air sampling at laboratory hoods.
- Local HEPA filters are used to minimize the spread of contamination throughout the vacuum piping system.

1.1.12.13.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities.

1.1.12.14 Diesel Fuel Piping

1.1.12.14.1 Functional Description

The function of the Diesel Fuel Distribution Tanks and Piping is to provide diesel fuel to two emergency diesel generators to provide back-up power for QL-1 loads. Diesel fuel supply tanks and piping are required to ensure fuel for the generators. (CRWMS M&O 1998n, Section 7.2.1.14)

1.1.12.14.2 Design Parameters

Diesel fuel will be provided from the main fuel oil storage tank. (CRWMS M&O 1998j, Section 7.4.1)

1.1.12.14.3 System Description

Each generator has an independent fuel supply, piping, and pumps. The diesel fuel supply for each generator is provided from an above-grade storage day tank located inside the hardened WHB generator room, adjacent to each generator, and separated by a 3-hr fire rated wall as required by NFPA 37, Paragraph 6-3.5. The diesel fuel storage tanks are sized to provide a 24-hr supply to each generator. The tanks are fabricated in accordance with API 650, and sized per the guidance provided in NFPA 20, Paragraph 8-4.3. (paragraph from CRWMS M&O 1998n, Section 7.2.1.14)

1.1.12.14.4 Operational Description

Diesel fuel to the storage tanks is provided from a delivery truck, which is refilled from a large site-storage tank, and Number 2 fuel oil is used to ensure fuel flow during cold weather. (CRWMS M&O 1998j, Section 7.4.1)

1.1.12.15 Chilled Water and Heating Water

1.1.12.15.1 Functional Description

The function of the CHW and HW supply and return piping is to provide heating and cooling to the building HVAC system for temperature control.

1.1.12.15.2 Design Parameters

Utility services will be extended to the WHB from the MGR Site Utility System.

1.1.12.15.3 System Description

The CHW, HW, and potable water systems will be piped inside the building and distributed to the HVAC equipment rooms.

1.1.12.15.4 Operational Description

A temperature controller/sensor will be located in the main supply air plenum to maintain a design supply air temperature setting by modulating the flow of the CHW to the cooling coil through the associated CHW control valve or the flow of the HW to the heating coil through the associated HW control valve.

Individual temperature controllers will be located in various rooms to maintain the design room temperature settings. The room temperatures will be maintained by modulating the HW flow to the reheat coils through the associated control valves.

1.1.13 Waste Handling Building Radiological Monitoring System

1.1.13.1 Functional Description

The WHB radiological monitoring system will monitor, display, annunciate, and report on the radioactivity levels in the WHB areas, including the building ventilation exhaust. The WHB radiological monitoring system, which is part of the SRM, consists of the 1) Area Radiation Monitoring System, 2) Continuous Air Monitoring System, and 3) WHB Exhaust Stack Radiation Monitoring, has a QA classification of QL-3. (CRWMS M&O 1999q, Table 1).

The system provides local and central display of all radiation levels, audible annunciation of unsafe levels and trends, and communication with the building central alarm, Radiation Protection, and emergency response system (ERS). Exhaust air is monitored and alarmed when safe levels are exceeded.

1.1.13.2 Parameters and Assumptions

1.1.13.2.1 Parameters

This section to be completed during the License Application design phase.

1.1.13.2.2 Assumptions

This section to be completed during the License Application design phase.

1.1.13.3 System Description

The system consists of area radiation and continuous air monitors and functions to maintain MGR operator radiation doses ALARA. Exhaust stack monitors are provided to monitor and alarm radiological releases in the WHB and WTB ventilation exhaust (CRWMS M&O 1999q, Section 5.1). The range of these monitoring systems are specified to assure that the instruments are on scale during both normal operations at the low end of the expected radiation levels, and during potential off-normal occurrences at the high end. This ensures that personnel may safely occupy these areas for the planned duration of their work activities, and that potential offsite releases are within acceptable limits. Exceeded limits are alarmed, and the sensitivity and reaction time of the system is adequate to protect personnel. The system and individual

instruments perform self-tests on their operating status and support calibration, plus record the results and report anomalies and failures.

1.1.13.4 Operational Description

This section to be completed during the License Application design phase.

1.1.13.5 Waste Handling Building –Dose Assessment Methodology

See Radiological Assessment, Section 1.8 of this document for Dose Assessment Methodology.

1.2 WASTE TREATMENT BUILDING

The WTB houses the site-generated Radiological Waste Handling System, which collects and prepares the site-generated low-level radiological solid, liquid, and mixed waste for disposal. The system controls the collection of the liquid LLW and treats it prior to packaging it for disposal. Solid LLW is also collected, condensed, and repackaged for disposal. The waste streams are of low enough radioactivity that no special features are required to meet NRC radiation safety requirements (shielding and criticality). (CRWMS M&O 2000ac, Section 1)

1.2.1 Waste Treatment Building - Architecture, Structure, and Foundation

1.2.1.1 Functional Description

The WTB System provides the spaces, layout structure, and embedded subsystems that support the processing of low-level radioactive waste generated within the MGR (CRWMS M&O 2000ac, Section 1). The activities conducted in the WTB include sorting, volume reduction, and packaging of dry waste, and collecting, processing, solidification, and packaging of liquid waste. The WTB System is located on the surface within the protected area of the MGR. The WTB System helps maintain a suitable environment for the LLW processing and protects the systems within the WTB from natural and induced environments. The WTB also confines contaminants and provides radiological protection to personnel. In addition to the LLW processing operations, the WTB System provides space and layout for industrial and radiological safety systems, control and monitoring of operations, safeguards and security systems, and fire protection, ventilation and utilities systems. The WTB System also provides the required space and layout for staging of packaged LLW, maintenance, tool storage, and personnel administrative and support facilities. (CRWMS M&O 2000ac, Summary)

The WTB System integrates LLW processing systems within its protective structure to support the throughput rates established for waste emplacement. The WTB System also provides shielding, layout, and other design features to help limit personnel radiation exposures to levels which are ALARA.

The WTB System requires interface with MGR systems that perform or LLW processing operations.

1.2.1.2 Parameters and Assumptions

1.2.1.2.1 Parameters

Parameters cited will come from the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 4). There is no new analysis in this document.

1.2.1.2.2 Assumptions

This section to be completed during License Application design phase.

1.2.1.3 System Description Architecture

1.2.1.3.1 Process Areas

See Section 1.5 of this document and the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.1).

Low-Level Wastes

The process areas within the WTB provide space for the handling, processing, and packaging for disposal of site generated secondary LLW. The waste streams treated in the WTB are dry-solid LLW, recyclable liquid LLW, non-recyclable liquid LLW, and wet-solid LLW. The wet-solid LLW (spent ion exchange resins and filter cartridges) generated within the WTB are packaged for disposal within the WTB. (CRWMS M&O 2000af, Section 6.3.1.1.)

A total floor area of 36,800 sq ft was defined in *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.1.1) for LLW processing in the WTB.

Mixed and Hazardous Wastes

Hazardous waste generated at the Repository is packaged for shipment off site for treatment and disposal. These wastes are staged outside of the WTB in order to reduce the likelihood of generating mixed waste from this material.

Mixed waste is not anticipated to be generated as a result of normal repository operations; however, provision has been made to stage a small quantity of mixed waste within the WTB. The area provided for this purpose should be about the same as in the advanced conceptual design, or 800 sq ft. This mixed waste storage area allocation is in addition to the LLW area defined in the previous paragraphs. Hazardous waste is staged outside of the WTB, prior to disposal off site. (CRWMS M&O 2000af, Section 6.3.1.2)

1.2.1.3.2 Facility Support Areas

The WTB contains areas within the facility required for support of the treatment process. These areas include Security, Operations, and Administration. Circulation of personnel and equipment throughout the facility is also needed. (CRWMS M&O 2000af, Section 6.3.2)

Security

Security includes spaces housing the necessary security functions within the WTB. The area is located at the main entry to the facility with a second security portal at shipping/receiving. Spaces include two security portals and an office. (CRWMS M&O 2000af, Section 6.3.2.1)

- **Security Portals**

  Security Portals are required for WTB personnel entry and egress security control. The portals provide area for access control points for vital areas. A portal is located at each operational entrance to the facility from the exterior and includes area for one security officer and one personnel radiation counter. At this time, two portals are anticipated, one at the main entry and one at shipping/receiving. The required minimum floor area is 150 sq ft for each portal, 300 sq ft for both portals. (CRWMS M&O 2000af, Section 6.3.2.1.1)

- **Office**

  One shift office for security personnel is provided adjacent to the main security portal. Workspace is provided for the security staff including both portal and roving officers. The minimum required floor area is 150 sq ft. (CRWMS M&O 2000af, Section 6.3.2.1.2)

Operations

Operations include spaces that provide for support of operational activities and associated personnel. The area includes parts storage, men's and women's change rooms with shower facilities and restrooms for non-radiological coverall worker clothing, coverall storage, a lunchroom, janitor closet, forklift staging and charging, and shipping/receiving. (CRWMS M&O 2000af, Section 6.3.2.2)

- **Parts Storage**

  A storage room is provided for parts used within the WTB. The floor area indicated for this room is 120 sq ft. No other information is available. (CRWMS M&O 2000af, Section 6.3.2.2.1)

- **Change rooms**

  Change rooms with associated showers are provided for both male and female operational and maintenance employees, working within the WTB, to change into worker coveralls. Restrooms are also provided for anticipated male and female employees. The change rooms are located to provide direct access into the process areas of the facility. Determination of size is based on the maximum staff anticipated during one shift. An assumption is made, for calculation of plumbing fixture counts, that male usage is 100 percent of the maximum shift staffing and female usage is 50 percent of maximum shift staffing. The required minimum floor area for both change rooms is 1,389 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.2)

- **Coverall Storage**

  Coverall Storage is provided for clean and dirty coverall clothing. The storage area is located adjacent to the change rooms. The space is sized to accommodate coveralls for the anticipated number of workers using the change rooms. The required minimum floor area is 85 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.3)

- **Lunchroom**

  A lunchroom is provided for all staff within the WTB for minimal food preparation and storage, eating, and space for vending equipment. Food preparation includes heating of precooked items, and food storage includes refrigeration. The room accommodates the maximum shift staffing. The required minimal floor area is 980 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.4)

- **Janitor Closet**

  The Janitor Closet is used for all areas within the WTB and provides janitorial supply storage. The required minimum floor area is 150 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.5)

- **Forklift Staging**

  Space is provided within the operations area for staging (parking) of forklifts, including battery- charging stations. The total area required is 1,340 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.6)

- **Shipping/Receiving**

  The shipping/receiving area provides space for the receiving of supplies for the process, operations, and administrative areas, including a loading dock and staging area. The dock is also used for shipping of waste materials produced by the WTB process area. The area is located for access from the mixed waste accumulation areas and to the exterior of the facility for site shipping. The height of the room is a minimum of 12 ft open to the building structure. The total area required is 1,450 sq ft. (CRWMS M&O 2000af, Section 6.3.2.2.7)

<u>**Administration**</u>

Administration includes spaces that house various management and support functions for the WTB. These spaces include supervisor and plant operations offices, staff offices, health physics and QA offices, inventory control office, a calibration lab, and copy/supply storage. The administrative area is located adjacent to the main entry to the facility. Administrative space and staffing levels incorporated in this report are as described in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.2.3).

- **Plant/Process Maintenance Supervisor Offices**

  Two offices are provided to accommodate a plant maintenance supervisor and a process maintenance supervisor. The required minimum floor area is 100 sq ft per office, 200 sq ft total. (CRWMS M&O 2000af, Section 6.3.2.3.1)

- **Plant Manager Office**

  One office is provided for the WTB plant manager. The required minimum floor area is 225 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.2)

- **Plant Management Supervisor Office**

  One office is provided for the plant management supervisor. The required minimum floor area is 150 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.3)

- **Staff Support**

  One open work area is provided with six workstations for the staff support. The required minimum floor area is 600 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.4)

- **Health Physics Office**

  One office is provided for two HPTs. Space is provided for storage of radiation detection equipment and dosimetry. The office is located adjacent to instrument calibration and the entry to the process area. The required minimum floor area is 250 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.5)

- **QA Office**

  One office is provided for a QA office. Space is provided for one QA staff person and associated QA files. The required minimum floor area is 128 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.6)

- **Inventory Control Office**

  One office is provided for inventory control of incoming and outgoing waste processed in the WTB. Space is provided for one staff person and associated file storage. The required minimum floor area is 128 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.7)

- **Copy and Storage Room**

  A space for a copy machine, fax machine, and general office supply storage are provided. The required minimum floor area is 60 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.8)

- **Instrument Calibration**

  Space is provided for minor calibration and storage of radiological instruments used in the WTB. (Repair of instruments is performed at the WHB.) The room is located adjacent to the HPT's office. The required floor area is 250 sq ft. (CRWMS M&O 2000af, Section 6.3.2.3.9)

- **Circulation**

  Circulation is required for movement of personnel within the operation and administrative areas. Circulation for the WTB is calculated for the administrative and operations area excluding forklift staging/charging and shipping/receiving. These areas, along with the remainder of the WTB, are operational areas with internal circulation included in their specific areas. Adjacencies between the areas are direct and no additional circulation is required. The minimum required floor area is 2,400 sq ft. (CRWMS M&O 2000af, Section 6.3.2.4)

1.2.1.3.3 Heating, Ventilation, and Air Conditioning Equipment Rooms

Methodology

The methodology for configuring the equipment rooms of the WTB is the same as performed for the WHB (CRWMS M&O 2000af, Section 6.3.3.1) except that:

a. The WTB ventilation equipment is not safety-class and a hardened equipment room is not provided.

b. HVAC equipment rooms require clear ceiling height is 15 ft because the equipment capacity is smaller and does not require large ducts.

WTB HVAC Equipment Rooms Configuration

There are two mechanical rooms, one for the outside air intake units with fans and hydronic system, and the other for the recirculation and exhaust HEPA filter units, with fans serving the confinement area systems. The non-contaminated facility support area HVAC equipment is in a separate room. The space for the MCCs located inside the HVAC room is estimated for 9 large horsepower motors. (CRWMS M&O 2000af, Section 6.3.3.3)

WTB HVAC Equipment Space Summary

The estimated allocated space represents a composite of the equipment space and maintenance and circulation aisles. (CRWMS M&O 2000af, Section 6.3.3.4, Table 6.3)

a. Process Area Supply Air Intake Equipment Space Requirement is 5,375 sq ft
b. Process Area Exhaust Air Equipment Space Requirement is 13,500 sq ft

The minimum space required for the WTB HVAC mechanical equipment is
5,376 + 13,500 = 18,875 sq ft.

1.2.1.3.4 Miscellaneous Building Support Areas

Fire Protection

The WTB is provided with fire suppression and alarm systems. Adequate area is provided for sprinkler system risers. Two risers are provided to service the building. A fire alarm annunciation panel is located within the vestibule at the main entry to the facility.

The required fire riser areas may be located either in a separate room or within a general area that does not detract from the function of the space. A riser requires area for the riser piping, valves, backflow preventer, and associated alarm annunciation. The riser space may be open to the building structure above. The minimum required floor area for risers are 200 sq ft, based on a 10-ft by 10-ft floor area for each riser.

The fire alarm annunciation panel required is located on the wall of the main entry vestibule. No additional floor area is required. (CRWMS M&O 2000af, Section 6.3.4.1)

Electrical

The WTB is provided with normal/backup power with uninterruptible power provided to critical systems. Facility requirements for backup and uninterruptible power have not been determined. Equipment with associated floor area for these systems has been assumed.

Electrical power is supplied from normal/backup electrical rooms (including uninterruptible power), and electrical switchgear rooms. Required minimum floor area for these spaces is 1,300 sq ft for normal/backup power and 650 sq ft for switchgear. (CRWMS M&O 2000af, Section 6.3.4.2)

Communication

A communication room is provided for telephone, radio, computer networking, and building/site alarm system equipment. The rooms are open to the building structure above. Communication systems are yet to be defined. It is assumed the room requires a minimum of 50 sq ft. (CRWMS M&O 2000af, Section 6.3.4.3)

1.2.1.4 System Description - Structure

The WTB is also sited on the existing ESF pad, adjacent to the WHB carrier bay. This facility houses the equipment, tanks, piping and support personnel involved in the collection of chemical liquid and solid waste from both the wet and dry cask preparation processes. The WTB also contains the equipment, tanks, and piping for the water recycling process of the three water pools (CRWMS M&O 2000af, Section 6.3.5).

The supporting concrete floor slab with concrete walls will be designed for appropriate DBEs to preclude tank spills from leaking into the surrounding soil.

The building is an open, high bay, industrial structure without radiation shielding requirements. The main operating floor is a slab on grade. The superstructure is a structural steel, braced frame

with metal siding and metal deck roof. Support personnel offices are located on the ground floor. An elevated floor or mezzanine is located above the personnel offices for the building mechanical equipment. The WTB and the WHB are separated by a seismic joint to prevent structure interaction between the two different framing systems during an earthquake. (CRWMS M&O 2000af, Section 6.3.5)

1.2.1.5 System Description - Foundation

Foundation Recommendation

The WTB is a relatively lightly loaded building. There are no overhead cranes inside the facility and all major process equipment sits on the ground floor slab. Because the building columns have modest loads, individual spread footings can be assumed for the column foundations (CRWMS M&O 2000af, Section 6.3.5.1).

Assuming an interior column with a maximum load of 60,000 lbs, a square spread footing of 5 ft by 5 ft results in a bearing value of under 2,500 psf. This is below the 3,000 psf bearing pressure discussed in the geotechnical report the *Preliminary Geotechnical Investigation for Waste Handling Building, Yucca Mountain Site Characterization Project* (CRWMS M&O 1999r, Section 7.5.1). A uniform bearing pressures of 3,000 psf should result in acceptable, potential settlements of 0.25 in.

This conclusion must be verified by a site-specific geotechnical evaluation for the WTB.

1.2.1.6 Operational Description

This section to be completed during License Application design phase.

1.2.2 Waste Treatment Building Piped Utility Systems

The WTB requires various piped utility systems (i.e., liquids and gases), to perform its function of receiving, processing, and repackaging for disposal of secondary radioactive waste materials. This section discusses those various utility systems. The classification of the WTB piped utility systems are CQ (CRWMS M&O 1999l, Table 1). The functional and design criteria for the WTB Piped Utility Systems are as identified in the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac, Section 1.3.2).

1.2.2.1 Potable Water

1.2.2.1.1 Functional Description

The function of the potable water distribution piping is to supply potable water from the site potable water supply system to those end-users within the WTB (e.g., lunchrooms, restrooms, safety showers).

1.2.2.1.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1.1)

Potable water service is provided to the WTB and piped as necessary for consumption under the following criteria, as identified in *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.1):

- Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6.
- The potable water system shall be designed and installed to comply with Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

1.2.2.1.3 System Description

Cold potable water is provided to the WTB from the central potable water system. The cold potable water is distributed to the men's and women's change rooms, operations lunchroom, men's and women's restrooms, lunchroom, janitor closets, and drinking fountains. (CRWMS M&O 1998n, Section 7.3.1.1)

Cold potable water is routed to an electric water heater. The hot water tank is stamped in accordance with ASME Section IV and includes pressure and temperature relief valve. The hot water system includes a pressurized diaphragm hot water expansion tank, temperature gauge and low water cutout. Hot potable water is distributed to the same areas as the cold potable water, excluding the drinking fountains. The hot water system includes recirculation to ensure hot water will be continuously available at all hot water fixtures. (CRWMS M&O 1998n, Section 7.3.1.1)

1.2.2.1.4 Operational Description

Water is available at outlets through the opening of local manual valves.

1.2.2.2 Sanitary Sewer

1.2.2.2.1 Functional Description

The function of the WTB sanitary sewer system is to collect and transfer sanitary sewage to the MGR site sanitary sewer mains.

1.2.2.2.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1.2)

An environmentally acceptable method for disposal of sanitary wastes is required to support operations within the WTB. The sanitary waste system shall be designed and installed per the criteria identified in Section 4.2.1.3 of the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j):

- The design, construction, and operation of sanitary sewage handling and disposal systems shall be permitted in accordance with the Clean Water Act of 1972, as amended (CWA), 33 USC 1251 et. seq. Section 1345, and applicable State laws.

1.2.2.2.3 System Description

The sanitary sewer lines are consolidated and gravity drained to the existing site sanitary sewer system. Sanitary sewage from the operations lunchroom, janitor closets, men's and women's restrooms, lunchroom, outside air intake rooms, and the drinking fountains is drained and connected to a sanitary vent system that extends through the roof of the WTB. Groups of fixtures vent piping are consolidated, where possible, using a central vent stack.

No sanitary sewer will be provided at eye wash stations, combination safety showers/eye washes, or in the personnel decontamination room decontamination shower. This provides isolation of the sanitary sewer lines from these potentially contaminated areas. Liquids from these systems will be collected locally, sampled, and analyzed, and then the liquids disposed of appropriately. (CRWMS M&O 1998n, 7.3.1.2)

1.2.2.2.4 Operational Description

The sanitary sewer system is gravity drained. Clean-outs are provided per UPC guidance for maintenance purposes.

1.2.2.3 Safety Shower Water

1.2.2.3.1 Functional Description

The function of the Safety Shower Water piping system is to provide potable water for safety showers and eye wash stations within the WTB.

1.2.2.3.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1.3)

Potable water service is provided to the WTB and piped as necessary for consumption under the following criteria (CRWMS M&O 1998j, Section 4.2.1.1):

- Where the possibility exists for the eyes or body of any person to be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the immediate work area for emergency use.

1.2.2.3.3 System Description

A copper water line is extended from the cold potable water supply. The line is tied into the cold sanitary water supply line upstream of the main building shut-off valve. The safety shower water system has a locked open isolation valve and reduced-pressure principle backflow prevention device installed at the branch connection. Safety shower water is extended to an eye wash station at each laboratory, a combination safety shower/eye wash station located in the corridor between the laboratories, in the solid LLW area, in the non-recyclable liquid LLW area, in the recyclable liquid LLW area, and the mixed and hazardous waste staging area. The combination safety shower/eye wash stations are identified with a highly visible sign and will be well lighted. Eye washes and safety showers comply with ANSI Z358.1 for flow, pressure, installation, and testing requirements. (CRWMS M&O 1998n, 7.3.1.3)

1.2.2.3.4 Operational Description

Water to safety showers and eyewashes is hard piped. Valves are locked in the open position. Maintenance activities are administratively controlled under lock and tag procedures.

1.2.2.4 De-Ionized Water

1.2.2.4.1 Functional Description

The function of the de-ionized water distribution piping is to provide de-ionized water to those end-users within the WTB.

1.2.2.4.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.2)

1.2.2.4.3 System Description

De-ionized water is supplied from the site de-ionized water system to points of consumption within the WTB. The site de-ionized water system is connected to back-up power to ensure water availability in the event of a power outage. (CRWMS M&O 1998j, 7.1.6.2)

1.2.2.4.4 Operational Description

De-ionized water is hard piped to points of consumption. Water flow for manual decontamination activities is controlled with manual valves. Maintenance activities are administratively controlled under lock and tag procedures for those valves normally locked open.

1.2.2.5 Recycled Water

1.2.2.5.1 Functional Description

The function of the Recycled Water Distribution System will be to provide recycled water for selected decontamination activities within the WTB. (CRWMS M&O 1999t, p. 36)

1.2.2.5.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3)

1.2.2.5.3 System Description

Recycled water is distributed within radiological controlled areas within the WTB for utilization in decontamination activities.

1.2.2.5.4 Operational Description

Recycled water is hard piped to points of consumption. Water flow for manual decontamination activities is controlled with manual valves. Maintenance activities are administratively controlled under lock and tag procedures for those valves normally locked open.

1.2.2.6 Softened Utility Water

1.2.2.6.1 Functional Description

The function of the Softened Utility Water Distribution System is to provide utility water for activities such as facility cleaning in non-radiological controlled areas of the WTB.

1.2.2.6.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1)

1.2.2.6.3 System Description

Utility water is distributed from the main softened utility water supply system to those areas within the WTB where this water is utilized for facility wash down and housekeeping. (CRWMS M&O 1998j, 7.1.5)

1.2.2.6.4 Operational Description

Flow of water at points of consumption is controlled with manual valves.

1.2.2.7 Breathing Air

1.2.2.7.1 Functional Description

The function of the Breathing Air Distribution System is to provide breathing air through hose connections in the WTB for the purposes of allowing personnel access into the cell areas for the performance of non-routine maintenance and/or to correct off-normal occurrences.

1.2.2.7.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1.6)

Breathing air is provided through hose connections in the WTB for the purposes of allowing personnel access into the process areas for the performance of non-routine maintenance and/or to correct off-normal occurrences. The breathing air system is designed per the requirements of ANSI Z88.2-92, *Practices for Respiratory Protection;* 29 CFR 1910 (OSHA), *Selected General Industry Safety and Health Standards;* and Compressed Gas Association (CGA), ANSI/CGA G-7.1-1966, *Commodity Specifications for Air.* The provided air quality is per the requirements of ANSI/CGA G-7.1. (paragraph from CRWMS M&O 1998j, Section 4.4)

Section 4.2.2 of the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j) identified the following criteria for breathing air systems:

- When it is not practicable to apply process or other engineering controls in restricted areas to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the repository shall, consistent with maintaining the total EDE ALARA, have the capability to increase monitoring and limit intakes by one or more of the following: control of access, limitation of exposure times, use of respiratory protection equipment, and other controls.

- Each utility service system (i.e., fire protection water, potable water for safety showers and eye washes, and breathing air) that is ITS shall be designed so that essential safety functions can be performed under both normal and accident conditions.

1.2.2.7.3 System Description

Breathing air is piped from the site breathing air system to points of consumption within the WTB. Each branch line will end at a breathing air station consisting of a pressure regulator, a filter, pressure gauge, and quick-disconnect check-valve units for air hose connection. The breathing air quick-disconnect check-valves are not compatible with any other quick disconnects used within the WTB. The breathing air system complies with ANSI Z88.2 and 29 CFR 1910.134 for air quality, maintenance, testing, and training programs. (paragraph from CRWMS M&O 1998n, Section 7.3.1.6)

1.2.2.7.4 Operational Description

Breathing air service is controlled with manual valves locked in the open position. Maintenance activities are performed under administrative control using lock and tag procedures.

1.2.2.8 Instrument and Shop Air

1.2.2.8.1 Functional Description

The function of the Compressed Instrument and Shop Air Distribution System is to provide compressed air for I&C functions and actuators within the WTB. Compressed air is also required for use with pneumatic tools used in maintenance operations.

1.2.2.8.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.3.1.5)

1.2.2.8.3 System Description

Instrument and shop air is provided by the site instrument and shop air system and piped to required locations within the WTB. A back-up air compressor with a refrigerated air dryer, pre-filter, and final filter is installed to provide compressed air if the site compressed air system fails or is high use. Compressed air is provided to each cask preparation area room, each laboratory, forklift staging and servicing area, and the maintenance shop room. Air from this system also provides instrument air for pneumatic control systems. The instrument air supply includes a refrigerated air dryer, pre-filter, and final filter. (CRWMS M&O 1998n, Section 7.3.1.5)

1.2.2.8.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities. Switchover to the backup compressor is a manual operation.

1.2.2.9 Chilled Water and Heating Water

1.2.2.9.1 Functional Description

The function of the CHW and HW supply and return piping is to provide heating and cooling to the building HVAC system for temperature control.

1.2.2.9.2 Design Parameters

Utility services will be extended to the WTB from the MGR Site Utility System.

1.2.2.9.3 System Description

The CHW, HW, and potable water systems will be piped inside the building and distributed to the HVAC equipment rooms. (CRWMS M&O 1998j, par 7.1.2.3.C and 7.1.2.4B)

1.2.2.9.4 Operational Description

A temperature controller/sensor located in the main supply air plenum will maintain a design supply air temperature setting by modulating the flow of the CHW to the cooling coil through the

associated CHW control valve or the flow of the HW to the heating coil through the associated HW control valve.

Individual temperature controllers will be located in various rooms to maintain the design room temperature settings. The room temperatures will be maintained by modulating the HW flow to the reheat coils through the associated control valves.

Auditory and visual alarms are provided to alert personnel to conditions that have the potential to cause injury or death, result in equipment damage, or affect system performance.

1.2.3 Waste Treatment Building Fire Protection System

1.2.3.1 Functional Description

The WTB Fire Protection System is classified as CQ in accordance with *Classification of the MGR Waste Treatment Building System* (CRWMS M&O 1999l, Section 7.1).

The following descriptions are from the *Waste Treatment and Carrier Prep Buildings Fire Hazards Technical Report* (CRWMS M&O 1999z).

The process areas are used for the solid waste processing, chemical liquid LLW processing and recyclable liquid LLW processing. These are Group B or H-7 occupancies as defined by the UBC (ICBO 1997, Chapter 3). The fire hazards in these areas are low to moderate and are classified as an "Ordinary Hazard Group 1" occupancy by NFPA 13 (Section 1-4.7). All areas have been classified as Industrial occupancies per NFPA 101 (Section 4.1). (CRWMS M&O 1999z. Section 8.2.4)

The operations and office areas are used for staging, health physics, offices, and electrical and HVAC equipment rooms. The rooms are classified as B occupancies (Chapter 3). The fire hazards in these rooms are low to moderate and are classified as a "Light" or "Ordinary Hazard Group 1" occupancies (NFPA 13, 1999, Section 1-4.7).

All areas have been classified as Industrial occupancies per NFPA 101 (Section 4-1). (CRWMS M&O 1999z. Section 8.2.4)

1.2.3.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.2.3.2.1 Parameters

This analysis assumes that the system design, architecture, and functions are established by the *Waste Treatment Building System Description Document* (CRWMS M&O 2000ac).

1.2.3.2.2 Assumptions

None

1.2.3.3 System Description

A fire alarm system shall be provided in the WTB and include manual pull stations and detection equipment for monitoring sprinkler systems. (CRWMS M&O 1998j, Section 4.2.1.2.6) Automatic sprinklers shall be provided throughout the WTB. The fire water system shall be adequate to meet the sprinkler and hose stream demands (flow and pressure) for any fire expected in these facilities for a period of two hours. The Repository is to be designed and constructed to achieve the improved risk objectives prescribed by DOE. (CRWMS M&O 1998j, Section 4.2.1.2.7) The DOE requirements are based on the fire insurance "improved risk" level of protection. The improved risk level of protection requires the Maximum Possible Fire Loss (MPFL) be used to determine the extent of fire protection required at the facility. (CRWMS M&O 1998j, Section 4.2.1.2.7) A fire alarm system shall be installed in the WTB to warn occupants of a fire, to activate the automatic fire protection systems, and to alert the fire response personnel. (CRWMS M&O 1998j, Section 4.2.34)

1.2.3.4 Operational Description

The fire alarm systems in the WTB will sound in the building and be transmitted to the fire station by a radio system or over dedicated telecommunications copper-based loops. Suppression includes the fire fighters and response equipment that respond to detected fires. (CRWMS M&O 1998l)

The site fire alarm annunciation and monitoring system shall receive automatic fire detection and suppressions signals from the WTB. (CRWMS M&O 1998l, Section 7.2)

1.2.4 Waste Treatment Building Electrical System

1.2.4.1 Waste Treatment Building Functional Description

The WTB Electrical System performs the function of receiving, distributing, transforming, monitoring, and controlling AC and DC power to all WTB electrical loads. The system also provides lighting, grounding, and lightning protection for the WTB. (CRWMS M&O 2000ac, Section 1.1.11 and 1.2.1.9)

1.2.4.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.2.4.3 System Description

The WTB electrical power system is classified as CQ. (CRWMS M&O 1999l, Section 7.1) Electrical power is distributed to the WTB from the WHB. The output of transformer of the WHB feeds the WTB 480 V load centers. Breakers in the load centers feed MCCs located throughout the WTB which will supply the electrical loads in the area where the MCCs are located. (CRWMS M&O 1998n, Section 7.3.4)

A ground grid is provided under the WTB as appropriate for the site soil resistivity. The ground system is interconnected to the ground systems for other buildings, as well as to the switchyard

substation ground. All major electrical equipment, including the power panel boards, lighting panel boards, and motors are connected to the building ground mat. A separate instrument ground is provided for the control system equipment, which is tied to the building ground mat. Lightning protection is also provided. (CRWMS M&O 1998n, Section 7.3.4)

The subsystem shall provide general area lighting within and exterior of a building. Lighting levels shall comply with the recommended practices of the Illumination Engineering Society. (CRWMS M&O 2000ac, Section 1.2.6.1.9)

1.2.4.4 Operational Description

The WTB facility and subsystems shall have an operational life of 40 years. (CRWMS M&O 2000ac, Section 1.2.1.13)

1.2.5 Waste Treatment Building Ventilation System

1.2.5.1 Functional Description

The ventilation system provides heating, ventilation, and air conditioning to the potentially contaminated and uncontaminated areas of the WTB. The ventilation system maintains proper environmental conditions for equipment operation as well as for the comfort, health, and safety of the personnel. The ventilation system limits the release of radioactive or other airborne hazardous contaminants in the effluents from the facility for the protection of the environment and the public. The ventilation system minimizes the spread of radioactive and hazardous contaminants by directing the flow of air from uncontaminated areas successively to areas of higher potential for contamination by maintaining control of the negative pressure differential between the areas. The system will be operational to perform its required safety functions during normal and off-normal operating modes. (Assumption 1.2.5.2.2 and CRWMS M&O 2000ad, Section 1.1)

1.2.5.2 Parameters and Assumptions

1.2.5.2.1 Parameters

The rooms' ventilation confinement zoning classification, area occupancy, room air change frequency, calculated air quantities, ventilation system type, and the HVAC equipment description are as listed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.3).

1.2.5.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

The ventilation system design concept and/or design features were developed with the assumption that the ventilation system maintenance will be conducted using a preventative maintenance approach. Since the WTB ventilation system operates continually, the system will

be provided with enough redundancy so that maintenance can be performed without shutting the system down.

Basis: *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.2.2.1)

Used in: Section 1.2.5.1

1.2.5.3 System Description

The ventilation for the WTB includes the ventilation system serving potentially contaminated areas designated as contamination confinement zone and a ventilation system serving the uncontaminated areas designated as non-contaminated zone. This facility is considered an LLW treatment facility; therefore, it is only provided with one contamination confinement ventilation zone. The process areas, handling equipment operations area, handling equipment access area, and the mechanical equipment room that houses the contamination confinement HVAC equipment are considered to have high potential for low-level contamination. The rest of the WTB includes administration areas with no potential for contamination. (CRWMS M&O 2000ad, Section 1.2.1.4, Table 4) Example of the ventilation system is depicted in the WTB-HVAC Flow Diagram, Figure I-27, Attachment I, this document.

The ventilation system is housed in designated equipment rooms and configured so that the supply air (outside air) side equipment is located on one side of the building while the exhaust air is on the opposite side. Equipment room for the non-confinement area is located so that recycling of any exhaust air is prevented. The size of the HVAC equipment rooms allows sufficient space for the largest equipment plus space required for utilities, and space to perform required maintenance as shown in *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.3).

The rooms' ventilation confinement zoning classification, area occupancy, room air change frequency, calculated air quantities, ventilation system type, and the HVAC equipment description are as listed in the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Section 6.3.3.)

The indoor and outdoor design conditions are as described in the *Waste Treatment Building Ventilation System Description Document* (CRWMS M&O 2000ad, Section 1.2.1, Tables 1, 2, and 3).

1.2.5.3.1 Confinement Ventilation System

The ventilation system, in conjunction with physical barriers, includes the confinement system for the WTB. Effective confinement control is accomplished by properly compartmentalizing the facility into required confinement zones based on the level of potential for airborne radioactive contamination. The spread of contamination within the facility is minimized by directing the flow of air from uncontaminated areas to areas with successively higher potential for contamination by maintaining control of the negative pressure differential between the areas

(CRWMS M&O 2000ad, Section 1.2.1.4, Table 4). The Confinement Ventilation Zones are depicted in Figures I-23 and I-24.

The ventilation system serving the potentially contaminated zone (Operations Areas) is completely separate and independent from the ventilation system serving the areas with no potential for contamination (administration areas) (CRWMS M&O 2000ad, Section 1.2.1.9).

The ventilation system for the potentially contaminated areas is designed to provide once-through airflow (CRWMS M&O 2000ad, Section 1.2.1.6).

The ventilation system includes several operating supplies and exhaust equipment configured so that when any one component fails or is shut down for maintenance, the remaining components can still provide the required function. This arrangement or configuration provides a higher degree of system reliability. (CRWMS M&O 2000ad, Section 1.2.1)

The supply subsystem includes several air-handling units, supply fans, and supply ductwork distribution system. Each air-handling unit consists of pre-filter, final filters, heating coils, cooling coils, and humidifier (if needed). (CRWMS M&O 2000ad, Sections 1.2.6.4 and 1.2.6.5)

The exhaust subsystem includes several HEPA filtration units, exhaust fans, exhaust ductwork distribution system, and exhaust stack. Each HEPA filtration unit consists of pre-filter (moisture eliminator) and HEPA filters. (CRWMS M&O 2000ad, Sections 1.2.6.4 and 1.2.6.5)

The ventilation system provides suitable air volumes for the effective removal of noxious odors, hazardous gases, vapors, fumes, dust, and for the provision of fresh air for the health and safety of the operating personnel. (CRWMS M&O 2000ad, Sections 1.2.1.5 and 1.2.2.2.2)

The ventilation system for the potentially contaminated areas is provided with air cleaning units equipped with 90 percent (minimum) pre-filters and at least one stage of 99.97 percent HEPA filters in series. The number of required stages of HEPA filtration necessary for the removal of airborne radioactive contaminants to meet the quantity and concentration that may be released to the environment is to be determined by safety analysis. In the absence of such analysis, a two-stage HEPA filtration system is provided. (CRWMS M&O 2000ad, Sections 1.2.6.4, 1.2.6.5. amd 1.2.1.11)

The filtered exhaust air is discharged to the environment through a stack of sufficient height to allow adequate dispersion. Effluent air from the potentially contaminated areas is continuously monitored for radioactive contamination at the discharge stack, prior to being exhausted to the outside environment during normal and off-normal conditions. (CRWMS M&O 2000ad, Sections 1.2.1.8, 1.2.1.14, and 1.2.4.3)

The ventilation system serving the potentially contaminated areas is classified as QL-2. (CRWMS M&O 2000ad, Appendix B, Table 9)

1.2.5.3.2 Non-Confinement Ventilation System

The ventilation system serving the areas with no potential for contamination is classified as CQ. (CRWMS M&O 2000ad, Appendix B, Table 9)

The ventilation system utilizes appropriate conventional HVAC systems as recommended in the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) handbooks and standards that are widely accepted in the industry. (CRWMS M&O 2000ad, Section 1.2.6.9)

The ventilation system is designed to provide no less than the minimum quantity of outside air required for the safety and health of the personnel in the normally occupied areas. (CRWMS M&O 2000ad, Section 1.2.1.5).

The ventilation system provides suitable air volumes for the effective removal of noxious odors, hazardous gases, vapors, fumes, dust, and for the provision of fresh air for the health and safety of the operating personnel. (CRWMS M&O 2000ad, Sections 1.2.1.5 and 1.2.2.2.2)

1.2.5.4 Operational Description

1.2.5.4.1 Confinement Ventilation System

Outside air will be introduced into the potentially contaminated area ventilation system through a special-designed wall intake structure to withstand the effects of high winds, rain, tornado, snow, wind-blown dust and sand, and debris. The intake ductwork system will be provided with air dampers for isolation, volume control, tornado protection (if required), and bird screens. The air-handling unit filters and conditions the air before distribution to the rooms through mechanical fans and associated ductwork. The supply to each room will be provided with a pressure control damper for pressure control.

The potentially contaminated room exhaust air will be picked up at strategic locations for efficient removal of any potential airborne contaminants. The exhaust system is provided with HEPA filters, exhaust fans, pressure control dampers, isolation dampers, tornado dampers, and an exhaust stack.

Pressure differential will be provided between the potentially contaminated areas and the areas with no potential for contamination to maintain an airflow pattern from areas of no potential for contamination to areas of higher potential for contamination.

The exhaust stack, at least 12 ft higher than the WTB and adjacent structure, is provided with a continuous air emission monitoring system. The stack is designed to withstand maximum predicted wind loads and including DBEs it is required to withstand. (CRWMS M&O 2000ad, Section 1.2.1.8)

The monitoring and control of the ventilation system operations is provided with audible and/or visual alarms for off-normal conditions and equipment failures. The system shall interface with the MGR Operations Monitoring and Control System and with the SRM. (CRWMS M&O 2000ad, Sections 1.2.1.14, 1.2.1.15, 1.2.2.2.3, and 1.2.4)

The cooling and heating function is accomplished by the site utility chilled and HW system through their associated modulating control valves. (CRWMS M&O 2000ad, Section 1.2.4.1)

1.2.5.4.2 Non-Confinement Ventilation System

Outside air will be introduced into the ventilation system through an outside air intake structure and mixed with the recycled air. The air-handling unit filters, conditions, and supplies the mixed air to each thermal zone. The room thermal conditions will be achieved with terminal reheat coils and controlled by local thermostats. Exhaust air from the areas with no potential for contamination will be discharged to the outside environment by exhaust fans and associated ductwork.

The ventilation system is designed to have the capability to filter adverse elements present in the outside air to minimize their introduction into the occupied areas for the protection of the health of the occupants. (CRWMS M&O 2000ad, Section 1.2.2.2.2)

The cooling and heating function is accomplished by the site utility CHW and HW system through their associated modulating control valves. (CRWMS M&O 2000ad, Section 1.2.4.1)

Auditory and visual alarms are provided to alert personnel to conditions that have the potential to result in equipment damage, or affect system performance. (CRWMS M&O 2000ad, Section 1.2.2.2.3)

1.2.6 Waste Treatment Building Radiological Monitoring System

1.2.6.1 Functional Description

The WTB radiological monitoring system, when designed, monitors, displays, annunciates, and reports on the radioactivity levels in the WTB, including the building ventilation exhaust. The WTB Radiological Monitoring System, which is part of the SRM, consists of the 1) Area Radiation Monitoring System, 2) Continuous Air Monitoring System, and 3) WTB Exhaust Stack Radiation Monitoring, and has a QA classification of QL-3. (CRWMS M&O 1999l, Table 1)

1.2.6.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.2.6.3 System Description

The system consists of area radiation and continuous air monitors and functions to maintain MGR operator radiation doses ALARA. Exhaust stack monitors are provided to monitor and alarm radiological releases in the WTB ventilation exhaust. (CRWMS M&O 1999l, Section 5.1) The monitors operate independently and communicate with the WHB central monitor and control system. The range of these monitoring systems are specified to assure that the instruments are on scale during both normal operations at the low end of the expected radiation levels, and during potential off-normal occurrences at the high end. This ensures that personnel may safely occupy these areas for the planned duration of their work activities, and that potential offsite releases are within acceptable limits. Exceeded limits are alarmed, and the sensitivity and reaction time of the system is adequate to protect personnel. The system and individual

instruments perform self-tests on their operating status and support calibration, plus record the results and report anomalies and failures.

1.2.6.4 Operational Description

This section to be completed during the License Application design phase.

1.2.6.5 Waste Treatment Building – Dose Assessment

This section to be completed during the License Application design phase.

1.3 CARRIER PREPARATION BUILDING

The CPB houses the CPB Materials Handling System, which is required to prepare incoming carrier/cask configurations for unloading at the WHB and offsite shipment. The facility includes the utility, support, and safety systems required for supporting carrier/cask operations and protecting personnel.

1.3.1 Carrier Preparation Building Architecture and Structure

1.3.1.1 Functional Description

The CPB System facilitates the preparation of a waste transportation cask for entering the waste handling facilities or for leaving the repository. This system is located on the surface at the North Portal Pad and will house the equipment and support systems required for receipt/dispatch of transportation casks, removal/installation of personnel barriers and impact limiters, inspection of transportation casks, and staging carriers awaiting transfer to other repository facilities or off site. This system must provide the building structure, physical space, and several subsystems, including electrical power distribution, industrial grade HVAC, fire protection and detection, and piped utilities (CRWMS M&O 1998a, Summary).

The CPB System must provide adequate area for transportation cask preparation and staging activities. This system must also provide a structure commensurate with the expected service loads and natural phenomena hazards such as earthquakes, winds, and floods. Due to the nature of the operations to be conducted by the CPB System, radiological confinement features are not required.

The CPB System and subsystems interface with the site provided utilities. The system also interfaces with the CCTS for the road and rail bed that is used to move the casks and carriers over the MGR Site Layout for building siting, site utilities systems, and the carrier preparation facilities for the proper staging of casks to be processed or returned to service.

1.3.1.2 Parameters and Assumptions

1.3.1.2.1 Parameters

There are no parameters used in the building system description.

1.3.1.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

The sizing of the support areas in the CPB is assumed based on the following:

a. There are nine process individuals (inspectors, operators, handlers/riggers, and supervisor) who prepare the carriers for cask removal at the WHB and for return.

b. These individuals report directly to the facility every day (Shift 1, the largest shift) and utilize the change rooms.

c. Another eight or nine support staff individuals visit the facility intermittently on various tasks during the day.

d. Continuous activity is expected in the primary area and process personnel will eat in two shifts.

e. The lunchroom is sized for nine individuals.

Basis: *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e, Section 4.3.3.32)

Used in: Section 1.3.1.3.1

1.3.1.3 System Description

1.3.1.3.1 Carrier Preparation Building Architecture

Descriptions in this section are from the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e, Section 7.4).

Waste transportation casks arrive at the site by truck or railroad car. After initial inspection at the gate and temporary delay in the staging area, the CPB receives both means of transport as the cask and carrier are prepared to proceed to the WHB, where the cask is lifted from its carrier en route.

Activities that occur in the CPB for arriving casks and carriers are:

a. Personnel barriers are removed from around the transportation cask.
b. Cask and carrier are subjected to a radiological survey for contamination.
c. Impact limiters are removed or retracted.
d. Cask and carrier are staged until the WHB can accommodate the new arrival.

On the return trip, the empty cask and its carrier are prepared for return to their point of origin.

The CPB activities in this case are:

a. Impact limiters are reinstalled.
b. Personnel barriers are replaced.
c. Cask and carrier are staged until they can be returned to the parking area.

Primary Area

The building is designed to accommodate four parallel tracks/roadways for the passage of both truck and rail carrier over the same surface using recessed/sunken tracks. The CPB floor plan and section are shown in Attachment I, Figures I-14 and I-15, this document. All paths accommodate both arriving and departing traffic, depending on current needs. External trackage and roadway allows any necessary shunting.

As explained in the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e, Section 7.4.1), there are four lanes for cask arrival and sufficient queuing space to allow a 20-ft separation between loaded casks awaiting access to the cask handling facility. The largest multi-purpose canister (MPC) with a diameter of 103 in. is the maximum expected cask diameter. The separation between track centerlines must be 20 ft + 1 cask diameter. Thus the track to track centerline separation is 28 ft 7 in. The primary area width is determined by the four roadways, their required separation, and the additional overhang to accommodate the overall span and outside wall rail supports of the two 10-ton bridge cranes, which run the length of the building and service two sets of tracks. These cranes, in turn, each span a 2-ton gantry that services the same tracks down the length of the building. The final contribution to the width is the space between the wall and the nearest track centerline and is 17 ft 9 in. on both sides along the length of the primary area. The recommended building dimensions require a width of 121 ft 3 in., a vertical clearance of 33 ft and a length of 156 ft. This length accommodates two railroad carriers and separates the loaded casks by over 30 ft, cask end to cask end.

Miscellaneous Building Support (CRWMS M&O 1997e, Section 7.4.2)

- **Office**

  This is allotted 16 ft by 11 ft.

- **Restroom**

  A single restroom is provided. Its dimensions are 6 ft by 6 ft.

- **Storage Room**

  The storage room has dimensions of 10 ft by 5 ft.

- **Lunchroom**

  The main area of the CPB is an industrial environment where employees are subject to industrial and radiological hazards. Personnel who have completed assigned tasks or who are

facing an indefinite period of standby, should retire to a habitable environment in which to wait. A lunchroom is a practical solution that also serves as a break area.

The sizing of the lunchroom is based upon Assumption 1.3.1.2.2, and will seat nine individuals. This is sufficient for the assigned staff of nine individuals, who will usually eat in two shifts, and for other visiting support staff who might elect to eat at the CPB on a given day.

The lunchroom is provided for minimal food preparation and storage and eating. Food preparation includes heating of precooked items. Food storage includes refrigeration. The room minimum ceiling height is 9 ft. Required minimal floor area is 235 sq ft based on Assumption 1.3.1.2.2 and the following:

- Total staff:
  maximum seating - 9 persons

- Basis:
  seating - 15 sq ft per person
  food preparation - 10 linear ft casework with 10 sq ft per linear ft for casework and work area
  1 refrigerator
  1 microwave
  1 range
  1 sink
  10 linear ft of preparation area

- Total area required:
  seating area - 9 persons x 15 sq ft/person = 135 sq ft
  food preparation - 10 linear ft x 10 sq ft per linear foot = 100 sq ft

- Total area = 135 sq ft + 100 sq ft = 235 sq ft

<u>Change Room</u>

Change rooms with associated showers are provided for both male and female operational employees to change into worker coveralls. The change rooms are directly accessible from the preparation area, adjacent to the restroom and lunchroom.

For sizing purposes, the change rooms and shower facilities are designed to allow for 5 women (50 percent usage) and 9 men (100 percent usage). (CRWMS M&O 1997e, Section 7.4.2.5)

The calculation of size is based on:

	Male Facilities	Female Facilities
Users	9 persons	5 persons
Number of lockers	9	5
Change area (incl. locker)	16 sq ft/person	16 sq ft/person

Shower area	9 sq ft/person	9 sq ft/person
Number of showers	1	1

- Total area required:
  - Men's change room
    - change area - 9 workers x 16 sq ft/worker = 144 sq ft
    - shower area - 1 shower x 9 sq ft/shower = 9 sq ft
  - Total men's change room floor area:
    144 sq ft + 9 sq ft = 153 sq ft
  - Women's change room
    - change area - 5 workers x 16 sq ft/worker = 80 sq ft
    - shower area - 1 showers x 9 sq ft/shower = 9 sq ft
  - Total women's change room floor area:
    80 sq ft + 9 sq ft = 89 sq ft
- Total area men and women = 153 sq ft + 89 sq ft = 242 sq ft

1.3.1.3.2 Carrier Preparation Building Structure

The CPB building structure consists of steel framing with insulated metal siding and roofing. The two 10-ton bridge cranes are supported by the building columns. As the building weight loading is relatively light, it is recommended that reinforced concrete spread footings be used as column supports. It is also recommended that continuous concrete mat foundations be employed beneath the railroad tracks to support the heavy wheel loads. These should also be adequate to support the loads imposed by the 2-ton gantry cranes. Building column footings are separated from the mat foundations under the railroad tracks to isolate the structure from vibrations associated with carrier movement in the facility. (CRWMS M&O 1997e, Section 7.4.4)

Facility Program Area Summary

Table II-3 summarizes the minimum floor areas and ceiling heights for the CPB program spaces. Adjacency relationships between individual spaces and areas, if required for efficient function, are described in the individual sections above. Minimum floor areas indicated are net square footage areas and do not include allowances for building structure (i.e., walls, columns) in determining gross square footage.

Based on the building areas indicated in the table, the minimum required floor area for the CPB (excluding structure) is 19,639 sq ft.

Table II-3. Carrier Preparation Building Facility Program Area Summary

Facility Areas/Spaces	Floor Area (sq ft)				Space Height (ft)
	Sub Space	Space	Sub Area	Area	
PRIMARY AREA					
Total Primary Area				18,900	
MISCELLANEOUS BUILDING SUPPORT					
Office		176			9
Restroom		36			9
Storage Room		50			9
Lunchroom		235			9
Change Room		242			9
Total Building Support Areas				739	
TOTAL CARRIER PREPARATION BUILDING (Total minimum required floor area, not including building structure.)				**19,639**	

Source: CRWMS M&O 1997e, Table 7.4-1

1.3.1.4 Operational Description

This section to be completed during the License Application design phase.

1.3.2 Carrier Preparation Building Materials Handling System

1.3.2.1 Functional Description

The CPB Materials Handling System receives rail and truck shipping casks from the CCTS, and inspects and prepares the shipping casks for return to the CCTS. Carrier preparation operations for carriers/casks received at the surface repository include performing a radiation survey of the carrier and cask, removing/retracting the personnel barrier, sampling for contamination, measuring the cask temperature, removing/retracting the impact limiters, removing the cask tie-downs (if any), and installing the casks trunnions (if any). The shipping operations for carriers/casks leaving the surface repository include removing the cask trunnions (if any), installing the cask tie-downs (if any), installing the impact limiters, performing a radiation survey of the cask, and installing the personnel barriers.

There are four parallel carrier/cask preparation lines installed in the CPB with two preparation bays in each line, each of which can accommodate carrier/cask shipping and receiving. The lines are operated concurrently to handle the waste shipping throughputs and to allow system maintenance operations. One remotely operated overhead bridge crane and one remotely operated manipulator is provided for each pair of carrier/cask preparation lines, servicing four preparation bays. Remotely operated support equipment includes a manipulator, and tooling and fixtures for removing and installing personnel barriers, impact limiters, cask trunnions, and cask tie-downs. Remote handling equipment is designed to facilitate maintenance, dose reduction, and replacement of interchangeable components where appropriate. Semi-automatic, manual, and backup control methods support normal, abnormal, and recovery operations. Lay-down areas and equipment are included as required for transportation system components (e.g.,

personnel barriers and impact limiters), fixtures, and tooling to support abnormal and recovery operations.

The CPB Materials Handling System interfaces with the CCTS to move the carriers to and from the system. The CPB System houses the equipment, and provides the facility, utility, safety, communications, and auxiliary systems supporting operations and protects personnel. (CRWMS M&O 2000e, Summary)

1.3.2.2 Parameters and Assumptions

1.3.2.2.1 Parameters

This section to be completed during the License Application design phase.

1.3.2.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.3.2.2.2.1 Carrier/cask preparation operations will be performed in a contact operation area using manual and remote handling equipment. Readily available remote/robotic technology in the nuclear industry will be used to assist carrier/cask preparation operations and ensure that radiation exposure rates for manual operation are ALARA.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.1)

Used in: Section 1.3.2.4

1.3.2.2.2.2 The rail cask personnel barrier is retractable and stored on the railcar. The truck cask personnel barrier is tarpaulin-type and is removed manually by personnel. The truck cask personnel barriers are staged in the CPB.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.3)

Used in: Section 1.3.2.4

1.3.2.2.2.3 Rail and truck cask impact limiters are removed/retracted with their bolts retained and are stored on the cask rail car or cask truck trailer. The heaviest cask impact limiter weighs 15,800 lbs (7.9 tons).

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.4)

Used in: Section 1.3.2.4

1.3.2.2.2.4 The annual operating time for the CPB Materials Handling System is 3 shifts per day, 120 hrs per week, and 50 weeks per year (6,000 hrs per year).

Basis: *Repository Waste Handling Integrated Model Development Report* (CRWMS M&O 1998g, Section 4.3.6)

Used in: Section 1.3.2.4

1.3.2.3 System Description

The CPB Materials Handling System receives rail and truck transportation cask carriers from the CCTS, and inspects and prepares the carriers for transportation to the WHB or parking area. Carrier preparation operations for carriers/casks arriving at the MGR include performing a radiation survey, removing or retracting the cask personnel barriers, sampling for contamination, measuring the cask external temperature, removing the cask impact limiters, removing the cask tie downs, and installing the cask trunnions (if required). The operations for carriers/casks leaving the MGR include removing the cask trunnions (if required), installing the tie downs, installing the impact limiters, performing a radiological survey of the cask, and installing the personnel barriers.

The CPB Materials Handling System interfaces with the CCTS to provide adequate clearance for the onsite prime mover. (CRWMS M&O 2000e, Section 1.2.4.4)

1.3.2.4 Operational Description

Operations in the CPB sequentially utilize four equipment items, two bridge cranes, and two gantry-mounted manipulators. Four parallel tracks/roadways, for the passage of both truck and rail carrier, are provided. The two exterior lines are dedicated to incoming carriers and the two interior lines are dedicated to outgoing carriers. Each pair of rail/truck lines is serviced by a bridge crane and gantry-mounted manipulator. (CRWMS M&O 1998g, Section 7.3.2)

Carriers with disposable canister waste forms (DHLW, DSNF, and MPCs) are routed only to one of the incoming lines in the CPB. Commercial fuel carriers can be routed to either incoming line in the building. (CRWMS M&O 1998g, Section 7.3.2)

The CPB receives cask carriers, either from the RCA parking area or the WHB, for carrier preparation operations. The carrier/cask preparation in the CPB is a contact or remote operation using manual and remote equipment (Assumption 1.3.2.2.2.1). When radiation exposure rates exceed the administrative limits for manual operation (based on ALARA analysis), operators will remotely operate the overhead bridge crane or the bridge-mounted manipulator (provided with remote tools) from a safe distance by radio control, a portable control console, or the crane overhead cab. No operating galleries or viewing windows are provided in the CPB for the carrier/cask preparation operations. (CRWMS M&O 2000e, Sections 1.1 and 1.2)

Figure I-16, Attachment I, this document, provides a mechanical flow diagram of the operation of the CPB Materials Handling System. The operational steps in the diagram are described below.

A carrier containing a loaded cask is hauled from the RCA parking area by an SPM to the CPB. The radiation level of the external cask is measured to assess conformance to applicable regulatory requirements. The cask personnel barrier is removed/retracted by the bridge crane. The truck cask carrier personnel barrier is removed and stored on the lay-down area and the rail carrier personnel barrier is retracted and stored on the railcar (Assumption 1.3.2.2.2.2). After removal or retraction of the personnel barrier, the radiation level on the exposed external surfaces of the transportation cask is measured. In order to limit occupational radiation exposure, the radiation measurement may be performed remotely by using a bridge-mounted manipulator holding the radiation monitoring instruments. Temperature measurements of the cask external surface are taken at this time. (CRWMS M&O 2000e, Sections 1.1 and 1.2)

After temperature measurements, the impact limiters are removed. The bridge-mounted manipulator is used to loosen the impact limiter bolts. Before removing the impact limiter bolts, a sling is set in place around the impact limiter and attached to the overhead bridge crane. The sling is raised vertically, being careful to only lift the impact limiter load and not the cask itself. Once the impact limiter load is fully lifted, the bolts are removed and the bridge crane pulls the impact limiter away from the cask and sets it down on the carrier (Assumption 1.3.2.2.2.3). The cask tie downs are then removed, using the bridge-mounted manipulators. The final operation, before transfer to the WHB, is the installation of the transportation cask trunnions, if required. The loaded transportation cask is now ready for transfer to the WHB for unloading. If the WHB is not ready to receive a loaded transportation cask, the carrier may remain in the CPB until the WHB is available. (CRWMS M&O 2000e, Sections 1.1 and 1.2)

Unloaded transportation casks undergo the reverse of the loaded cask operations. When a space is available in the CPB preparation bay, an unloaded cask is transferred from the WHB to the CPB by an SPM. The cask trunnions are removed, if required, the tie downs and impact limiters are reinstalled, the final radiation contamination inspection is performed, the personnel barrier is reinstalled, and the transportation cask carrier is hauled to the RCA parking area to await for offsite transfer. (CRWMS M&O 2000e, Sections 1.1 and 1.2)

To ensure that the CPB Materials Handling System is capable of handling the throughput quantities specified in Section 4.22.2.1 of this document, a waste handling simulation has been performed using the WITNESS computer program (CRWMS M&O 1999aa). The results of the simulation indicate that the CPB Materials Handling System can receive, handle, and prepare waste transportation casks by operating 4,000 hrs annually (Assumption 1.3.2.2.2.4).

1.3.3 Carrier Preparation Building Electrical System

1.3.3.1 Functional Description

The electrical system will provide electrical power distribution to support carrier preparation material handling operations. It will support the CPB system, which facilitates the preparation of a waste transportation cask for entering the waste handling facilities or for leaving the repository. (CRWMS M&O 1998a, Summary and Section 1.1.8)

The CPB electrical system will interface with the site electrical power distribution system. (CRWMS M&O 1998a, 1.3.1.4.1)

1.3.3.2 Parameters and Assumptions

This section to be completed during the License Application design.phase.

1.3.3.3 System Description

The CPB electrical system is classified as CQ (CRWMS M&O 1999a, Table 1); however, backup power will be provided to all electrical loads in the CPB identified by analysis as requiring standby power upon loss of site electrical power. (CRWMS M&O 1999a, Section 7.1) Electrical power will be supplied to the CPB by a pad-mounted transformer located near the CPB. The pad mounted transformer's primary winding is fed from a loop arrangement from North Portal switchgear groups A and B (located in the switchgear building). The electrical power distribution system will provide power to meet all the CPB electrical requirements including the support of the carrier preparation material handling system operation. (CRWMS M&O 1998n, Section 7.4.4)

"A ground grid will be provided under the CPB, as appropriate for the site soil resistivity, to meet the grounding requirements of IEEE 142. The CPB building ground system will be interconnected to the ground systems for other buildings, as well as to the switchyard substation ground. All major electrical equipment, including the power panel boards, lighting panel boards, and motors will be connected to the building ground. All building steel will be grounded to meet the requirements of the above referenced standard. A separate instrument ground will be provided for the control system equipment, which will be tied to the building ground mat. Lightning protection will be provided in accordance with NFPA 780". (CRWMS M&O 1998n, Section 7.4.4)

The system will provide general area lighting within the building and for the exterior of the building. Lighting levels shall comply with the requirements of the recommended practices of the Illumination Engineering Society. (CRWMS M&O 1998a, Section 1.3.1.1.3)

The system will provide lightning protection, including lightning arrestors, static wires, and grounding systems. The system shall be connected to a ground grid around the facility and will be tied to the site ground system. (CRWMS M&O 1998a, Section 1.3.1.1.5)

1.3.3.4 Operational Description

The system will have a life expectancy of not less than 40 years and will be designed and installed to facilitate replacement in order to provide a 40-year maintainable service life. (CRWMS M&O 1998a, Section 1.2.5.1.1)

1.3.4 Carrier Preparation Building Fire Protection System

1.3.4.1 Functional Description

The CPB Fire Protection System is classified as CQ in accordance with *Classification of the MGR Carrier Preparation Building System* (CRWMS M&O 1999a, Section 7.1). The CPB is classified as a "B" occupancy by the UBC and an Industrial occupancy by NFPA 101. (*Waste*

Treatment Building and Carrier Preparation Building Fire Hazards Technical Report, CRWMS M&O 1999z, Section 8.3.4).

1.3.4.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.3.4.3 System Description

A fire alarm system shall be provided in the CPB and include manual pull stations and detection equipment for monitoring sprinkler systems (CRWMS M&O 1998j, Section 4.2.1.2.6). Automatic sprinklers shall be provided throughout the CPB and the fire water system shall be adequate to meet the sprinkler and hose stream demands (flow and pressure) for any fire expected in these facilities for a period of two hours. The Repository is to be designed and constructed to achieve the improved risk objectives prescribed by DOE (CRWMS M&O 1998j, Section 4.2.1.2.7). The DOE requirements are based on the fire insurance "improved risk" level of protection. The improved risk level of protection requires the Maximum Possible Fire Loss (MPFL) be used to determine the extent of fire protection required at the facility. (CRWMS M&O 1998j, Section 4.2.1.2.7)

A fire alarm system shall be installed in the CPB to warn occupants of a fire, to activate the automatic fire protection systems, and to alert the fire response personnel (CRWMS M&O 1998l, Section 4.2.34).

1.3.4.4 Operational Description

The central fire alarm system will monitor the CPB sprinkler systems and the fire detection systems. The fire alarm systems will sound in the building and be transmitted to the fire station by a radio system or over dedicated telecommunications copper-based loops. Suppression includes the fire fighters and response equipment that respond to detected fires. (CRWMS M&O 1998l)

The site fire alarm annunciation and monitoring system shall receive automatic fire detection and suppressions signals from the CPB. (CRWMS M&O 1998l, Section 7.2)

1.3.5 Carrier Preparation Building Ventilation System

1.3.5.1 Functional Description

The CPB will be provided with a ventilation system designed to heat, ventilate, and air condition the operations (high bay) and support areas (low bay) of the CPB. The ventilation system will maintain the proper environmental conditions for equipment operation as well as provide for the comfort, health, and safety of the operating personnel. Operations in the CPB are not expected to result in a breach of the transportation cask, consequently, no contamination confinement function is required by the CPB ventilation system.

1.3.5.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.3.5.3 System Description

The ventilation system for CPB is classified as CQ. (CRWMS M&O 1999a, Section 7.1)

The ventilation system will utilize appropriate conventional HVAC system suitable for a warehouse-type facility.

This section to be completed during the License Application design phase.

1.3.5.4 Operational Description

This section to be completed during the License Application design phase.

1.3.6 Carrier Preparation Building Piped Utility Systems

The CPB requires various piped utility systems to accomplish necessary shipping and receiving functions (CRWMS M&O 1998a, Section 1.3.3). The CPB piped utility system has been classified as CQ (CRWMS M&O 1999a, Section 7.1). The site water system has been classified as CQ (CRWMS M&O 1999g, Table 1). The site compressed air system has been classified as CQ (CRWMS M&O 1999e, Table 1). Design criteria for the CPB piped utility systems are defined in *Carrier Preparation Building System Description Document* (CRWMS M&O 1998a, Section 1.3.3).

1.3.6.1 Potable Water

1.3.6.1.1 Functional Description

The function of the potable water service piping is to provide potable water as necessary for consumption under the following criteria (CRWMS M&O 1998j, Section 4.2.1.1):

- Where the possibility exists for the eyes or body of any person to be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the immediate work area for emergency use.

- Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6.

- The potable water system shall be designed and installed to comply with Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

1.3.6.1.2 Design Parameters

Utility services will be extended to the CPB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.4.1.1)

1.3.6.1.3 System Description

Cold potable water is provided to the CPB from the central potable water system. The cold potable water is distributed through Type L copper tubing to the men's and women's change rooms, lunchroom, restrooms, and drinking fountains. (CRWMS M&O 1998n, Section 7.4.1.1)

Cold potable water is routed to a glass-lined electric hot water heater located in the men's change room. The hot water tank is stamped in accordance with ASME, Section IV and includes a pressure and temperature relief valve. The hot water system includes a pressurized diaphragm hot water expansion tank, temperature gauge, and low water cutout. Hot sanitary water is distributed to the same areas as the cold water except for the drinking fountains. The hot water system includes recirculation to ensure that hot water will be continuously available at all hot water fixtures. (CRWMS M&O 1998n, Section 7.4.1.1)

1.3.6.1.4 Operational Description

Water is available at outlets through the opening of local manual valves.

1.3.6.2 Softened Utility Water

1.3.6.2.1 Functional Description

The function of the softened utility water piping is to provide utility water to the CPB for use in facility cleaning.

1.3.6.2.2 Design Parameters

Utility services will be extended to the CPB from the MGR Site Utility System.

1.3.6.2.3 System Description

Softened utility water is piped to those areas within the CPB requiring facility wash down.

1.3.6.2.4 Operational Description

Softened utility water is available at outlets through the operation of manual valves.

1.3.6.3 Sanitary Sewer

1.3.6.3.1 Functional Description

The function of the sanitary sewer piping and plumbing is to provide for environmentally acceptable disposal of sanitary wastes as required to support operations within the CPB. The

sanitary waste system is designed and installed per the criteria identified in Section 4.2.1.3 of the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j):

- The design, construction, and operation of sanitary sewage handling and disposal systems shall be permitted in accordance with the CWA, 33 USC 1251 et. seq. Section 1345, and applicable State laws.

1.3.6.3.2 Design Parameters

Utility services will be extended to the CPB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.4.1.2)

1.3.6.3.3 System Description

The sanitary sewer lines are consolidated and gravity drained to the site sanitary sewer system. Sanitary sewage from the lunchroom, men's and women's change rooms, restrooms, and the drinking fountains are drained and connected to a sanitary vent system that extends through the roof of the CPB. Groups of fixtures and vent piping are consolidated, where possible, to use a central vent stack. (CRWMS M&O 1998n, Section 7.4.1.2)

1.3.6.3.4 Operational Description

The sanitary sewer system is gravity drained. Clean-outs are provided per UPC guidance for maintenance purposes.

1.3.6.4 Compressed/Instrument Air

1.3.6.4.1 Functional Description

The function of the instrument and shop air piping is to provide required compressed air for certain activities within the CPB. (CRWMS M&O 1998n, Section 7.4.1.3)

1.3.6.4.2 Design Parameters

Utility services will be extended to the CPB from the MGR Site Utility System. (CRWMS M&O 1998n, Section 7.4.1.3)

1.3.6.4.3 System Description

The compressed air line feeding the CPB is extended from the site industrial air system. A backup air compressor with a refrigerated air dryer, pre-filter, and final filter provides compressed air if the site industrial air system fails or is in high use. Compressed air is routed to the manipulators in the CPB. Air from this system also provides instrument air for pneumatic control systems. The instrument air system includes a refrigerated air dryer, pre-filter, and final filter. (CRWMS M&O 1998n, Section 7.4.1.3)

1.3.6.4.4 Operational Description

System connections are hard-piped, with local shut-off valves installed for maintenance activities. Switch-over to the backup compressor is a manual operation.

1.3.6.5 Heating, Ventilation, and Air-Conditioning Heating and Cooling Water

Hot water and CHW services for HVAC are not extended to the CPB due to the remote location of this facility from the central hot and CHW looped systems.

1.3.7 Carrier Preparation Building Radiological Monitoring System

1.3.7.1 Functional Description

The CPB Radiological Monitoring System will monitor, display, annunciate, and report on the radiation and radioactivity levels in the CPB areas, including the building ventilation exhaust. The CPB Radiological Monitoring System, which is part of the SRM, consists of the Area Radiation Monitoring System and the Continuous Air Monitoring System and has a QA classification of QL-3. (CRWMS M&O 1999q, Table 1)

The system provides local and central display of all radiation levels, audible annunciation of unsafe levels and trends, and communication with the building central alarm, Radiation Protection, and ERS. Exhaust air is monitored and alarmed when safe levels are exceeded.

1.3.7.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

1.3.7.3 System Description

The system consists of area radiation and continuous air monitors and functions to maintain MGR operator radiation doses ALARA. The monitors operate independently and communicate with the WHB central monitor and control system (Regulatory Guide 8.8, Rev. 3, 1978). The range of these monitoring systems are specified to assure that the instruments are on scale during both normal operations at the low end of the expected radiation levels, and during potential off-normal occurrences at the high end. This ensures that personnel may safely occupy these areas for the planned duration of their work activities, and that potential offsite releases are within acceptable limits. Exceeded limits are alarmed, and the sensitivity and reaction time of the system is adequate to protect personnel. The system and individual instruments perform self-tests on their operating status, support calibration, and record the results, and report anomalies and failures.

1.3.7.4 Operational Description

This section to be completed during the License Application design phase.

1.3.7.5 Carrier Preparation Building – Radiological Assessment

1.3.7.5.1 Waste Receiving and Carrier/Cask Handling Operation – Dose Assessment Methodology

The Waste Receiving and Carrier/Cask Handling Operations consists of operational steps and task times associated with each waste handling operation from the arrival of a cask at the site boundary to the placement of the cask in the cask preparation area.

The operational sequence for the Waste Receiving and Carrier/Cask Handling Operations is defined in Assumption 4.3.15 of *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y). The average dose per shipment from Table 7-5 of *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y) is 64.98 mrem. This dose per shipment assumes the ALARA Benefit Improvement and Changes listed in Table 7-4 of *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y), and reproduced here in Table II-4, are incorporated into the Waste Receiving and Carrier/Cask Handling Operations. The second column of Table II-4 lists the improvement and changes in the Waste Receiving and Carrier/Cask Handling Operations and the third column of Table II-5 shows the corresponding ALARA benefit.

Table II-4. Waste Handling Operation ALARA Benefit Improvement and Changes

	Improvement and Changes	**ALARA Benefit**
1	Cask Preparation: The cask will be transferred into the pool area on a cart, and then lifted into the cask preparation pit with the pool area bridge crane.	The cask preparation pit limits radiation dose from the cask. Allows semi-remote cask preparation operations on cask lids, ports, canister lids, and ports.
2	Cask Preparation: Flex hoses will be semi-remotely or manually attached to the cask vent and drain ports.	Reduces radiation dose by reducing time for manual operations. Reduces radiation dose by increasing distance for the attachment process.
3	Cask Preparation: Partially Remote equipment will be used to de-tension and remove the lid bolts, attach the lifting fixture, and cask lifting yoke.	Provides distance and shielding between operator and source (cask).
4	Carrier/Cask Preparation: Radiation measurements performed by semi-remotely using a bridge-mounted manipulator.	Semi-remotes required radiation survey. The radiation survey was one of the high radiation dose operations in the previous study.
5	Carrier/Cask Preparation: Temperature measurements performed by semi-remotely using a bridge-mounted manipulator.	Semi-remotes required temperature survey, and provide distance between the operator and the cask.
6	Carrier/Cask Preparation: The impact limiter bolts may be loosened using a bridge-mounted manipulator where possible.	Reduces the time operators are required to be in the area loosening the impact limiter bolts. The use of the bridge-mounted manipulator provides distance between the operator(s) and the cask (source).

	Improvement and Changes	ALARA Benefit
7	Carrier/Cask Handling: Gantry-mounted manipulator is used to semi-remotely assist cask maintenance operations (repair the cask tie-downs and install cask trunnions). Used for semi-remote recovery activities.	Provides distance between operators and source (cask).

1-3 From Meyers 1997.
4 From Assumption 4.33 of CRWMS M&O 1999y.
5 From Assumption 4.34 of CRWMS M&O 1999y.
6 From Assumption 4.35 of CRWMS M&O 1999y.
7 From Section 6.2.1.1 of CRWMS M&O 2000af.

The Waste Receiving and Carrier/Cask Handling Operations – Total Dose from Table 7-6 of *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y) is shown in the column 2 of Table II-5. The TD per unit operation was determined in Section 6.2.3 of *CRWMS Modular Design/Construction and Operation Options Report* (CRWMS M&O 1998c) and is shown in column 3 of Table II-5.

Table II-5. Dose Summary

Operation	Total Dose (mrem/yr)	Total Dose/Unit (mrem/unit)
Cask Receipt and Shipment	40,027.68	64.98

1.4 CARRIER/CASK TRANSPORT SYSTEM

The Carrier/Cask Transport System moves transportation casks and their carriers between the waste entry point of the repository, the cask staging shed, and the waste handling facilities. (CRWMS M&O 2000g, Section 6.1.1) This system is located on the surface at the North Portal Pad.

This system moves rail and truck casks and their carriers in a certain amount of time to support the waste emplacement schedule and return of casks and carriers to service, and handles the size and weight of a carrier with a fully loaded cask. (CRWMS M&O 2000g, Section 6.1.1)

This system interfaces with the transportation segment of the Civilian Radioactive Waste Management System (CRWMS) for the type of cask/carrier delivered to the repository or returned to service. This system interfaces with the MGR Site Layout for the location and arrangement of rail and road beds as well as the parking area that are all a part of the system. This system also interfaces with the Cask Staging Shed and Waste Handling Facilities for the movement of casks/carriers into those structures for subsequent operations. (CRWMS M&O 2000g, Section 6.1.1)

1.4.1 Not Used

1.4.2 Carrier/Cask Rail System

The system will be designed to the requirements of applicable codes and standards in *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.2.4).

1.4.3 Carrier/Cask Road System

The system will be designed to the requirements of applicable codes and standards in *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.2.4).

1.4.4 Site Prime Mover System

The SPM hauls rail and truck carriers containing radioactive waste containers, waste handling equipment, and other heavy materials over the road and rail system inside the RCA. The SPM rail and truck carriers convey transportation casks between the waste entry point at the repository security gate and the surface waste handling facilities. The SPMs also haul carriers with empty DPC overpacks, empty DCs, DC emplacement pallets, emplacement equipment, waste handling equipment, and other heavy loads on the site. (CRWMS M&O 2000g, Section 6.3.1.1)

The track-guided SPM transports rail carriers containing transportation casks between the waste entry point at the repository security gate and the carrier staging (rail yard parking) area. The tire-mounted SPM also transports truck carriers containing transportation casks between the waste entry point at the repository security gate and the carrier staging (truck parking) area. The SPMs also transport rail and truck carriers containing transportation casks between the carrier staging areas and the surface waste handling facilities (CPB and WHB).

The track-guided SPM transports rail carriers containing empty DPC overpacks, empty DCs, and waste handling equipment between the repository security gate and the WHB. The track-guided SPM also transports rail carriers containing emplacement equipment and other heavy loads between the repository security gate and the WP TMB. The track-guided SPM also transports the WP transporter between the repository security gate and the WP TMB. (CRWMS M&O 2000g, Section 6.3.1.1)

The tire-mounted SPM transports truck carriers containing DC emplacement pallets, equipment, and other heavy loads inside the MGR RCA.

1.4.4.1 Design Parameters and Assumptions

To date, there are no parameters or assumptions for the Carrier/Cask Transport Structure, Rail, and Road systems.

1.4.4.2 Prime Mover System Description

The SPMs are vehicles used for hauling the rail or truck carriers inside the RCA (Assumption 1.4.4.2.2.1). Figure I-10, Attachment I, this document, provides a sketch of the track-guided

SPM for hauling rail carriers. The track-guided SPM hauls rail carriers over the repository RCA site rail system. Three rail SPMs are used in the RCA (Assumption 1.4.4.2.2.5).

Figure I-9, Attachment I, this document, provides a sketch of the tire-mounted SPM for hauling truck carriers. The tire-mounted SPM hauls truck carriers over the RCA road system. Three truck SPMs are used in the RCA (Assumption 1.4.4.2.2.5). Heavy-haul transports (HHTs) cannot be accommodated with the current design of the waste handling facilities (Assumption 1.4.4.2.2.6).

Figure I-17, Attachment I, this document, provides a block diagram for the flow of truck and rail carriers inside the MGR RCA. The diagram was developed based on the waste handling system operations (Parameter 1.4.4.2.1.1). The operations have been simulated to demonstrate that the system performs adequately, and that maximum carrier receipt rates can be accommodated (Parameter 1.4.4.2.1.2). The SPMs leave the RCA to haul a truck or rail carrier onto the site and through the MGR security gate (Assumption 1.4.4.2.2.3). The rail SPM transports cask carriers to the rail yard parking, to the CPB and to the Carrier Bay of the WHB. Once the cask waste is unloaded, the empty casks are returned in the reverse order to the MGR security gate for offsite shipment. The rail SPM also transports carriers containing empty DCs from the MGR security gate to the DCHS of the WHB.

The truck SPM transports cask carriers to the truck parking area, to the CPB, and to the Carrier Bay of the WHB. Once the cask waste is unloaded, the empty casks are returned in the reverse order to the MGR security gate for offsite shipment. The truck SPM transports carriers containing DPC overpacks from the WHB through the MGR security gate for offsite shipment and disposal. The truck SPM also transports carriers containing DC emplacement pallets, equipment, and other heavy loads from the MGR security gate to the TMB and the WHB.

The track-guided SPM is capable of conversion from steered to rail-track-guided motion (Assumption 1.4.4.2.2.2). The vehicle is equipped with a diesel engine and torque converter transmission. The operator controls the motion and movement of the SPM, including coupling to a rail carrier from the inside of a cab.

The tire-mounted SPM is a LWT tractor with rubber-tired wheels for hauling the truck carriers on the roadway. The SPM for truck carriers is a commercially available vehicle. The vehicle is powered with a diesel engine and equipped with a fifth-wheel disk, and a weatherproof driver cab (Assumption 1.4.4.2.2.2). The overall configuration and dimensions of the SPMs are based on manufacturer information for commercially available vehicles (Assumption 1.4.4.2.2.4).

1.4.4.2.1 Prime Mover Parameters

1.4.4.2.1.1 The SPM operations are depicted in the overview of the Repository Surface Design mechanical flow diagrams. (CRWMS M&O 1997c)

1.4.4.2.1.2 The throughput performance of the CCTS is defined in the *Repository Waste Handling Integrated Model Development Report.* (CRWMS M&O 1998g, Section 4.3.11)

1.4.4.2.2 Prime Mover Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

1.4.4.2.2.1 Rail and truck carriers are moved within the MGR RCA by an SPM.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.5)

Used in: Section 1.4.4.2

1.4.4.2.2.2 The track-guided SPM for rail carriers is a diesel-powered vehicle with truck tires and retractable rail-gage guides. The tire-mounted SPM for truck carriers is a diesel tractor with a fifth-wheel disk similar to LWT tractors used for hauling truck casks to the MGR site.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.5)

Used in: Section 1.4.4.2

1.4.4.2.2.3 All arriving cask and DC carriers are queued outside of the security gate (MGR Security Station 3). Offsite prime movers (OPMs) (truck tractors or rail locomotives) will not enter the RCA. SPMs will exit the RCA, engage the carriers for entry and inspection, and transport the carriers into the RCA through Security Station 3.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.6)

Used in: Sections 1.4.4.2 and 1.4.4.3.1

1.4.4.2.2.4 The maximum capacities and dimensional envelopes for the truck and rail SPMs and carriers were developed using industry information, manufacturers data, and previous experience with DOE and commercial nuclear facilities design of similar equipment for cask handling systems.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 5.9)

Used in: Section 1.4.4.2

1.4.4.2.2.5 It is assumed that two rail carrier SPMs and two truck carrier SPMs are required for operation at all times. One additional rail SPM and one additional truck carrier SPM are added for backup service.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 6.3.1.1)

Used in: Section 1.4.4.2

1.4.4.2.2.6 The current CCTS design does not include capability for receipt, transport, handling, and unloading of HHTs. If HHTs are used, an inter-modal transfer system must be constructed near the MGR site to transfer the cask from the HHT to an onsite rail carrier prior to entering the waste handling facilities.

Basis: *Carrier/Cask Preparation & Transportation Systems Input to Support Site Recommendation Phase* (CRWMS M&O 2000g, Section 4.2.1)

Used in: Section 1.4.4.2

1.4.4.3 Prime Mover Operational Description

1.4.4.3.1 Loaded Cask Operations

Rail or truck carriers, containing loaded transportation casks, are delivered by an OPM to a receiving/queuing area near the MGR security gate by diesel locomotive or truck tractor. The carrier is hauled by an SPM into the repository RCA and inspected as it passes through the security gate (Assumption 1.4.4.2.2.3). The carriers are then parked in either the rail yard or truck parking areas within the RCA (Attachment I, Figure I-18, this document). The OPM waits outside of the gate for a return shipment.

When required, an SPM transfers the cask carrier from the RCA parking areas to the CPB for carrier preparation operations. If the WHB is not ready to receive a cask, the cask carrier will remain in the CPB staging area. When the WHB is ready to receive a cask, the prepared carrier is hauled using an SPM to the WHB. After being de-coupled from the carrier the SPM exits the WHB. After the cask is removed from the carrier, the empty carrier may remain in the Carrier Bay or may be moved, by an SPM, to one of the parking areas until the empty cask is available for removal from the WHB. These operations are diagramed in Figure I-17, Attachment I, this document.

1.4.4.3.2 Empty Cask Operations

An empty cask is loaded onto a carrier in the WHB carrier bay. The carrier is hauled by an SPM to the CPB. The SPM is de-coupled from the carrier and exits the CPB. Inside the CPB, the cask and carrier are prepared for offsite shipment. Once ready, the carrier may be transported using a SPM to one of the parking areas in the RCA. When scheduled, the SPM hauls the carrier containing the empty cask through the security station to the receiving/queuing area outside the

RCA for shipping to an offsite nuclear waste generating facility. These operations are diagramed in Figure I-17, Attachment I, this document.

1.4.4.3.3 Empty Dual-Purpose Canister Overpack Operations

A portion of the commercial SNF is received in transportation casks containing a DPC. After removing the SNF from the DPC in the WHB, the empty DPC is transferred to an overpack for offsite disposal at the Nevada Test Site (NTS). The DPC overpack is loaded onto a carrier in the WHB carrier bay. The tire-mounted SPM hauls and delivers the loaded DPC overpack to the NTS disposal site and returns an empty DPC overpack to the MGR from the NTS. The DPC overpack is moved through the security station by an SPM to the RCA parking area so it can be reused. These operations are diagramed in Figure I-17, Attachment I, this document.

1.4.4.3.4 Empty Disposal Container Operations

Rail carriers containing empty DCs are delivered by an OPM to the receiving/queuing area outside of the MGR security gate (Assumption 1.4.4.2.2.3). The SPM exits the RCA to pickup the carrier and move it to the security gate where it is inspected. The OPM waits outside of the gate for a return shipment. The carrier is then hauled by the SPM into the repository RCA rail yard parking area. The RCA transport operations for empty DCs are similar to the loaded casks except that the operations taking place in the CPB are not required.

When the WHB is ready to receive an empty DC, the SPM moves the carrier into the empty DC preparation area of the WHB DCHS where the DC is removed from the carrier. If necessary, the carrier may be staged in the rail parking area prior to transport off the site. The empty carriers are returned to the receiving/queuing yard outside the RCA for pickup. These operations are diagramed in Figure I-17, Attachment I, this document.

1.5 SECONDARY LOW-LEVEL WASTE TREATMENT SYSTEM

This section discusses the overall management of secondary low-level and mixed waste associated with the operation of the MGR. This section also discusses radiological monitoring and sampling systems associated with management of secondary low-level and mixed waste, and presents discussion on potential source terms.

1.5.1 Waste Treatment Building Waste Management Overview

Secondary LLW is generated at the MGR as a result of receiving, handling, and repackaging, for disposal at the repository, CSNF and DOE HLW materials. The major portion of secondary LLW is generated in the WHB, with lesser quantities of LLW generated in the WTB. The CPB is not anticipated to be a significant generator of secondary LLW. All secondary waste generated is monitored at the source of generation and the disposition of the waste subject to administrative controls. Secondary LLW generated as a result of operation of the MGR is properly treated and packaged for disposal at the NTS LLW Disposal Complex under the requirements of the NTS Waste Acceptance Criteria. (DOE 1997)

Operations at the MGR primarily preclude the use of hazardous materials, and therefore, it is not anticipated that any significant quantity of mixed waste will be generated by MGR operations.

(CRWMS M&O 1999u, Section 5.7) In the event of generation of mixed waste, that waste is collected and repackaged for disposal at its point of generation. Properly packaged mixed waste is then transferred to the WTB for interim storage until being transported to an appropriately approved disposal facility.

Secondary LLW consists primarily of liquid wastes or solid wastes. Subject to administrative controls, all secondary liquid LLW is transferred to the WTB for treatment, potential recycle, and solidification prior to shipment to the NTS for disposal. Liquid LLW is collected, segregated into a recyclable liquid LLW fraction or a non-recyclable liquid fraction, and transferred to the recyclable liquid LLW process in the WTB or to the non-recyclable liquid LLW process in the WTB, respectively. (CRWMS M&O 1997d, Section 7.2) Recyclable liquid LLW is treated (using filtration, evaporation, and ion exchange) and then recycled back for reuse within the WHB or WTB. The residuum liquid from this recycling is solidified for disposal at the NTS. (CRWMS M&O 1999u, Section 6.4.2) Non-recyclable liquid LLW is solidified and shipped to the NTS for disposal. (CRWMS M&O 1999u, Section 6.4.2.) There are no liquid effluents from this processing.

Wet-solid LLW (e.g., spent ion exchange resins and filtration materials), generated in the WHB, are packaged for disposal at the source of generation, and then transferred to the WTB in containers to await transfer to the NTS for disposal. (CRWMS M&O 1999u, Section 6.4.1, Footnote 9) Subject to administrative controls, all remaining solid LLW is collected at its point of origin, and then transferred to the WTB for processing and packaging for disposal. (CRWMS M&O 1997d, Section 7.2)

Dry solid LLW transported to the solid LLW processing system in the WTB undergoes sorting, sizing, shredding, compacting, and packaging before this material is shipped to the NTS for disposal. (CRWMS M&O 1999u, Section 6.4.2)

1.5.2 Liquid Low-Level Waste Radioactive Waste Management System

Liquid LLW is classified as recyclable liquid or non-recyclable liquid LLW. These two waste forms are collected and treated in separate systems within the WTB. The liquid LLW system has been classified as QL-2. (CRWMS M&O 1999f, Table 1) Functional and design criteria for the liquid LLW waste management system are identified in *Secondary Low-Level Waste Treatment Strategy Analysis* (CRWMS M&O 1999u, Section 6.4.2).

1.5.2.1 Recyclable Liquid Low-Level Waste Management System

1.5.2.1.1 Functional Description

The functions of the Recyclable Liquid LLW Management System are to collect recyclable liquid LLW from MGR operations, to treat this liquid waste sufficient that the product is acceptable for recycle purposes, to provide a source for recycle water, and to transfer the residue liquid from the recycling treatment to the Non-Recyclable Liquid LLW Management System for solidification. There are no liquid effluents from this processing. Residuum waste materials from the recycle process are solidified and shipped to the NTS for disposal. (CRWMS M&O 1999u, Section 6.4.2)

1.5.2.1.2 Parameters and Assumptions

To be completed during License Application design phase.

1.5.2.1.3 System Description

For both water conservation and waste minimization reasons, recyclable liquid LLW is treated sufficient to allow the product recycled water to be used for decontamination activities within the WTB and WHB. Recyclable liquid LLW is collected and segregated from non-recyclable liquid LLW in both the WHB and the WTB. The recyclable liquid LLW is transferred to the recyclable liquid LLW processing system in the WTB. (CRWMS M&O 2000af, Section 6.2.2.4.2) Liquid to be processed is initially filtered to remove particulate materials. After filtration, the liquid is transferred to a batch evaporator for evaporation. The vapor off the top of the evaporator is condensed and then passed through a mixed-bed ion exchange unit to remove any entrained radiologically active ionic species. The de-ionized water is then passed through an organic material-capturing filter to remove trace organic materials and any ion exchange resin carried out of the ion exchange bed. The final recycled water is transferred to a recycle water storage tank, and then pumped to users in the WHB and WTB. (CRWMS M&O 1997d, Figure 1, Attachment I) Figure II-3 presents a simplified process flow diagram for the recyclable liquid LLW processing system.

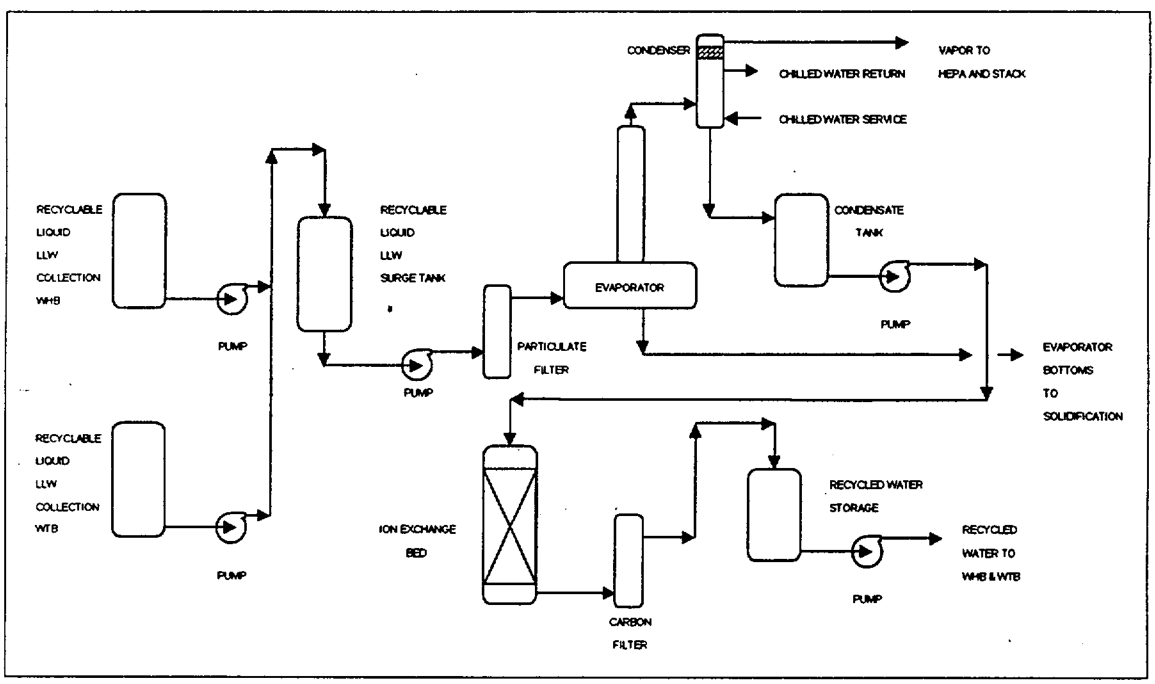

Figure II-3. Recyclable Liquid LLW Simplified Process Flow Diagram

1.5.2.2 Operating Description

The recyclable liquid LLW process system is operated under a batch mode, one operating shift per day. (CRWMS M&O 1997d, Section 4.3.10)

1.5.3 Non-Recyclable Liquid Low-Level Waste Management System

1.5.3.1.1 Functional Description

The function of the Non-Recyclable Liquid LLW Management System is to collect non-recyclable liquid from MGR operations, process this liquid sufficient that it is acceptable for solidification purposes, and to solidify this waste. Non-recyclable liquid LLW is solidified for disposal at the NTS. (CRWMS M&O 1999u, Section 6.4.2) There are no liquid LLW effluents from the MGR operations.

1.5.3.1.2 Parameters

1.5.3.1.2.1 Non-recyclable liquid LLW is aqueous liquid waste that contains minor quantities of cleaning agents (e.g., detergent or citric acid) that prevent this liquid from being recycled.

1.5.3.1.2.2 The non-recyclable liquid LLW processing system is designed per the guidance provided in *Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants* (ANSI/ANS-55.1-1992).

1.5.3.1.3 System Description

Non-recyclable liquid LLW is collected and segregated from recyclable liquid LLW in both the WHB and the WTB. The non-recyclable liquid LLW is transferred to the non-recyclable liquid LLW processing system in the WTB. (CRWMS M&O 2000af, Section 6.2.2.4.2)

Non-recyclable liquid LLW is collected in a surge tank. Also collected in this surge tank are the evaporator bottoms from recyclable liquid LLW processing (see discussion in Section 1.5.2.1.3). The contents of this tank are mixed, sampled, and analyzed to determine pH of the liquid. If necessary, acid or caustic solution is added to bring the pH of the contents to near neutral (pH of approximately 7). (CRWMS M&O 1999u, Figure IV-2, Attachment IV)

The non-recyclable liquid LLW is then mixed with Portland cement, or another appropriate solidification agent, to provide a waste stream free of liquid. The finished drum is then moved to a curing area, followed by shipment to the NTS for disposal. Figure II-4 presents a simplified process flow diagram for the non-recyclable liquid LLW processing system. (CRWMS M&O 1997d, Figure 2, Attachment I)

1.5.3.1.4 Operational Description

The processing of non-recyclable liquid LLW is performed under operator control. Liquid transfers and drum filling operations are performed after sampling and analysis has confirmed liquids fall within operating parameters.

1.5.4 Solid Low-Level Waste Management System

Solid wastes include two separate categories (i.e., dry-solid and wet-solid waste). These two solid waste forms are discussed separately below.

1.5.4.1 Dry-Solid Waste

1.5.4.1.1 Functional Description

The function of the dry-solid waste management system is to collect, segregate, volume reduce, and package dry-solid waste for disposal at the NTS per the requirements of 10 CFR 61 and the *Nevada Test Site Waste Acceptance Criteria* (DOE 1997).

1.5.4.1.2 Parameters

The dry-solid waste processing system is designed per the guidance provided in *Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants,* ANSI/ANS-55.1-1992.

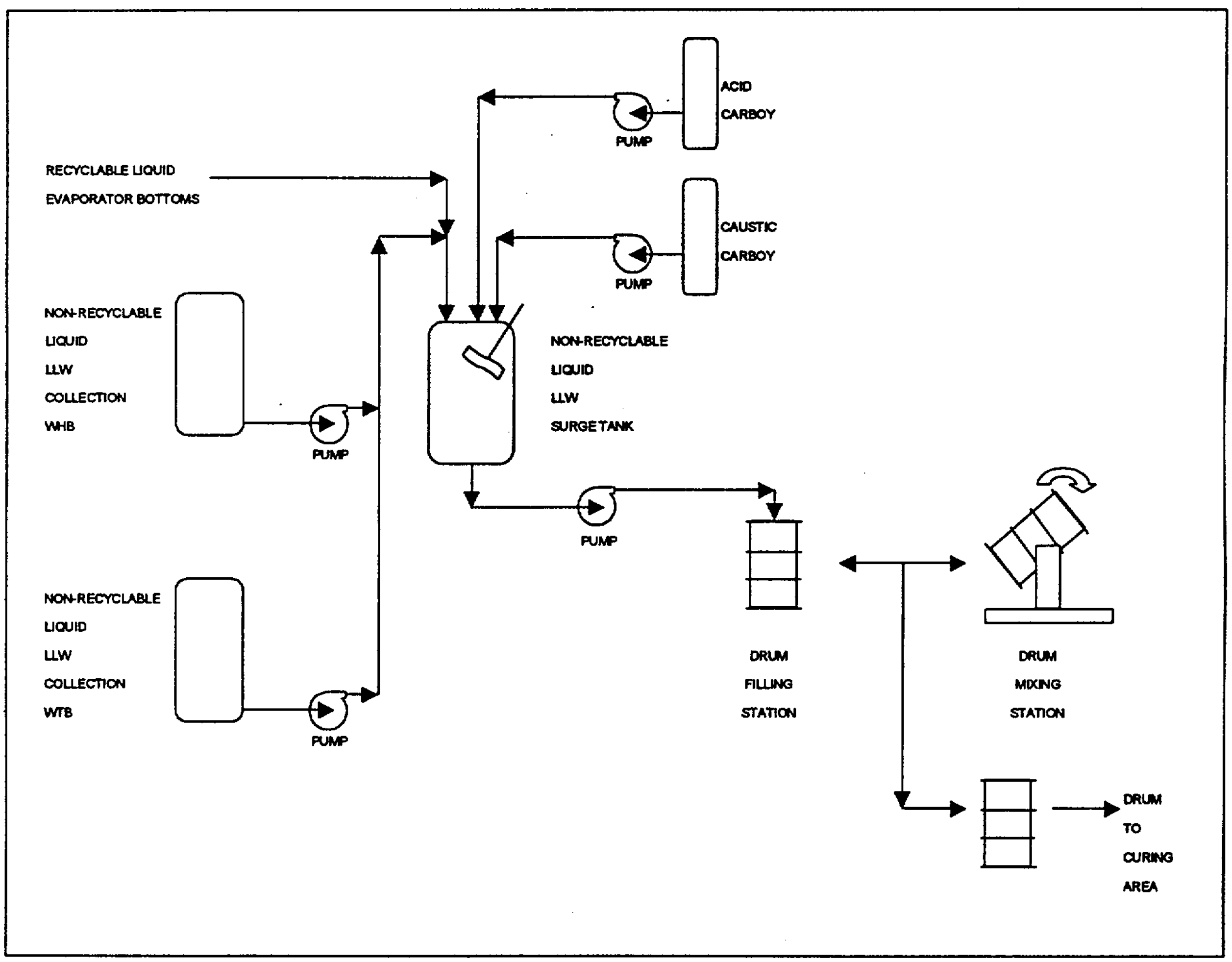

Figure II-4. Non-Recyclable Liquid LLW Simplified Process Flow Diagram

1.5.4.1.3 System Description

Dry solid waste is collected at its point of generation (i.e., the WHB, the WTB, and potentially the CPB) and transferred to the WTB for processing. Inside the WTB, the dry-solid waste is initially sorted to segregate out non-contaminated waste (i.e., waste acceptable for landfill), and any hazardous or mixed waste materials. The dry-solid waste is also sorted to separate non-compactible waste from compactible waste. Non-compactible waste may be size reduced prior to packaging for disposal or directly packaged for disposal depending upon size and material characteristics. Compactible waste is fed into a shredder for size reduction. The shredded dry-solid waste is then compacted into drums for disposal at the NTS. (CRWMS M&O 1997d, Figure 3, Attachment I) Figure II-5 presents a simplified process flow diagram for the solid LLW processing system.

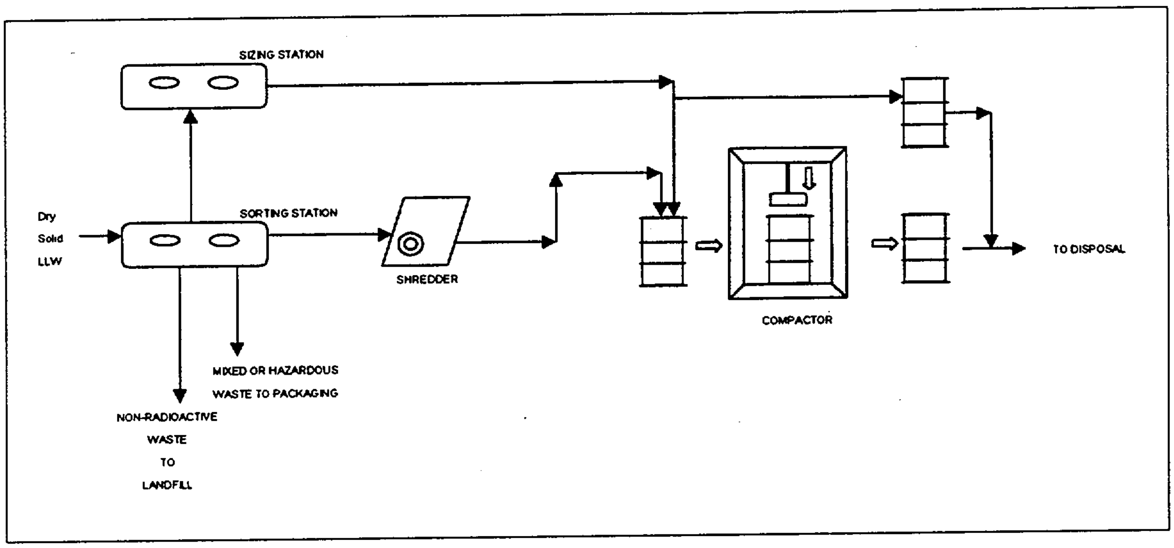

Figure II-5. Solid LLW Simplified Process Flow Diagram

1.5.4.1.4 Operational Description

All operations performed in the processing and packaging of dry-solid waste are performed under direct operator control.

1.5.4.2 Wet-Solid Waste

1.5.4.2.1 Functional Description

The function of the Wet-Solid Waste Management System is to collect, de-water, and package wet-solid waste for disposal at the NTS per the requirements of 10 CFR 61 and the *Nevada Test Site Waste Acceptance Criteria* (DOE 1997). These materials are typically sufficiently contaminated to be classified as non-contact handled. For this reason, these wastes will be handled and packaged into shielded containers at their points of origin.

1.5.4.2.2 Parameters

The dry-solid waste processing system is designed per the guidance provided in *Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants,* ANSI/ANS-55.1-1992.

1.5.4.2.3 System Description

Spent Ion Exchange Resin

The processing of spent ion exchange resins is performed in both the WHB and the WTB at their points of origin. Spent ions exchange resins become wastes when the ion exchange beds in the pool water treatment areas of the WHB or the recyclable liquid LLW processing area of the WTB require change out. The waste resins are transferred directly to a high-integrity container (HIC), which will later serve as the DC. The resin in the HIC is then dried through the passing of dry air through the HIC to ensure the HIC contains no free water. (CRWMS M&O 1999u, Section 6.4.1)

Spent Filter Cartridges

Filter cartridges used in the pool water treatment system or in the recyclable liquid LLW processing system are changed out by removing a cartridge unit (multiple filters in certain units) from a system and placing the spent cartridge unit into a 55-gal drum. The lid to the 55-gal drum is then placed onto the drum. The drum is then placed into a shielded transporter and moved to the filter grouting station in the WTB or the WHB, subject to administrative controls.

At the grouting station, pre-mixed grout is added to the drum to encapsulate the waste filter cartridge.

1.5.4.2.4 Operational Description

All operations are performed under direct operator control with the operator working from a remote and shielded area as required by a given operation.

1.5.5 Mixed Waste Management System

1.5.5.1 Functional Description

The function of the Mixed Waste Management System is to collect and package mixed waste sufficient for disposal at the NTS under the requirements identified in the NTS Waste Acceptance Criteria. (DOE 1997)

1.5.5.2 Parameters and Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

Operations at the MGR primarily preclude the use of hazardous materials, and therefore, it is not anticipated that any significant quantity of mixed waste will be generated by MGR operations. (CRWMS M&O 1999u, Section 5.7) In the event of generation of mixed waste, that waste is collected and repackaged for disposal at its point of origin. Properly packaged mixed waste is then transferred to the WTB for staging pending until transport to a suitable disposal facility.

1.5.5.3 System Description

If suspect mixed waste is generated, the waste is contained and packaged, at the source, as mixed waste. During the course of packaging, samples are collected for analytical characterization. After packaging, the waste is transferred to a mixed waste holding area in the WTB.

1.5.5.4 Operational Description

All operations are performed under direct operator control.

1.5.6 Process Radiological Monitoring and Sampling Systems

1.5.6.1 Functional Description

The functions of the Process Radiological Monitoring and Sampling Systems are to provide on-line process radiological monitoring, collect samples, analyze samples, and provide data required for process control purposes, for ALARA purposes, and for waste characterization, classification, and certification purposes.

1.5.6.2 Parameters and Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

Waste form characterization requirements are identified in *Nevada Test Site Waste Acceptance Criteria* (DOE 1997).

1.5.6.3 System Description

Both on-line radiological monitoring and sample/analysis radiological monitoring is included in the LLW processing systems to ensure proper process control and waste form QA and QL.

Surface dose measurements are continuously monitored at ion exchange beds and filter modules to ensure dose limits are not exceeded. Dose limits are set to ensure that facility shielding design limits and cask design limits are not exceeded, and thereby maintaining ALARA operational standards. Ion exchange resin beds and filter cartridges are changed out prior to surface dose exceeding administratively established limits. (CRWMS M&O 1999t, Section 7.3.3)

Sample/analysis radiological monitoring is performed at various locations to ensure in-process control, radiological inventory control, and to fulfill data requirements for waste acceptance.

Samples are analyzed within analytical laboratory areas in both the WHB and the WTB. QA samples are also sent off site for analysis at commercial laboratories.

1.5.6.4 Operational Description

On-line monitoring is performed under computer control with operational notification provided as set points are approached. Sampling is performed with automatic sampling equipment under operator control. Analytical equipment is both automatic/computer controlled and technician controlled.

1.5.7 Source Terms

This section addresses, in an overview manner, the radiological characteristics of the various LLW streams anticipated from the processing of SNF/HLW for disposal at the MGR.

It is anticipated that the secondary radioactive wastes generated during the course of repackaging SNF/HLW for disposal will be primarily contaminated with minor levels of activation products (e.g., ^{60}Co) and water soluble fission products (e.g., ^{137}Cs). The majority of this contamination will enter the system as crud (i.e., inorganic layers) deposited on the fuel assembly surfaces as a result of their use within a power reactor. An additional small amount of contamination (e.g., ^{137}Cs) may result from the leaching of soluble fission products into the waste transfer pool from fuel cladding failures.

Additional minor amounts of contamination enter the facility through contamination on the outer surfaces of casks. Even though casks will be surveyed and decontaminated as needed prior to shipment to the MGR, minor amounts of surface contamination may be encountered due to the phenomena of weeping of casks. Weeping is the result of radionuclides (primarily ^{60}Co) being sorbed below the surface and then migrating to the surface. Typically these small surface contaminations can be smeared and easily removed with detergents and/or weak acids (citric acid is typically used because it exhibits chelating characteristics). (CRWMS M&O 1999t, Section 7.3)

Radiological Characteristics of Dry Solid Waste

Dry-solid waste is a mixture of materials, with the compactible portion primarily including paper, plastic, and cloth. Although a repository like the MGR has never been operated, it is reasonable to assume that the dry-solid waste characteristics for the MGR will be similar to those for power reactors. (CRWMS M&O 1999t, Section 7.3)

The source term data for typical reactor dry-solid waste is presented in Table II-6. (CRWMS M&O 1999t, Section 7.3)

Table II-6. Typical Reactor Dry-Solid Waste

Reactor Type	Dry-solid Waste Type	Specific Activity (mCi/ft3)	Relative Isotopic Distribution (%)	Radiation Levels (As Shipped)
PWR	Compactible	0.7	60Co – 72% 137Cs – 28%	21 mrem/hr
	Non-compactible	0.4	60Co – 77% 137Cs – 23%	17 mrem/hr
BWR	Compactible	0.25	60Co – 78% 137Cs – 22%	17 mrem/hr
	Non-compactible	0.20	60Co – 76% 137Cs - 24%	15 mrem/hr

Radiological Characteristics of Solidified Liquid LLW

Although specific decontamination levels cannot be defined, and therefore liquid LLW radiological characteristics cannot be estimated, it is estimated that the average liquid LLW generated will have the following radiological characteristics (CRWMS M&O 1999t, Section 7.3):

Dose Rates - 5 mrem/hr (contact)

Specific Activity - ^{60}Co - 1×10^{-3} micro Ci/ml
^{137}Cs -1.5×10^{-3} micro Ci/ml

The estimated concentration of Co and Cs in the final solidified waste form is:

Specific Activity - ^{60}Co – 2.6×10^{-3} Ci/m^3
^{137}Cs –3.9×10^{-3} Ci/m^3

This is below the criteria for Class A waste as identified in 10 CFR 61, therefore the waste is classified as Class A. (CRWMS M&O 1999t, Section 7.3)

Radiological Characteristics of Wet-Solid Low-Level Waste

Wet-solid LLW will be generated from filter cartridges and ion exchange resins used in pool water treatment and decontamination water recycle. It is envisioned that the bulk of this waste will be generated at the primary point of contamination (i.e., the waste transfer pools).

Fuel crud typically contains the following constituents:

Al_2O_3	Fe_3O_4	$Co(OH)_2$	$Ni(OH)_2$
NiO	ZrO_2	$NiFe_2O_4$	MnO_2
CuO	Fe_2O_3	$Fe(OH)_2$	

These compounds are essentially insoluble in water, therefore if they spall off the fuel assembly surfaces, they will result in particulate materials being introduced into the pools. These particles

typically run in the 1-5 micron range, with a small distribution of larger particles. These particles will be picked up in the filter system of the waste transfer pools treatment systems. The primary radioactive constituent of this particulate material will be ^{60}Co. (CRWMS M&O 1999t, Section 7.3)

There is no way of predicting how much of this material may collect on a given filter cartridge before the filter would need to be changed out due to pressure drop across the cartridge. And more importantly, there is no way of predicting what the radioactive isotopic content of the cartridge would be. The *Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type* document (ANSI/ANS-57.7-1988, Appendix B) recommends a design source term in the 1 by 10^4 mrem/hr, 10 rem/hr, range for shielding purposes for waste filter cartridges from water purification systems. For the purpose of establishing waste characterization properties, and waste handling requirements, filter cartridges will be administratively controlled below 10 rem/hr. (CRWMS M&O 1999t, Section 7.3) That is, if a filter cartridge does not load up with particulate material sufficient to require change out due to pressure drop, the filter cartridge will be changed out as it approaches the 10 rem/hr limit.

The other source of wet-solid LLW is spent ion exchange resin that is used to remove soluble constituents, both radioactive and non-radioactive during water treatment operations. As with the fuel crud, there is no way of predicting how much radioactive material (primarily Cs isotopes) will be placed into the pool systems and other water from the fuel being processed at any given time. The *Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type* document (ANSI/ANS-57.7-1988, Appendix B) recommends a design source term in the 1 by 10^4 mrem/hr, 10 rem/hr, range for shielding purposes for ion exchange resin units cartridges from water purification systems. For the purpose of establishing waste characterization properties and waste handling requirements, ion exchange resins will be administratively controlled below 10 rem/hr. That is, if an ion exchange unit does not reach ionic breakthrough before 10 rem/hr, the resin unit will be changed out as it approaches the 10 rem/hr. (CRWMS M&O 1999t, Section 7.3)

Potential Gas Source Terms

The estimated gas source terms (average annual release) are:

- ^{85}Kr 2.56 x 103 Ci/yr
- ^{81}Kr 1.03 x 10-6 Ci/yr
- ^{219}Rn 3.32 x 10-5 Ci/yr
- ^{220}Rn 5.90 x 10-2 Ci/yr
- ^{221}Rn 4.59 x 10-6 Ci/yr

Inspection of these estimated quantities indicates that the only significant gaseous source term is that of ^{85}Kr (CRWMS M&O 2000l).

1.6 NORTH PORTAL ACCESS VESTIBULE

1.6.1 Functional Description

The North Portal will be protected by an access vestibule that allows the access of the loaded, shielded transporter with trolley locomotive to the tunnel ramp; that prevents human intrusion (Dyer 1999, Section 21(c)8); minimizes the introduction of nuisance trash and debris; and prevents the entrance to unwanted vermin. The vestibule works in conjunction with the subsurface ventilation system to allow the intake of ventilation air satisfying the minimum requirements of the subsurface design airflow and modes of operation.

The building will have louvers to allow for air intake to the tunnel. Door controls will be manual, semi-automatic, full automatic or a combination of these, depending on the conceptual design configuration to be determined.

The principal dimension of the building is 50 ft by 150 ft with a floor space of 7,500 sq ft. (CRWMS M&O 1998f, Table 7-2)

This section to be completed during the License Application design phase.

1.6.2 Parameters and Assumptions

1.6.2.1 Parameters

This section to be completed during the License Application design phase.

1.6.2.2 Assumptions

This section to be completed during the License Application design phase.

1.6.3 System Description

This section to be completed during the License Application design phase.

1.6.4 Operational Description

This section to be completed during the License Application design phase.

1.7 SAFEGUARDS AND SECURITY

1.7.1 Functional Description

The primary function of the Safeguards and Security (S&S) system is to ensure that only authorized personnel and materials are allowed access to the site (CRWMS M&O 1998l, Section 7.1.3). This will be accomplished with a perimeter intrusion detection and alarm system (CRWMS M&O 1999s, Section 1.2.1.9).

Functions of the S&S system include:

- Security administration and badging
- Access control
- Intrusion detection
- Threat deterrance
- Alarm monitoring and threat assessment
- Protection against radiological sabotage
- Theft detection and deterrence
- Material Control and Accountability

1.7.2 Parameters and Assumptions

1.7.2.1 Parameters

This section to be completed during the License Application design phase.

1.7.2.2 Assumptions

This section to be completed during the License Application design phase.

1.7.3 System Description

The site safeguards and security (S&S) system includes the staff, facilities, equipment, alarms, sensors, and computer software necessary to protect the Geologic Repository Operation Area (GROA) facilities, materiel, and personnel. Support auxiliary systems include network communications, communications, energy supply, fire detection and suppression, and site utilities.

Functions of the site S&S system include:

- Security administration and personnel qualification/badging
- Security access control
- Security facilities
- Intrusion detection and delay
- Threat detection, and deterrence
- Alarm monitoring and threat assessment
- Protection against radiological sabotage
- High value equipment theft detection and deterrence
- Wasteform (SNF and HLW radiological material) control and accounting
- Security forces control and support.

S&S will include methods to ensure that only authorized personnel and materials are allowed access to security areas of the site. Attempts at unauthorized entry of personnel or material will be detected and assessed, and an appropriate security force response will be generated to mitigate the treat. Appropriate delay mechanisms are also defined to increase the probability of

neutralizing threats by allowing appropriate numbers of security response personnel the time necessary to be activated and deployed.

Access denial techniques are further offered as part of this assessment to preclude the potential introduction of unacceptable individuals and/or radiological sabotage. (CRWMS M&O 1998l, Section 7.1.3)

1.7.4 Operational Description

The S&S System provides the staff, facilities, and materials necessary to protect the GROA facilities. (CRWMS M&O 1998l, Section 7.1.3)

Three security stations provide the primary security for the site.

1.7.4.1 Security Station 1

Station 1 is located at the entrance to the BOP. Personnel and material access to the BOP is controlled from this station. This station contains the badging facilities for personnel requiring temporary access to the facilities.

Visitors and employees will enter this station for badges that are required for access to various parts of the facility.

Pedestrian and vehicle traffic will pass through Station 1 for access to BOP facilities.

In the event that the Central Alarm System (CAS) is inoperable, the secondary alarm system housed in Station 1 will provide the necessary alarm indication for the S&S site operations. (CRWMS M&O 1998l, Section 7.1.3.1.2)

1.7.4.2 Security Station 2

Station 2 is located at the entrance to the RCA. Personnel and material access to the RCA is controlled from this station. This station contains the CAS for the S&S operations. Alarms annunciated in the CAS will enable the Alarm Monitoring and Threat Assessment System (AMTAS) and Emergency Dispatch System (EDS) to access, and dispatch the appropriate countermeasures required for the site security.

Station 2 is suitably hardened and secure to house the AMTAS and EDS (CRWMS M&O 1999s, Section 1.2.1.36). The facility is manned 24 hrs a day by multiple security and dispatch personnel.

Auxiliary support systems include on- and offsite communications, video surveillance, physical barriers, detection and delay systems, fire detection, and site utilities.

Pedestrian and vehicle traffic will pass through Station 2 for access to RCA facilities. (CRWMS M&O 1998l, Section 7.1.3.1.3)

1.7.4.3 Security Station 3

Station 3 is located at the primary entrance point for waste forms delivered to the plant. Waste material access to the plant is controlled from this station. Station 3 will provide the initial receipt of waste forms delivered, log and account for the material being received, and provide for site movers to transport the cask carriers to various receiving areas in the plant. (CRWMS M&O 1998l, Section 7.1.3.1.4)

1.7.4.4 Alarm Stations

The Central Alarm Station (CAS) will house all sitewide alarm system components, assessment and surveillance equipment, the security access control system, security backup power sources, and the site central communications center for emergency dispatch. The CAS will be located at Security Station 2, and hardened against bullet or missile assaults. The facility will be self-contained, including restroom and lunchroom facilities. (CRWMS M&O 1998l, Section 7.1.3.1.5)

The Secondary Alarm Station (SAS) will be a complete backup for all security and emergency dispatch communications systems deemed vital to sustain site security and safety. The SAS will be located within the hardened area of Security Station 1 (CRWMS M&O 1998l, Section 7.1.3.1.6)

1.8 RADIOLOGICAL ASSESSMENT

1.8.1 Waste Handling Building – Radiological Assessment

The methodology, as described in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Section 3.1), used the factors of time, distance, and dose rate to determine the anticipated doses that would be received by personnel in waste handling operations, and off-normal operations (maintenance) associated with the equipment used in the WHB.

The method used predefined operational sequences for the various stages of the WHB waste handling operations. The operational sequences used were provided by mechanical personnel and are documented in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Table II-1).

The Assembly Waste Handling Operations consist of those operational steps and the task time associated with each Assembly Waste Handling Operation are described in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Section 3.2.3). The Canister Waste Handling Operations consist of those operational steps and the task time associated with each Canister Waste Handling Operation are described in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Section 3.2.2). The DC Waste Handling Operation consists of those operational steps and the task times associated with each DC Waste Handling Operation are described in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Section 3.2.4).

The task time (hrs per shift per year) for each Waste Handling Operations described above is based upon the %BUSY (percentage of time equipment is operating [busy] for the associated

equipment). The following parameters were then established for each Waste Handling Operation (CRWMS M&O 1999y, Section 3.2.4):

- Number of personnel required
- Labor class of the personnel
- Percentage of time working in area
- DR in mrem per hr at the work location

The TD for each Waste Handling Operation was then determined by using the following equation in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Section 3 and Attachment II),

$$TD = DR(\frac{mrem}{hour})(\frac{\%WorkingArea}{100})(NumberofPersonnel)(\frac{hours}{shift})(\frac{1}{year})(\frac{shifts}{lines})(lines)$$

where %Working in Area is defined as the percentage of time the personnel are working or exposed to the radiation source.

1.8.2 Carrier Preparation Building – Radiological Assessment

The Waste Receiving and Carrier/Cask Handling Operations consists of operational steps and task times associated with each waste handling operation from the arrival of a cask at the site boundary to the placement of the cask in the cask preparation area.

The operational sequence for the Waste Receiving and Carrier/Cask Handling Operations is defined in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Assumption 4.3.15). The average dose per shipment from the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Table 7-5) is 64.98 mrem. This dose per shipment assumes the ALARA Benefit Improvement and Changes listed in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Table 7-4) and reproduced in Table II-7 are incorporated into the Waste Receiving and Carrier/Cask Handling Operations. The second column of Table II-7 lists the improvement and changes in the Waste Receiving and Carrier/Cask Handling Operations and the third column of Table II-7 shows the corresponding ALARA Benefit.

Table II-7. Waste Handling Operation ALARA Benefit Improvement and Changes

	Improvement and Changes	ALARA Benefit
1	Cask Preparation: The cask will be transferred into the pool area on a cart, and then lifted into the cask preparation pit with the pool area bridge crane.	The cask preparation pit limits radiation dose from the cask. Allows semi-remote cask prep operations on cask lids, ports, canister lids, and ports.
2	Cask Preparation: Flex hoses will be semi-remotely or manually attached to the cask vent and drain ports.	Reduces radiation dose by reducing time for manual operations. Reduces radiation dose by increasing distance for the attachment process.
3	Cask Preparation: Partially Remote equipment will be used to de-tension and remove the lid bolts, attach the lifting fixture, and cask lifting yoke.	Provides distance and shielding between operator and source (cask).
4	Carrier/Cask Preparation: Radiation measurements performed semi-remotely using a bridge-mounted manipulator.	Semi-remotes required radiation survey. The radiation survey was one of the high radiation dose operations in the previous study.
5	Carrier/Cask Preparation: Temperature measurements performed semi-remotely using a bridge-mounted manipulator.	Semi-remotes required temperature survey, and provide distance between the operator and the cask.
6	Carrier/Cask Preparation: The impact limiter bolts may be loosened using a bridge-mounted manipulator where possible.	Reduces the time operators are required to be in the area loosening the impact limiter bolts. The use of the bridge-mounted manipulator provides distance between the operator(s) and the cask (source).
7	Carrier/Cask Handling: Gantry-mounted manipulator is used to semi-remotely assist cask maintenance operations (repair the cask tie-downs and install cask trunnions). Used for semi-remote recovery activities.	Provides distance between operators and source (cask).

Source: CRWMS M&O 1999y, Table 7-4.

The Waste Receiving and Carrier/Cask Handling Operations – TD from the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Tables 7-7 and 7-8) is shown in the column 2 of Table II-8. The TD per unit operation was determined in the *Modular Design/Phased Construction Alternative Evaluation Report* (CRWMS M&O 1999o, Section 6.2.3) and is shown in column 3 of Table II-8.

Column 5 contains the number of unit operations from *Calculations from Surface Facilities Operations in Support of the Revision to the Waste Quantity, Mix, and Throughput Study* (CRWMS M&O 2000c, Section 3.5). The mrem per unit (CRWMS M&O 1999o, Table 6-3) (see column 4 of Table II-8) is multiplied by the number of unit operations (see column 5 of Table II-8) to obtain the TD in mrem (see column 6 of Table II-8) for the current design configuration.

Table II-8. EFSR – Wet Dose Summary

Operations	Total Dose (mrem/yr) (1)	Units per Year(2)	mrem per unit(2)	Unit Operations(3)	Total Dose (mrem)	% of Total Dose
Cask Receipt and Shipment	40,027.68	616	64.98	12,470	810,300.6	66.36
ATS - Cask Preparation	9,059.90	457	19.82	9,604	1,903,51.2	15.59
ATS SFA Handling	3,939.27	12,870	0.31	288,065	89,300.15	7.31
ATS DC Load	3,453.73	394	8.77	7,667	67,239.59	5.51
ATS DC Decontamination	106.22	394	0.27	7,667	2,070.09	0.17
CTS - Cask Preparation	721	656	1.1	2,866	3,152.6	0.26
CTS Canister Transfer	341.12	144	2.37	1,463	3,467.31	0.28
DC Welding	2,851.39	540	5.28	9,130	48,206.4	3.95
WP Processing - Tilting	104.71	540	0.19	9,130	1,734.7	0.14
WP Processing - Inspection	188.35	540	0.35	9,130	3,195.5	0.26
WP Processing - Load	125.92	540	0.23	9,130	2,099.9	0.17
Total					1,221,118.04	100.00

1.8.2.1 Parameters

This section to be completed during the License Application design phase.

1.8.2.2 Assumptions

This section to be completed during the License Application design phase.

1.8.3 Waste Treatment Building – Radiological Assessment

This section to be completed during the License Application design phase.

1.8.4 Off-normal Operation Maintenance

The dose associated with the outage frequencies or off-normal operations of the equipment used in the WHB waste handling operations was determined in the *Waste Handling Operations - Dose Assessment* (CRWMS M&O 1999y, Attachment III). A remote or local tag was associated with each equipment failure. Based on the remote or local tag, an associated dose rate in mrem per hr was then applied. The type and number of maintenance personnel associated with the maintenance recovery are estimated along with the number of hours personnel are "exposed." The TD for the maintenance recovery operation was determined by multiplying the exposure time by the dose rate, associated with the repair times by the number of personnel exposed at the noted dose rates. The exposure time can be estimated from the MTTR.

$$TD = (ExposureTime(hours))(DR(\frac{mrem}{hour}))(\frac{6000}{MTBF}(\frac{hours}{year})(\frac{1}{hours}))(Qty.)$$

Where MTTR = Mean-Time-to-Repair (hrs)
MTBF = Mean-Time-Between-Failures (hrs)
DR = Dose Rate (mrem/hr)
QTY. = Quantity of Equipment in WHB

$$6000(\frac{hours}{year}) = (8\frac{hours}{shift})(5\frac{days}{week})(3\frac{shifts}{day})(50\frac{weeks}{yr})$$

The TD for the anticipated equipment failures is 3,414 mrem per year. (CRWMS M&O 1999y, Table 7-8)

1.8.5 Shield Wall – Radiological Assessment

1.8.5.1 Preliminary Shield Wall Assessment

A preliminary shield wall estimate was made in Attachment IV of the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e). Results indicated in IV-1 of the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e), that a 5-ft (152.4cm) concrete wall thickness is able to satisfactorily reduce the radiation to an acceptable level.

There appears to be sufficient latitude to accommodate any envisioned combination of sources. The areas of the structure which are adjacent to where exposed fuel is handled will be safe with a 5-ft (152.4 cm) thick wall. These areas include the assembly cells, disposal container load cells, the waste package remediation cell, and any others in which bare fuel is exposed to the wall.

It was recommended in IV-2 of the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e), that the wall thickness at the upper levels (>30 ft [914.4 cm]) be reduced to at least 3 ft (91.44 cm) because of the distance from the radiation source to the dose point and because the angle through the wall between the source and the dose point dramatically increases the effective shield thickness.

1.8.5.2 Updated Shield Wall Assessment

The initial calculations that have been performed were selected on the basis of need by the design team. The purpose was to provide the design teams with the necessary information to assure an efficient and effective design.

The calculational models are the building blocks for the more sophisticated calculations that will follow when the design is developed to a point where the geometric dimensions, the materials, and other influencing factors are known.

At this phase of the design, it is recommended that the shielding wall thickness for the WHB be as shown in Table II-9. The recommended shield wall thickness will ensure that the surface facilities that house radioactive materials or in which work is performed on radioactive materials will be designed to control occupational exposures to 500 mrem per year (CRWMS M&O 1999y, Section 4.3.1.2) and will be used as input to more detailed analysis that will determine if

the facility meets the ALARA criteria. This will provide flexibility for pursuing the further design of the WHB.

The models were established in such a way that other configurations in the WHB could be estimated by comparison of similar parameters. Areas of the WHB ground elevation not evaluated during this analysis (e.g., Assembly Handling Line [DC load cell, DC inner lid weld, decontamination cell], and the Dry Handling Line [e.g., handling airlock, cask prep/lid unbolt cell]) will be evaluated during the ongoing design process.

The Assembly Handling Line (DC load cell, DC inner lid weld, and decontamination cell) contains the same source strength. By comparison with other cases, it is recommended that the minimum shield wall thicknesses for these areas be 5 ft (152.4 cm).

As the design of the WHB progresses, further calculation will be required to recommend required shield wall or door thickness in areas not addressed in this release and to re-evaluate those areas changed due to the evolving WHB design.

Shield wall thickness are based on Attachment IV of the *Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997e), as discussed in the Preliminary Shield Wall Assessment section above. This wall thickness was used in the VA Report (DOE 1998).

Subsequent analysis from the *Waste Handling Building Shield Wall Analysis* (CRWMS M&O 2000w), as summarized in the Updated Shield Wall Assessment section above, reduced the wall thickness in certain areas.

As the design of the WHB progresses, further calculation will be required to recommend required shield wall or door thickness, in areas not addressed in this release.

Table II-9. Waste Handling Building Shielding Summary

Case Title	Shield Thickness Recommended
DC Transfer Load	3 ft (91.44 cm)
WP Remediation	3 ft (91.44 cm)
DC Handling Cell West Wall	3 ft (91.44 cm)
DC Handling Cell South Wall	3 ft (91.44 cm)
DC Load	3 ft (91.44 cm)
DC Decontamination	3 ft (91.44 cm)
DC Tilting Station	3 ft (91.44 cm)
Canister Cask Preparation Cell	1 ft 1.2 in. (33.53 cm)
DHLW Canister Staging Cell	3 ft (91.44 cm)
East and West Walls	3 ft (104.14 cm)
North and South Walls	3 ft (91.44 cm)
Ceiling	2 ft (60.96 cm)

Case Title	Shield Thickness Recommended
Canister Handling Area	4 ft (121.92 cm)
DC Staging Cell	3 ft (91.44 cm)
Drying Vessels/Transfer Canal	5 ft (152.4 cm)
DC Handling Cell - Operator Gallery Floor and Side	4 ft (121.92 cm)

1.9 AS LOW AS IS REASONABLY ACHIEVABLE

1.9.1 Functional Description

1.9.1.1 Functional Surface Facilities Design Features

Facility and equipment design features reflect the ALARA policy considerations. Common equipment and facility design features include:

- The inclusion of the design organization (e.g., maintenance, operations, radiation protection, technical support, engineering, and safety groups in the review of the design of the MGR Surface Facility and the selection of equipment. (CRWMS M&O 1999n, Section 6.5)
- Reflect consideration of the activities of station personnel (such as maintenance, SNF processing, in-service inspection, and the processing of radioactive waste. (CRWMS M&O 1999n, Section 6.5)
- Decontamination and decommissioning will be factored into the planning, designing, construction, and modification (Regulatory Guide 8.8 [1][c][2]).
- Access into the MGR structures, yard area, and radioactive material storage will be regulated and controlled. (CRWMS M&O 1999n, Section 6.5)
- Operations with the potential to result in significant occupational exposure will be automated.
- Design of SSCs that require maintenance or repair to minimize maintenance frequency and personnel stay times in radiation areas.
- Instrument devices will be located in low radiation zones and away from radiation sources whenever practical. (Regulatory Guide 8.8 [2][c])
- Airborne contamination control will be maintained through air pressure gradients and airflow from areas of low potential airborne contamination to areas of higher potential contamination.
- Placement of administrative and security activities will be away from radiation areas.

- Remote inspection systems will be used for inspection activities to minimize personnel exposure to radiation sources (not yet incorporated into the proposed design).

- Shielded, remote-operating stations established for operation personnel. (CRWMS M&O 1999n, Section 6.5 g11 and 6.10 g2)

- Radiation Access Zones provide a design framework to limit radiation exposures. (CRWMS M&O 1999n, Section 6.5 g10 and 7.2 g5)

- Cask venting systems will be connected to the WHB exhaust ventilation system to reduce radiological release concentrations and to allow monitoring.

- Decontamination facilities for transportation casks will be designed into the WHB to reduce radiological contamination of other SSCs and personnel during cask handling operations.

1.9.1.2 Shielding Functional Description

Radiation shielding is used for protecting workers and the public. In general, the shielding design basis is to maintain personnel radiation exposures ALARA. 10 CFR 60.131(a)(3) requires that the geologic repository operations area design include suitable shielding to control doses within the limits of 10 CFR 20. Shielding is an integral part of the initial planning of the MGR. Ultimate decontamination and decommissioning of the shielding is considered in the design of shielding for the MGR. The design will ensure that future changes to the shielding can be accommodated. Shielding is selected based on the type of radiation, energy of the radiation, space considerations, and desired exposure rates in the area to be shielded.

1.9.1.3 Surface Facility Shielding

The WHB is a large, nuclear facility consisting of heavy concrete construction in the areas requiring radiation shielding. Radiation shielding is the primary factor in sizing areas within the WHB structure. These areas include the dry process delid/transfer and DC area, assembly cells, DC load and decontamination cells, and DC welding/staging areas. Wall thickness is based on an analysis performed to evaluate the potential radiation sources that will be experienced in these areas. (CRWMS M&O 2000af, Attachment II)

The WHB structure has concrete walls up to 5 ft thick to a height of 30 ft above the operating floor in the dry process delid/transfer and DC area, the assembly cells, the DC load and decontamination cells, and the DC welding/staging areas. Above 30 ft, the wall thickness can be stepped down to 3 ft to the rooftop. Concrete walls 3 ft thick will be safe in the areas where filled WP/DCs will be handled. The concrete roof structure is also designed to act as radiation shielding for maintenance workers. (CRWMS M&O 2000af, Attachment II)

The spatial arrangement within the facility and structural components provides for efficient throughput and handling of WPs and materials, while providing for radiological containment and protection to personnel (CRWMS M&O 2000af, Attachment II).

The anticipated radiation zones for the WHB/WTB are shown in Figure I-28 (Attachment I, this document) for the +100 ft elevation and Figure I-29 (Attachment I, this document) for the +130 ft elevation.

Areas in the WHB have radiation levels that either preclude human occupancy or in which occupancy will be controlled. Radiation Access Zones provide a design framework to limit radiation exposures to ALARA given the state of technology, economics, and the benefits to the public health and safety. Designated radiation access zones for the WHB are described in Table II-10 below from the *Preliminary Design Concept for the Repository and Waste Package* (Volume 2 of *Viability Assessment of a Repository at Yucca Mountain*, DOE 1998, Table 4-1, p 4-27). (This information is limited to the level of design information available as of January 1999 and is primarily based on the *Preliminary Design Concept for the Repository and Waste Package*. Volume 2 of *Viability Assessment of a Repository at Yucca Mountain* (VA) [DOE 1998] development documentation.)

Table II-10. Waste Handling Building Radiation Access Zone Designations

Radiation Zone	Description	Access
Very High Radiation Area >500 rem/hr	This zone occurs where sources (e.g., SFAs, high-level radioactive waste canisters) are transferred to either storage or DCs.	No Normal Access Permitted
High Radiation Areas >0.1 rem/hr to <500 rem/hr	This zone covers the loaded DC handling areas and cask operations areas.	No Normal Access Permitted Access permitted to cask operations areas under Special Work Permits.
Radiation Work Permit Areas >0.25 mrem/hr to <0.1 rem/hr	General Work areas, Carrier Bay and Cask Preparation Area.	Access Permitted per Radiation Work Permit limits.
Unrestricted Operations Area <0.25 mrem/hr	General areas of the operating corridors.	

The following radiation access zone designations for work permit areas, shown in Table II-11, were proposed in *Radiation Access Zones* (CRWMS M&O 2000q).

Table II-11. Radiation Access Zone Designation

Radiation Access Zone	mrem/hr	Exposure Duration
1	<0.25	40 hr/wk
2	>=0.25 to <2.0	1 hr/day
3	>=2.0 to <10.0	1 hr/wk
4	>=10.0 to <50.0	1 hr/month
5	>=50.0	No Normal Access Permitted

1.9.1.4 Surface Facility Ventilation

Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, packaging, or performance confirmation is designed to control airborne radiation

levels to as far below those required by 10 CFR 20 as is reasonably achievable. (CRWMS M&O 1999n, Section 6.5.g.13) The spread of airborne contamination within surface facilities are limited by maintaining air pressures and gradients from areas of low potential airborne contamination to areas of high potential airborne contamination.

Refer to Section II-1.1.7 of this document for a description of the WHB Ventilation System.

1.9.1.5 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

10 CFR 60.131(a)(6) requires that the MGR operations areas design include a radiation alarm system to warn of significant increases in radiation levels and in concentrations of radioactive material in air. Fixed continuous airborne radioactivity monitors and effluent radiation monitors will be part of the surface facilities. Fixed area radiation monitors with local and remote readouts will be part of the surface facilities. Radiological monitoring instrumentation is discussed in Section II-1.1.13.

1.9.1.6 Surface Facility Area Radiation Monitoring System

The WHB fixed radiation monitoring system consists of the WHB, WTB, and CPB area radiation monitoring system and the WHB and WTB radioactive airborne effluent monitoring system.

Refer to Section II-1.1.13 for a description of the WHB Monitoring System.
Refer to Section II-1.2.6 for a description of the WTB Monitoring System.
Refer to Section II-1.3.7 for a description of the CPB Monitoring System.

1.9.1.7 Surface Facility Radioactive Airborne Effluent Monitoring System

The WHB and WTB radioactive airborne effluent monitoring system constantly samples the effluent from the WHB and WTB HVAC system to ensure compliance with environmental discharge and ALARA compliance.

Refer to Section II-1.1.13 for a description of the WHB Monitoring System.
Refer to Section II-1.2.6 for a description of the WTB Monitoring System.

1.9.2 Parameters and Assumptions

1.9.2.1 Parameters

This section to be completed during the License Application design phase.

1.9.2.2 Assumptions

This section to be completed during the License Application design phase.

1.9.3 Operational Description

ALARA design reviews will be conducted and documented, if applicable, in accordance with the *Mined Geologic Disposal System Design ALARA Program* (CRWMS M&O 1995b), which is

expected to be supplemented by the Repository Surface Design Department (RSDD) ALARA Design Program (pending) that includes Optimization and Cost Benefit Analysis to demonstrate MGR Surface Facilities design is ALARA.

1.10 DECONTAMINATION AND DECOMMISSIONING OF SURFACE FACILITIES

1.10.1 Functional Description

The system will facilitate permanent closure and decontamination or dismantlement of surface facilites.

1.10.2 Parameters and Assumptions

1.10.2.1 Parameters

This section to be completed during the License Application design phase.

1.10.2.2 Assumptions

This section to be completed during the License Application design phase.

1.10.3 System Description

Any repository surface facilities that could become contaminated will be designed to simplify decontamination. Thus, the design of the surface facilities will support three general DOE goals:

- Health and safety performance objectives that will limit loss of, or damage to, Federal property, including losses resulting from an inability to readily decontaminate or decommission facilities for subsequent uses
- Interior corridors of a size and arrangement that will accommodate the facility's ultimate decontamination and decommissioning, including enough room for the equipment required to perform the decontamination.
- Dispersion limits on radioactive or other hazardous contaminating materials, to simplify periodic decontamination and the ultimate decontamination and decommissioning of the facility for disposal or reuse.

To more directly support these goals, surface facilities will include specific features for future decontamination and decommissioning. For example, items like service piping, conduits, and ductwork will be kept to a minimum in areas of potential contamination; where they are necessary, they will be arranged to ease the job o decontamination. Ventilation system filters will be located to minimize potential contamination of ductwork. Walls, ceilings, and floors will be finished with washable or strippable coverings. Metal liners will be used where needed to ensure a means of decontamination.

Taken together, these and other design features will serve the goals of decontamination and decommissioning of the surface facilities, while permitting reuse or proper disposal of Federal property after the repository is sealed and closed. (CRWMS M&O 2000h)

This section to be completed during the License Application design phase.

1.10.4 Operational Description

This section to be completed during the License Application design phase.

1.11 TRANSPORTER MAINTENANCE BUILDING

A carrier/cask transporter and WP transporters are stored in a garage south of the WHB. The garage is 7,200 sq ft. It will have five bays for parking and repair work on transporters as well as space for storage of tools and parts, and change rooms. The building will also include a wash/decontamination area, hazardous waste staging, health physics area, lockers, showers, and offices. (CRWMS M&O 1998f, Table 7-2)

The structure will be a light-gage steel structure supported on reinforced concrete spread footings. The structure will be covered with insulated metal siding and roofing. The design and construction will comply with commercial standards.

This section to be completed during the License Application design phase.

2. BALANCE OF PLANT

BOP facilities are located in the BOP area adjacent to the RCA. The facilities provide non-radiological support to surface and subsurface operations, including management and administration, warehousing, maintenance, fire, medical, utility (including fuel and steam generation), security, and mockup and testing.

2.1 BALANCE OF PLANT FACILITIES

This section describes the planned BOP surface facilities at the North Portal repository. (CRWMS M&O 1998f, Section 7.2) These surface facilities are identified by site building number, and are shown in Figure I-20, Attachment I, this document, and are tabulated below. The BOP facilities are laid out to provide security protection and efficient arrangement.

BOP surface facilities features include:

Division of the BOP into two distinct security areas with access controlled through Security Station 1 (220-3A). The easterly portion will provide a delivery area for offsite vendors and deliveries to the Central Warehouse (220-7), Central Shops (220-4A), and Motor Pool and Facility Service Station (220-4B) and can be accessed with an NTS Site Badge. The westerly portion contains the more sensitive facilities, such as the Administration Building (220-5A), Medical Center (220-1B), Fire Station (220-2), and Mock-up Building (220-6), and can be

accessed only by those personnel with a CRWMS project picture badge. A chain link fence will separate these two security areas.

The Central Warehouse (220-7), Central Shops (220-4A), and Motor Pool and Facility Service Station (220-4B) are separated from the RCA security fence and entry portal BOP/RCA Security Station (220-3B) to minimize the possibility of an adversary using either the tools or fuel to carry out an attack. By not having tools/fuel (e.g., explosives) immediately available to an adversary, the attack scenario is made more difficult in that tools/fuel must either be brought in or, at least, are made harder to obtain. As discussed in the preceding paragraph, the Central Warehouse (220-7) is situated so non-cleared visitors do not need to access security areas in order to make deliveries.

The Medical Center (220-1B) and Fire Station (220-2) are located in the westerly area to minimize travel distance from the RCA for emergencies. This location also eliminates a straight roadway leading to the Security Station 2 (220-3B), which would allow a vehicle to gain a great deal of speed and crash through the RCA fence or Security Station 2 (220-3B), gain access to the RCA, and start an explosive or terrorist attack. The Administration Building (220-5A) is also placed within this higher security zone to provide additional protection to sensitive areas such as the security administration/weapons storage area and the computer facility.

The Security Station (220-3B) is situated to eliminate congestion in the area adjacent to the TMB (220-4C).

Facilities are provided inside the RCA and the BOP areas for water supply, redundant fire water storage tanks, electrical equipment, sewer systems, process utilities (CHW, compressed air, etc.), access roads, and rail lines, as needed.

The ventilation systems to be used for the various BOP facilities are conventional HVAC systems.

The BOP Facilities are described in Table II-12, which includes a site plan building number, facility name, a list of the primary functional areas and support areas, type of construction, principal facility dimensions, and the gross floor space (unless noted otherwise).

Table II-12. Balance of Plant Area Facilities

Site Plan Building Number	Facility Name	Areas	Type of Construction	Principal Dimensions (ft)	Floor Space* (ft^2)
220-3A	Security Station 1 (Main BOP portal)	Waiting room, badge distribution, communications center, records storage, security administration, offices, lockers, and showers	Two-story, architectural-steel frame with insulated metal siding	50 x 80	8,000

Site Plan Building Number	Facility Name	Areas	Type of Construction	Principal Dimensions (ft)	Floor Space* (ft^2)
220-3B	Security Station 2 (RCA/BOP portal)	Security check station, health physics offices	Single-story, architectural-steel frame with insulated metal siding	65 x 80	3,000
220-3C	Security Station 3 (RCA truck/rail portal)	Storage for contamination equipment, security check station, health physics offices	Single-story, architectural-steel frame with insulated metal siding	40 x 70	2,800
220-5A	Administration Building	Offices, laboratories, training rooms, and mechanical areas	Two-story, architectural-steel frame with insulated metal siding	100 x 220	44,000
220-5B	Food Service Facility	Kitchen, lunchroom, serving area, food/supplies storage, and rest rooms	Single-story, architectural-steel frame with insulated metal siding	60 x 180	11,000
220-5C	Training Auditorium	Auditorium	Single-story, architectural-steel frame with insulated metal siding	25 x 40 50 seat capacity	1,000
220-1B	Medical Center	Examination rooms, X-ray, medical labs, waiting room, ambulance garage, mechanical rooms, and offices	Single-story, architectural-steel frame with insulated metal siding	40 x 175	8,200
220-2	Fire Station	Apparatus room, communications room, equipment storage, firemen's quarters, offices, lunchroom, lockers, and showers	Single-story, architectural-steel frame with insulated metal siding	85 x 100	7,600
220-22	Computer Center	Computer room, mechanical equipment areas, offices, and central monitoring center	Single-story, reinforced-concrete structure	60 x 65	4,000
220-7	Central Warehouse	Storage space, receiving and shipping dock, offices, lunchroom, lockers, and showers	Single-story, (clear height 23 ft) architectural-steel frame with insulated metal siding	200 x 285	57,000
220-4A	Central Shops	Craft shops (electrical, mechanical, plumbing, welding, automotive, machining), central covered work area (not included in floor area), offices, lunchroom, first aid, and, lockers	Single-story, architectural-steel frame with insulated metal siding	200 x 285	57,000
220-4B	Motor Pool and Facility Service Station	Dispatch office, car wash, fuel storage, light maintenance, parking (heavy maintenance is off site)	Single-story, architectural-steel frame with insulated metal siding	30 x 40	1,200
220-6	Mockup Building	High-bay mockup room, classrooms, and offices	Single-story, architectural-steel frame with insulated metal siding	72 x 120	8,640

Site Plan Building Number	Facility Name	Areas	Type of Construction	Principal Dimensions (ft)	Floor Space* (ft^2)
N221-2	Utility Building	Water chillers, water boilers, cooling tower water make-up treatment, plant and instrument air compression.	Single-story, architectural-steel frame with insulated metal siding	100 x 220	22,000
Site Service Facilities					
N120-1C	General Parking	Car parking lots, bus loading areas, and bus parking lot	Asphalt	250 x 250	62,500
N120-1E	Cooling Tower	Cooling tower, cells, and pump basin			
N221-3	Visitor Center	Theater, meeting rooms, reception area, food service, offices, and restrooms		150 x 150	14,300
	Fire Storage Tanks and Pump Houses	Two tanks and two pump houses (Tank size and pump capacity not yet determined)	Steel tanks and single-story, architectural-steel frame with insulated siding buildings		
	Waste Water Pond	Waste water pond, waste water pipe	Pond is Polyvinyl Chloride (PVC) lined	500 x 500	
	Bulk Fuel Storage Tank	One tank (Tank size not yet determined)	Steel tank inside an earthen bermed area		
	Exterior Process Equipment	Three water tanks, one fuel tank, one liquid nitrogen dewar, and two tube trailers (Sizes not yet determined)			
	Storm Water Retention Pond	Storm water pond, storm water sewer piping	Pond is unlined	1,130 x 1,130	

Source: CRWMS M&O 1998f,Table 7-2

* Floor space is gross unless noted.

2.2 SITE ELECTRICAL POWER SYSTEM

2.2.1 Functional Description

The site electrical power system receives and distributes utility power to all North Portal site users (see Figure I-33, Attachment I, this document). The major North Portal users are the protected area, including the subsurface facility and BOP areas. The system is remotely monitored and controlled from the surface operations monitoring and control system. The system monitors power quality and provides the capability to transfer between offsite utility and standby power (including dedicated safeguards and security power). Security power is only distributed to essential security operations. The standby safeguards and security power is independent from all other site power. The system also provides surface lighting, grounding grid, and lightning protection from the North Portal. The system distributes power during construction, operation, caretaker, and closure phases of the repository. (CRWMS M&O 1999v, Summary)

Renewable energy sources, for providing electrical power, will be applied at the MGR. One application is that solar power will be used in conjunction with commercially available power to meet the power requirements of the MGR, which include the subsurface emplacement ventilation system. The solar power system will be constructed in a phase approach to match the subsurface ventilation requirements for WP emplacement. The solar power system shall also be capable of accommodating future modular-type expansion. Figures I-34 and I-35, Attachment I, this document, depict the potential MGR Solar Power System. (CRWMS M&O 1999w)

The system consists of substation equipment (disconnect switches, breakers, transformers, and grounding equipment) and power distribution cabling from substation to the North Portal switchgear building. Additionally, the system includes subsurface facility substation (located on surface), switch-gear, standby diesel generators, underground duct banks, power cables and conduits, switch-gear building, and associated distribution equipment for power distribution. Each area substation distributes power to the electrical loads and includes the site grounding, site lighting, and lightning protection equipment. The site electrical power system distributes power of sufficient quantity and quality to meet users' demands. (CRWMS M&O 1999v, Summary)

The site electrical power system interfaces with the North Portal surface systems requiring electrical power. The system interfaces with the subsurface electrical distribution system, which will supply power to the underground facilities from the North Portal. Power required for the South Portal and development side activities of the subsurface facility will be provided at the South Portal by the subsurface electrical distribution system. The site electrical power system interfaces with the offsite utility system for the receipt of power. The system interfaces with the surface operations monitoring and control system for monitoring and control. The site electrical power system interfaces with the offsite utility system for the receipt of power. The system interfaces with MGR Site Layout System for the physical location of equipment and power distribution. (CRWMS M&O 1999v, Summary)

2.2.2 Parameters and Assumptions

2.2.2.1 Parameters

This section to be completed during the License Application design phase.

2.2.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

2.2.2.2.1 There will be a minimum of one 138 kV transmission line with capacity to meet peak power.

Basis: *Site Electrical System Technical Report* (CRWMS M&O 1998i, Section 4.3.4)

Used in: Section 2.2.3

2.2.2.2.2 The main Substation is located near the North Portal Pad along the "H" road just west of the access road to the North Portal Pad.

Basis: *Site Electrical System Technical Report* (CRWMS M&O 1998i, Section 4.3.1)

Used in: Section 2.2.3.1

2.2.3 System Description

The site electrical power system receives and distributes electrical power to the power distribution equipment located throughout the MGR North Portal site. Power is transmitted to the MGR North Portal site from an offsite utility (Assumption 2.2.2.2.1). The 138 kV transmission line from the offsite utility terminates in the MGR main substation and is connected to transformers through substation power circuit breakers and disconnect switches. (CRWMS M&O 1998i, Section 7.2)

The site electrical power system has five distribution points: main substation, North Portal distribution, shaft emplacement substation, South Portal substation, and shaft development substation. These five distribution points are described as follows. (CRWMS M&O 1998i, Section 7.3)

2.2.3.1 Main Substation

The main substation, which is anticipated to be constructed, operated, and maintained by the MGR, is located near the North Portal pad along the "H" road, just west of the access road (Assumption 2.2.2.2.2). (CRWMS M&O 1998i, Section 7.4.1)

The transmission line terminates on a structural steel tower in the MGR main substation. The substation contains both structural steel and concrete. Structural steel is used as the material for disconnect switch mounts, breaker mounts, and any other equipment mounts. The disconnect switches, breakers, and other equipment are mounted on concrete pads. The transmission line connects to each transformer through a 138 kV power circuit breaker. Disconnect switches, located on both sides of the breakers, isolate the circuit breaker for maintenance. (CRWMS M&O 1998i, Sections 7.4.2 and 7.4.3)

Each of the main transformers is rated to provide the load requirements of the entire attached load. The transformers are also sized to supply power to future additions. The transformer ratings are in mega-volt amperes (Mva), oil immersed self-cooled/oil immersed forced air cooled (OA/FA). The voltages are in kV, with the primary windings connected in delta and the secondary windings in solidly grounded or mine safety grounded wye. They are oil filled and will have load tap changers if required by load conditions. (CRWMS M&O 1998i, Section 7.4.4)

The transformers step the voltage down to 12.47 kV for distribution to the North Portal. The secondary of each transformer is connected to a dedicated 12.47 kV circuit breaker located in the

main substation. The load side of the 12.47 kV breakers feed 12.47 kV distribution lines. Two of the 12.47 kV distribution lines are connected to the North Portal surface switchgear groups (switchgear "A" and switchgear "B" located in the North Portal switchgear building, and the third 12.47 kV distribution line, are connected to the North Portal subsurface non-QA-1 switchgear. The South Portal substation is fed by a 138 kV transmission line. (CRWMS M&O 1998i, Section 7.4.4)

The site electrical power system also includes the grounding system which consists of 1) a grounding grid for the surface substation, 2) a grounding grid located beneath each building, and 3) a separate subsurface grounding grid. The main surface substation-grounding grid is connected to the building ground grids. The subsurface ground grid is isolated from the surface ground grid. Electrical equipment as well as building structural steel is connected to each grid in accordance with applicable IEEE requirements. (CRWMS M&O 1998i, Section 7.4.4)

Each of the oil filled transformers will have containment dikes, and a firewall will be provided between each of the transformers to prevent mitigation of a fire. (CRWMS M&O 1998i, Section 7.4.4)

2.2.3.2 North Portal Distribution

Two 12.47 kV switchgear buses are located in a switchgear building in the North Portal surface substation. One is fed by each 15/20 Mva OA/FA transformer through a 12.47 kV distribution line to an incoming breaker located in the switchgear. Each switchgear (A and B) bus provides power to approximately half of the North Portal surface loads through a number of feeder breakers and transformers. A normally open tiebreaker allows one of the buses (and therefore one main transformer) to serve the entire facility in the event of a transformer, substation circuit breaker, or 12.47 kV distribution line failure. The WHB and WTB are fed radially from switchgear A and B. All other surface buildings are fed by a loop arrangement from either switchgear A or B. The switchgear is sized to serve future loads as described above for the main transformers. The main switchgear bus "B" also provides power to the shaft emplacement substation. (CRWMS M&O 1998i, Section 7.5.1)

A 12.47 kV switchgear bus is located at the North Portal entrance for supplying electrical power to the subsurface. It is fed by a 15/20 Mva OA/FA transformer through a 12.47 kV distribution line and an incoming breaker located in the switchgear. The switchgear bus provides power to the North Portal subsurface loads through a number of feeder breakers. (CRWMS M&O 1998i, Section 7.5.1)

The switchgear groups A and B are located in the existing switchgear building on the North Portal Pad. This building houses major switchgear, the associated equipment, and a local control panel for control of the substation breakers and transformer fans. The equipment is accessed for installation, removal, or maintenance through double swinging doors. (CRWMS M&O 1998i, Section 7.5.2)

Power is distributed to secondary substations consisting of pad mounted transformers and disconnect switches throughout the MGR by 15 kV class cables of appropriate ampacity. These

cables terminate in secondary substation transformer disconnect switches. These switches allow the removal of a secondary substation without affecting the continued operation of the remaining secondary substations. Cables that penetrate the protected area will be routed through conduit banks in order to meet applicable security requirements. Conduit banks are also provided under roads and railroad tracks for physical protection of the cables. Power is distributed from the secondary substations to the various buildings. (CRWMS M&O 1998i, Section 7.5.3)

Emergency power will be provided by a diesel generator located at each distribution location that has QA-1 electrical loads (North Portal, Shaft Emplacement, and Shaft Development). Emergency power is defined as an independent reserve source of electric energy that, upon failure or outage of the normal source, provides reliable electric power to critical devices and equipment whose failure to operate satisfactorily would jeopardize the health and safety of personnel or result in damage to property. This backup power source is provided to ensure the continued operation of equipment/systems designed to prevent radiological releases to the environment in the event of a loss of normal power. Only loads meeting this definition will be tied to these emergency diesels. (CRWMS M&O 1998i, Section 7.5.4)

The security system at the MGR facilities will be designed using the requirements of comparable DOE surface facilities (10 CFR 60.31b), such as the Monitored Retrievable Storage facility which is governed by 10 CFR 72 which references 10 CFR 73 for security. 10 CFR 73 requirements will be applied to the surface facilities, which will likely be removed once the repository is closed. 10 CFR 73.50e(4) states that "All communication equipment, including offsite equipment, shall remain operable from independent power sources in the event of a loss of primary power." 10 CFR 73.46e(6) states that "All alarms required by this section shall remain operable from independent power sources in the event of the loss of normal power. Switchover to standby power shall be automatic and shall not cause false alarms on annunciator modules." Intrusion detection equipment, alarm annunciation equipment, security lighting, equipment to provide assessment of alarms, and communication equipment will be provided with independent power sources, in order to meet these requirements. A diesel generator and uninterruptible power supply equipment will be provided for this purpose. (CRWMS M&O 1998i, Section 7.5.5)

A backup diesel generator will be provided at the entrance to the subsurface to provide backup power for ventilation, lighting, etc., upon a loss of normal power for evacuation of personnel who may be underground during the loss of offsite power. This backup diesel generator may be used to provide supplementary power to the Solar Power System Subsurface Ventilation System. (CRWMS M&O 1998i, Section 7.5.6)

2.2.3.3 Shaft Emplacement Substation, South Portal Substation, Shaft Development Substation

The south portal substation receives site electrical power from a 138 kV power transmission line and the shaft emplacement and shaft development substations receive site electrical power from a 12.47 kV power distribution line. A diesel generator provides for standby power to these substations. (CRWMS M&O 1998i, Sections 7.6, 7.7, and 7.8)

2.2.4 Operational Description

The site electrical system will operate within the environmental conditions of the site and will provide an availability *factor* of greater than 0.9883. (CRWMS M&O 1999v, Section 1.2.5.1)

2.3 SITE WATER SYSTEM

This section discusses the design of the various water systems supporting operations within the surface facilities area at the North Portal. Identification of the various water systems is made in the included subsections. Potable (sanitary) water from the potable water tank is chlorinated, and during operation of the MGR, potable water will only be used for potable purposes (e.g., showering, drinking, cooking, etc.). All other water consumed in operations at the North Portal surface facilities utilizes raw well water (i.e., non-chlorinated water). Figure II-6 presents a simplified block flow diagram of the water system for the North Portal surface facilities.

The MGR site water system has been classified as CQ (CRWMS M&O 1999g, Table 1). The only exception to this classification is for the de-ionized water system that provides make-up water for the assembly transfer and lag storage pools within the WHB. This system has been classified as QL-3. (CRWMS M&O 1999d, Table 1)

2.3.1 Well Water Supply

2.3.1.1 Functional Description

The function of the well water supply system is to provide well water from the NTS from Well J13 (CRWMS M&O 1995a, Reference Drawing No. YMP-025-1CIVL-CI108, CI109, and CI110, Rev 00, Sheets 1, 2 and 3), and associated wells, for consumption during activities at the MGR.

The well water supply system is included in the MGR Offsite Utilities System and designated as CQ. (CRWMS M&O 1999c, Table 1)

2.3.1.2 Parameters

As identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1), it is required that the Repository Segment connects with the existing NTS water supply system.

2.3.1.3 System Description

Prior to operation of the MGR, modifications to the existing well water supply system are required. These modifications include the installation of new pipelines, new pumps, and additional tanks to provide sufficient water surge demand. (CRWMS M&O 1998j, Section 7.1.8) (CRWMS M&O 1998f, p 41)

Water, both for potable and non-potable use, is pumped to Exile Hill, and placed into a 50,000-gal tank for potable water, and a 100,000-gal tank for non-potable water. The potable

water is chlorinated in the 50,000-gal tank. Water flows from these two tanks by gravity to the North Portal Surface Facilities. Figure I-22, Attachment I, this document, presents an illustration of the well water system.

2.3.1.4 Operational Description

Water supply pumps and tank levels are controlled and managed through local computer control. Redundant pumps are installed to ensure that water pressure is maintained in the supply system.

2.3.2 Potable Water System

2.3.2.1 Functional Description

The function of the potable water system is to provide potable water to all normally occupied NPSFs for consumption by personnel for drinking, washing/showering, cooking, etc. Potable water will also be provided to facilities and facility areas for safety equipment use (e.g., safety showers, eye washes).

2.3.2.2 Parameters

The water system is designed to the criteria identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.1):

- Each utility service system (i.e., fire protection water, potable water for safety showers and eye washes, and breathing air) that is ITS shall be designed so that essential safety functions can be performed under both normal and accident conditions.

- Where the possibility exists for the eyes or body of any person to be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the immediate work area for emergency use.

- Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6.

- The potable water system shall be designed and installed to comply with Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

The water quality monitoring system shall have the capability to sample, measure, and analyze physical, chemical, and biological conditions consistent with the requirements of the CWA (33 USC 1251) and the Safe Drinking Water Act (42 USC 300f). Such capability shall also be compatible with the type and range of concentrations/occurrences of conditions specified in governing regulations (e.g., 40 CFR 122, 141, 143, and State and local regulations).

2.3.2.3 System Description

A new water line is connected to the existing 8-in. potable water line, to provide potable water to the North Portal Surface Facilities. The connection is near the point where the existing water line enters the North Portal area (CRWMS M&O 1998j, Section 7.1.1). To provide sufficient surge capacity, a new potable water tank is installed at the Utility Building (CRWMS M&O 1998j, Attachment III, p 1). Potable water is then pumped through distribution piping throughout the NPSFs.

Potable water is sampled and analyzed at the Utility Building to ensure that it meets identified drinking water quality criteria. Provisions are included to augment water sterilization (e.g., addition of hypochlorate) if necessary. The water pumps at the Utility Building are connected to back-up electrical power to ensure that safety shower and eye wash water is available in the event of an electrical outage.

2.3.2.4 Operational Description

Water supply pumps and ank levels are controlled and managed through local computer control. Redundant pumps are installed to ensure that water pressure is maintained in the supply system.

2.3.3 Water Softening and Supply System

2.3.3.1 Functional Description

The function of the water softening and supply system is to provide softened water for use in non-radiological facility cleaning and for cooling tower supply/makeup water.

2.3.3.2 Parameters

Utility water (softened) system capacity is as defined in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.5.1).

2.3.3.3 System Description

As identified in a drawing, *Exploratory Studies Facility Package 1A, ESF Water System Supply and First Access P&ID Sheet 1* (CRWMS M&O 1995a), untreated well water presently comes to the North Portal area from the fire water storage tank (200,000 gal) used for ESF operations. A new 8-in raw water supply main extends from the 10-in main line, just external to the RCA, to the Utility Building. This new line provides well water for feed to the water softening and supply system, for feed to the de-ionized water treatment and supply system, and for firewater supply for the NPSFs Firewater Storage Tanks. The Water Softening and Supply System concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.5).

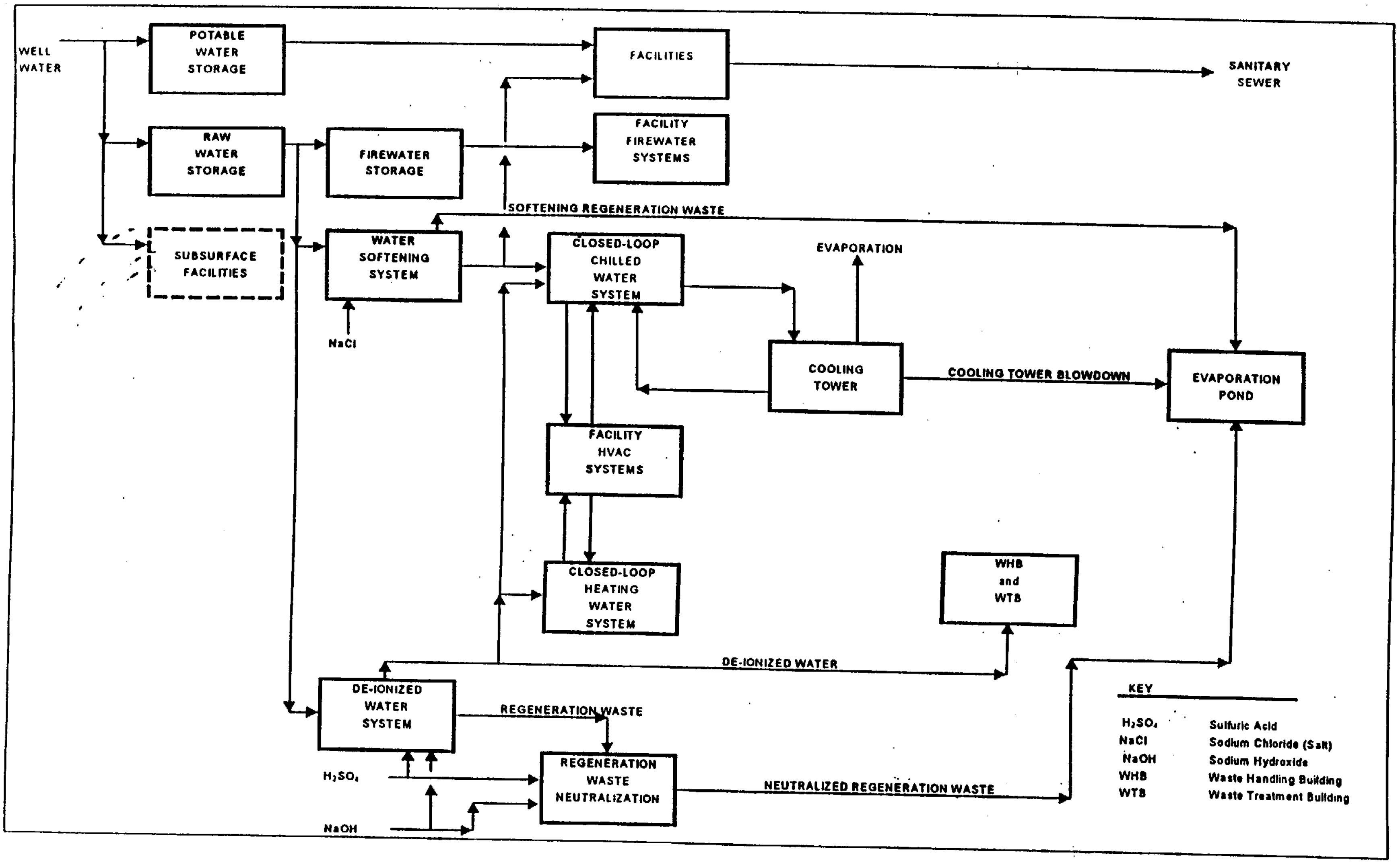

Figure II-6. Block Flow Diagram of the Water System for the North Portal Surface Facilities

The primary use for this raw well water is for the production of softened water for makeup to the cooling tower. Softened water is also made available through distribution piping for use as utility water for such activities as non-RCA facility wash down and housekeeping.

The water softening system is a multiple bed system. The number of beds is defined such that, at maximum flow rate through the softening system, at least one bed will either be regenerating or on standby. To minimize the amount of water and salt consumption for regeneration purposes, the system monitors the hardness of the processed water, and automatically transfers between beds prior to breakthrough of an operating bed. A surge tank is used in the system to level flows through the ion exchange beds and to handle short-term peak flows.

2.3.3.4 Operational Description

The water softening system and the utility water supply system are operated under local computer control. Redundant pumps are provided to ensure utility water supply pressure is maintained.

2.3.4 Chilled Water System

2.3.4.1 Functional Description

The function of the CHW system is to provide HVAC cooling throughout the NPSFs.

2.3.4.2 Parameters

The CHW system shall be designed to the criteria identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.2):

- HVAC equipment in facilities shall be sized to conform to the guidelines in NUREG 0700, Section 6.1.5, MIL-STD-1472D Section 5.8.1, and applicable ASHRAE standards.
- The capacity of the cooling and heating system shall be sized sufficient to handle the peak block load or the maximum simultaneous cooling and heating loads of all the buildings and in accordance with ASHRAE standards.

2.3.4.3 System Description

Because of the cooling loads associated with the size and quantity of surface facilities at the North Portal, a centralized closed-loop CHW system is used to provide building cooling through the complex and process cooling for the WTB. The centralized CHW system is located in the Utility Building. The centralized CHW system concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.2). The CHW system is a closed-loop system. The CHW system provides process cooling to the WTB. Process cooling systems in the WHB (e.g., storage pool water-cooling) are provided by their own dedicated closed-loop systems.

The central cooling plant consists of chillers, primary (chiller loop) pumps, secondary (distribution loop) pumps, controls, and ancillary equipment. The chiller loop pumping system is a constant-flow type system. To handle the variations in cooling loads, the operation of the chillers is sequenced by monitoring the CHW return temperature. The distribution loop pumping system is a variable-flow type system.

The central CHW system uses a number of electric-driven water-cooled centrifugal chillers. The total peak cooling load requirements are handled equally by the chillers. The chillers utilize environmentally acceptable refrigerant (e.g., R143).

The primary CHW pumping system consists of multiple pumps, one pump per chiller with a spare pump in standby. The secondary CHW pumping system consists of multiple pumps, the same number as the primary pumps, with a spare pump in standby. The secondary CHW piping loop starts at the Utility Building, extends around the site to all CHW users, and then returns to the Utility Building.

2.3.4.4 Operational Description

The control system for HVAC systems (CHW service and HW) is in the control room of the Utility Building. Primary controls are in the Utility Building, and secondary controls are remote (e.g., cooling tower). System parameters are transmitted over the control local area network (LAN) to the computer control center.

2.3.5 Cooling Tower Water System

2.3.5.1 Functional Description

The function of the cooling tower water system is to provide evaporative cooling capacity for the site CHW system.

2.3.5.2 Parameters

Cooling water makeup is provided by the softened utility water system as discussed in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.5.1).

2.3.5.3 System Description

A central cooling tower water system provides cooling water for heat removal from the chiller condensers. The cooling tower water system consists of cooling towers, circulation pumps, controls, and ancillary equipment. Capacity control is based on water temperature in the cooling tower sump. Control is maintained through the cycling of the cooling tower fans, through the bypassing of the cooling tower return to the tower sump, and/or through the shutting down of a cooling tower cell and its associated pump. The cooling tower water system concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.3).

2.3.5.4 Operational Description

The water level in the cooling tower sump is controlled along with the amount of blowdown water through a local process control system.

2.3.6 Heating Water System

2.3.6.1 Functional Description

The function of the HW system is to provide HW required for providing HVAC heating and hot water heating throughout the NPSFs.

2.3.6.2 Parameters

The HW system shall be designed to the criteria identified in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.1.2):

- HVAC equipment in facilities shall be sized to conform to the guidelines in NUREG 0700 Section 6.1.5, MIL-STD-1472D Section 5.8.1, and applicable ASHRAE standards.

- The capacity of the cooling and heating system shall be sized sufficient to handle the peak block load or the maximum simultaneous cooling and heating loads of all the buildings and in accordance with ASHRAE standards.

2.3.6.3 System Description

A central heating plant at the Utility Building provides HW through a closed-loop system to the NPSFs. The central heating plant consists of heaters, distribution loop pumps, controls, and ancillary equipment. The temperature of the supply HW is reset automatically by representative building heating loads and/or outside air temperature. The HW system is a closed-loop system. The distribution loop pumping system is a constant-flow type system. Steam will not be provided for large-scale use. Any steam requirement is provided locally where needed (e.g., maintenance steam-cleaning equipment) and excluded from centralized utility operation.

The central plant hot water system consists of multiple oil-fired, water heaters. The total peak heating demand is shared equally by these multiple heaters. The primary HW pumping system consists of multiple pumps, one pump per heater, with one additional pump in standby. The closed-loop HW piping starts at the Utility Building, extends around the site to all the HW users, and then returns to the Utility Building. The centralized HW system concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.4).

2.3.6.4 Operational Description

The control system for HVAC systems (CHW service and heating water) is in the control room of the Utility Building. Primary controls are in the Utility Building, and secondary controls are remote (e.g., cooling tower). System parameters are transmitted over the control LAN to the computer control center.

2.3.7 De-Ionized Water System

2.3.7.1 Functional Description

The function of the de-ionized water system is to provide de-ionized water required for several operations within the NPSFs. The primary consumer of de-ionized water is makeup water provided to the assembly storage pools and to the assembly transfer pools in the WHB. Other de-ionized water users include the CHW system, the HW system, makeup water to the recycled water system in the WHB and WTB, and for decontamination operations where recycled water is not available.

2.3.7.2 Parameters

The de-ionized water system is designed to provide de-ionized water with a conductivity of 2 micro-siemens (CRWMS M&O 1998j, Section 7.1.6.1).

2.3.7.3 System Description

The primary use of de-ionized water within the NPSFs is for makeup water for the fuel storage pools within the WHB. The de-ionized water system concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.6).

The ion exchange system uses two parallel sets of ion exchange beds. One set of beds is in operation while the other set of beds is either being regenerated, or is in standby after being regenerated. A set of beds consists of two ion exchange beds in series (i.e., cation exchange followed by anion exchange). Tanks are provided for acid storage and caustic storage. The acid and caustic solutions are utilized for regeneration of the cation beds and the anion beds, respectively. The conductivity of the water being de-ionized is monitored to ensure that change over to the standby beds occurs just prior to breakthrough. Operation in this manner minimizes the amount of acid, caustic, and de-ionized rinse water consumed in regeneration activities.

A surge tank is used for the interim storage of de-ionized water, and two pumps, one operating, one on standby, are used to pump de-ionized water to end users. Because the de-ionized water is used in the handling and storage of SFAs, the de-ionized water pumps are connected to standby power to ensure water availability in the event of a long-term power outage.

2.3.7.4 Operational Description

The de-ionized water system is controlled through the use of a process controller located in the Utility Building.

2.3.8 Evaporation Pond and Storm Water Disposal

2.3.8.1 Functional Description

The function of the evaporation pond and storm water disposal system is to provide an environmentally acceptable method for disposal of cooling tower blowdown water, ion exchange bed regeneration water, storm water, etc., as required to support operations of the NPSFs.

2.3.8.2 Parameters

Evaporation and precipitation data are taken from the *Surface Wastewater Calculation* (CRWMS M&O 1993).

2.3.8.3 System Description

Blowdown water from the cooling tower is sent to the evaporation pond for retaining and disposal through evaporation. The regeneration wastes from the water softening system and the de-ionized water system are also sent to the evaporation pond. Radiologically contaminated water is excluded from this system through double barriers and through an inline monitoring/diversion system. The pond is lined to prevent leaching of dissolved solids in these waste streams into the soil column. The pond is sized to permit total evaporation. The evaporation pond concept is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.11).

Water to be evaporated in the evaporation pond is collected in gravity collection piping and transferred to the evaporation pond. Manholes are provided in this collection system at angle points and required grade breaks.

Rainwater collected from roadways, graded areas, and roof surfaces are excluded from entering the evaporation pond.

Gravity collection lines are installed to connect catch basins and roof drains for the transpiration of rainwater to the rain water retention pond. This pond is unlined, and storm water is disposed of through both evaporation and percolation into the soil column.

2.3.8.4 Operational Description

Operation of the system requires no operator or other mechanism for control.

2.3.9 Sanitary Waste

2.3.9.1 Functional Description

The function of the sanitary waste system is to provide an environmentally acceptable method for disposal of sanitary wastes as required to support operations of the NPSFs.

2.3.9.2 Parameters

The sanitary waste system shall be designed and installed per the criteria identified in Section 4.2.1.3 of the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j):

- The design, construction, and operation of sanitary sewage handling and disposal systems shall be permitted in accordance with the CWA, 33 USC 1251 et. seq. Section 1345, and applicable State laws.

2.3.9.3 System Description

The drain field for the sanitary waste water system is designed for a daily flow of 20,000 gpd. The system design is to the requirements as identified in NAC 555.750 through NAC 444.840 and the UPC. (paragraph from CRWMS M&O 1995c)

2.3.9.4 Operational Description

Operation of the system requires no operator or other mechanism for control.

2.3.10 Fire Water System

2.3.10.1 Functional Description

The site water system is classified as CQ in accordance with the *Classification of the MGR Site Water System* (CRWMS M&O 1999g, Section 7.1). The fire water supply system, which was originally installed to support exploratory operations at the North Portal, has insufficient capacity to provide adequate fire protection water for future NPSFs. The fire water supply system for the NPSFs utilizes both the previously installed main well water supply line and the 200,000 gal storage tank to provide supply to the North Portal fire water system. The fire water system and supply is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.1.7).

2.3.10.2 Parameters

This section to be completed during the License Application design phase.

2.3.10.3 Assumptions

This section to be completed during the License Application design phase.

2.3.10.4 System Description

Two fire water tanks and two firewater pump-houses are to be utilized (tank sizes not yet determined). Each pump-house will contain one electrically-driven fire water pump, one jockey pump to maintain system pressure, and one-diesel-driven pump for backup in the event of an electrical outage. A diesel fuel day tank will be located at each pump-house to provide fuel for the diesel firewater pump. The two tanks and two pump houses will be sufficiently apart that seismic hardening of the tanks and pump-houses is not required. (CRWMS M&O 1998j, Section 8.1)

The water for the fire fighting activities for automatic and manual suppression systems will be provided by two sources with sufficient flow and pressure. It is expected that the maximum requirement for sprinkler demand will be the palletized and rack storage in the Central Warehouse Building. This type of sprinkler system will require that the sprinklers be designed in accordance with NFPA 13 for an "Extra Hazard, Group 2" occupancy. This protection will require a density of 0.4 gpm/sq ft over the remote 2,500 sq ft. The inside hose allowance is 250 gpm and the outside allowance is 500 gpm. DOE and NRC guidelines require that the flow to

the sprinkler system be available for 2 hr. DOE requires that a 500 gpm hose stream be included in the calculation. NFPA 231, *Standard for General Storage,* 1995 and NFPA 231C, *Standard for Rack Storage of Materials, 1995,* require the installation of an inside hose station and an allowance for it in the calculation. The flow for the sprinkler system is expected to be (0.4 gpm/sq ft x 2,500 sq ft =) 1000 gpm. An additional 25 percent is added to allow for balance of the sprinklers; this brings the total flow to (1,000 gpm x 1.25 =) 1,250 gpm. Total flow is therefore (1,250 gpm + 250 gpm + 500 gpm =) 2,000 gpm. (paragraph from CRWMS M&O 1998j, Section 7.1.7.1)

The pressure requirement is based on the flow to the sprinklers in the highest building. It takes 0.433 psig to raise water one foot in elevation. For a 120-ft high building, it will take (120 ft x 0.433 psig/ft =) 52 psig. The end head pressure of an operating sprinkler system is typically about 20 psig. The friction loss through the sprinkler system at the required flow rate is typically designed to be about 25 psig. Friction loss in the mains and pumping station is typically designed to about 15 psig at the required flow rate. This requires a total pressure of approximately (52 psig + 20 psig + 25 psig + 15 psig =) 112 psig to allow the system to operate as designed. The closest listed or approved pump to this value is 125 psig. The tank size is calculated by multiplying the required flow rate of 2,000 gpm by the two hour requirement for flow (2,000 gpm x 60 min/hr x 2 hr =) 240,000 gal. The nearest listed or approved tank size is 250,000 gal. Each fire source will have two pumps rated at 2,000 gpm at 125 psi (one diesel and one electric) taking suction from a 250,000 gal tank. A jockey pump will be provided at each location. The suction tank will be refilled from the site water system. The suction tanks can supply the automatic sprinkler and hose stream demand flows for two hours as required by DOE and NRC guidelines. (paragraph from CRWMS M&O 1998j, Section 7.1.7.1)

2.3.10.5 Operational Description

The two fire water tanks supply a looped system at opposite ends of the loop. The WHB and WTB are dual fed from the loop to ensure that firewater is provided in the event of a main section break. Each fire pump in either location is able to provide the required amount of fire protection water. Pressure is maintained in the system by either jockey pump. The electrical fire pump will start when the required pressure cannot be maintained by the jockey pump(s), indicating a sprinkler system has activated or a hydrant is being utilized. The diesel pump(s) will start on power failure to the pump house. (CRWMS M&O 1998j, Section 7.1.7.1)

Each pump house is heated, provided with an automatic fire suppression system, and contain the heating system for the suction tanks as required by NFPA 22 Chapter 13. Tank heating is provided by a pump that circulates hot water through the tank. The circulated hot water is heated by a diesel fired hot water boiler. The operation of the fire pumps, tank water levels, and tank water temperatures is monitored by the fire alarm system. Alarms from this monitoring system are transmitted to the CAS in the Fire Station. (paragraph from CRWMS M&O 1998j, Section 7.1.7.1)

Water mains for fire protection are separated from other plant water systems. Valves are utilized in main piping so that each pumping source can be isolated without impacting the operation of the other pumping system. (CRWMS M&O 1998j, Section 7.1.7.1)

Each sprinkler system for the nuclear facilities is provided with its own lead-in that can be isolated from other systems. Dual feeds, sectional valves, and separate lead-ins allow the sprinkler systems to remain in operation even with a main break. Manual fire-fighting activities are provided by fire hydrants and small diameter hose stations. (CRWMS M&O 1998j, Section 7.1.7.1)

The layout of fire hydrants is based on approximately 300 ft between hydrants to ensure that total hose length in the fighting of a fire is no greater than 300 ft. The hydrants are located 50 ft or more from buildings per the requirements of NFPA 24. Post indicator valves for section valves and sprinkler system control valves are provided. The sprinkler system control valves are located 40 ft or more from buildings in accordance with NFPA 13. (paragraph from CRWMS M&O 1998j, Section 7.1.7.1)

Fire Protection standards for the Repository Segment are imposed by various authoritative sources. In the event of conflict, the requirements affording greater protection (as determined by design technical report) prevail. (CRWMS M&O 1998j, Section 4.2.1.2.3)

2.4 SITE COMMUNICATION SYSTEM

2.4.1 Functional Description

The Site Communication System includes a number of different communication systems. The function of these systems is to provide communications with various administrative organizations within and outside the MGR, with the Surface and Subsurface I&C systems, and with the S&S/ERS.

Some examples of communication systems include (CRWMS M&O 1998h, Section 7.2.2):

- Site Radio System
- Pager System
- Data Local Area Networks
- Sitewide Telephone System
- Hot Lines Telephone System
- Offsite Emergency Communication Interfaces
- Sitewide Emergency Notification System

The functional operations of these various systems will provide communication between operating personnel, Human Machine Interfaces (HMIs), visual/audible alarming, local/distributed control functions, and monitoring of site parameters.

2.4.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.4.3 System Description

The Site Communications System provides the staff, facilities, and materials necessary to provide secured communications capability to monitor, alarm, and control the GROA facilities.

The System includes a Central Command and Control Center (CCCC) located inside the Administration Building (CRWMS M&O 1998h, Section 7.3.1). The CCCC contains all of the network communication equipment and automated data processing equipment necessary to maintain and operate the Site Communication System.

The CCCC is networked over the entire MGR site via LANs, telephone lines, PA system, and very high frequency two-way radio communications.

The CCCC provides the operator consoles and human machine interfaces to monitor the site alarm system, provide messages, and advisories to operating personnel at other facility monitoring stations, and control the Site Communication System networking capability in the complex.

The Site Communication System interfaces with the following (CRWMS M&O 1998h, Section 7.3.1):

- Surface Facility Control Stations
- Subsurface Facility Control Stations
- Utility Systems Monitoring and Control Stations
- Emergency Detection and Response Stations
- Health Safety System
- Safeguards and Security System
- Environmental Monitoring System

A site radio system will be provided to serve the radio communication needs for a minimum of 15 years. The system will be used for normal operations, maintenance functions, and off-normal/emergency response situations. (CRWMS M&O 1998h, Section 7.2.2.1)

LANs will connect all users of personal computers and workstations to shared resources. (CRWMS M&O 1998h, Section 7.2.2.2)

Some common functions of the LAN are:

- Electronic mail (e-mail)
- Common file storage
- Software application access
- Internet access

A site-wide telephone system consisting of a private automatic branch exchange will be installed to furnish internal and external telephone communications. (CRWMS M&O 1998h, Section 7.2.2.3)

Offsite communication will be provided by:

- Microwave communications
- Satellite dishes
- Radio systems

- Telephone
- Audible visual annunciation such as sirens and rotating beacons

In addition to the CCCC in the administration building, there will be a telecommunications room. Each of the major buildings on the site will house a telecommunications room to interface with the telephone system, the data acquisition hardware, and the LAN. (CRWMS M&O 1998h, Section 7.2.2)

2.4.4 Operational Description

The principle communication center is the CCCC located in the administration building. Principle communication will occur between the administration building, WHB, WTB, CPB, and the subsurface facilities. (CRWMS M&O 2000m, Section 5.4)

2.4.4.1 Administration Building Central Control Center

The administration building CCC is the location for the MGR I&C system operator consoles. The Control System is connected via a LAN to a CCC located in the WHB and to the Subsurface I&C system located on the surface facilities. The instrumentation in the CCCs communicates with their control cabinets via local control networks.

Communication occurs between the CCCs and the subsurface operators over the LANs, PA system, phone lines, and radio transmission.

2.4.4.2 Waste Handling Building Central Control Center

The WHB CCC houses the operator consoles that control operations within the WHB. Many of the operations within the WHB are controlled by LCC located in the operating galleries. Communications between the CCC operators and the LCC operators are over LANs, dedicated hardwired communications lines, phone system, and PA announcements.

2.4.4.3 Subsurface Repository Integrated Control System

Communications between the WHB, administration building CCCs, and the Subsurface I&C System will be over the LAN, phone system, and radio communication. The Subsurface I&C System will interface with its operating systems over local control networks.

2.5 SITE COMPRESSED AIR SYSTEM

The compressed air system includes air supply for both shop/instrument air and breathing air. The air compressors, surge tanks, and ancillary equipment are located in the Utility Building. The compressed air system is described in detail in the *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 7.2).

The site air compression system, the industrial air distribution system, and the instrument air distribution system have been classified as CQ. (CRWMS M&O 1999e, Table 1)

2.5.1 Breathing Air System

2.5.1.1 Functional Description

The function of the breathing air system is to provide breathing air through hose connections in the WTB and WHB for the purposes of allowing personnel access into the cell areas for the performance of non-routine maintenance and/or to correct off-normal occurrences.

2.5.1.2 Parameters

The breathing air system is designed per the requirements of ANSI Z88.2-92, Practices for Respiratory Protection; 29 CFR 1910 (OSHA), Selected General Industry Safety and Health Standards; and CGA, ANSI/CGA G-7.1-1966, Commodity Specifications for Air. The provided air quality is per the requirements of ANSI/CGA G-7.1. (paragraph from CRWMS M&O 1998j, Section 4.4)

The *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.2.2) identified the following criteria for breathing air systems:

- When it is not practicable to apply process or other engineering controls in restricted areas to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the repository shall, consistent with maintaining the total EDE ALARA, have the capability to increase monitoring and limit intakes by one or more of the following: control of access, limitation of exposure times, use of respiratory protection equipment, and other controls.

- Each utility service system (i.e., fire protection water, potable water for safety showers and eye washes, breathing air) that is ITS shall be designed so that essential safety functions can be performed under both normal and accident conditions.

2.5.1.3 System Description

The *Site Gas/Liquid Systems Technical Report* (CRWMS M&O 1998j, Section 4.4) describes the system as follows:

- The air compressors and equipment are designed to meet the criteria in OSHA 29 CFR 1910.134 – Respirator Protection. To maintain operator comfort, the breathing air temperature at the respirator is maintained between 45° – 80° F. The breathing air supply equipment and distribution piping is designed to provide 15 SCFM/outlet. Delivered air pressure at both the WHB and WTB is 135 psig. To provide sufficient reserve capacity for emergency egress in the event of a main air system outage, a 1,000 gal (150-psig) air reserve tank is installed.

- The air compressors are two (redundant) water cooled, non-lubricated screw compressors, with dual air purifiers and a single carbon monoxide detector. The electric motors for the compressors are connected to standby power to provide breathing air in the event of a lengthy power outage.

2.5.1.4 Operational Description

The breathing air system is controlled from a control system located in the Utility Building. No operator interface is required with the exception of the performance of routine maintenance.

2.5.2 Instrument and Shop Air System

2.5.2.1 Functional Description

The function of the instrument and shop air system is to provide compressed instrument and shop air as required for certain minimal activities within the WHB, WTB, CPB, and in the Central Shops Building.

2.5.2.2 Parameters and Assumptions

This section to be completed during License Application design phase.

2.5.2.3 System Description

The receiver for instrument/shop air is sized to allow for a reasonable shutdown of equipment in the event of compressor(s) failure.

Because the compressors for breathing air are infrequently used, these compressors are utilized to produce the compressed instrument shop air. This is appropriate as long as the two receivers and distribution systems are totally independent.

2.5.2.4 Operational Description

The instrument and shop air system is controlled from a control system located in the Utility Building. No operator interface is required with the exception of the performance of routine maintenance.

2.6 SITE FIRE PROTECTION SYSTEM

2.6.1 Functional Description

The Site Fire Protection System is classified as QL-2 in accordance with the *Classification of the MGR Waste Handling Building Fire Protection System* (CRWMS M&O 1999j, Section 7.1). The design scope includes explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on SSCs ITS (CRWMS M&O 1998j, Section 4.2.1.2.1). Each utility service system (i.e., fire protection water) that is ITS will be designed so that essential safety functions can be performed under both normal and accident conditions (CRWMS M&O 1998j, Section 4.2.1.2.2).

2.6.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.6.3 System Description

The system shall comply with the applicable provisions of "Facility Safety" (DOE Order 420.1) and "Implementation Guide for use with DOE Orders 420.1 and 440.1 Fire Safety Program." For requirements governed by both the NRC and DOE Order 420.1, NRC requirements take precedence. (CRWMS M&O 2000s, Section 1.2.6.3)

Fire and explosion detection and alarm systems are required in SSCs ITS (CRWMS M&O 1998l, Section 4.2.29). A fire alarm system shall be installed in each major facility to warn occupants of a fire, to activate the automatic fire protection systems, and to alert the fire response personnel (CRWMS M&O 1998l, Section 4.2.34). Display interface stations will be used to collect, store, and display information from the site safety related systems including surface and subsurface fire systems (CRWMS M&O 1998l, Section 7.1.1.1.1).

The Fire Station System consists of the fire station, fire fighting and emergency response equipment and staff, hazardous materials response equipment, ambulance, staff support facilities and equipment, and associated records system. Support auxiliary systems include emergency communications, fire detection and suppression, and site utilities. The functions of the fire station include:

- Equipment housing and control
- Fire response and suppression
- Hazardous materials release response
- Medical emergency initial response and transport
- Staff quartering and housekeeping
- Staff training
- Fire station equipment and monitoring.
- Fire alarm siting and monitoring

Fire-fighting equipment provided (including trucks) will meet the need for structural and wildland fire fighting. The fire station system will also provide ambulance service and house the hazardous material response team and equipment. The fire station system will likely also support underground and south portal facilities and activities. These facilities and activities are out of the scope of this document, but must be considered in future efforts (CRWMS M&O 1998l, Section 7.1.1.2).

2.6.4 Operational Description

The site wide enterprise fire detection, annunciation, and suppression systems consists of the staff, facilities, and equipment necessary to detect, annunciate, and suppress fire. Auxiliary systems include site emergency communications. The central fire annunciation station in the fire station will monitor the fire alarm systems throughout the site. This system will monitor various sprinkler systems, deluge systems, fire pump systems, suction tank head and levels, special fire protection system, and the fire detection systems. The fire alarm systems in the various facilities and buildings will sound in the buildings and be transmitted to the fire station by a radio system or over dedicated telecommunications copper-based loops. Suppression includes the fire fighters and response equipment that respond to detected fires. Individual facility and component fire

suppression systems, although part of the site-wide fire detection, annunciation, and suppression system identified in this section, are considered unit control and operation (Level 3) subsystems, and are discussed with the facilities that they protect. The fire detection, suppression and annunciation will likely also support or interface with underground and south portal facilities and activities. (CRWMS M&O 1998l, Section 7.1.1.4)

The site fire alarm annunciation and monitoring system shall receive automatic fire detection and suppressions signals from the following facilities and equipment, as summarized from the *Site Safety and Security Systems Technical Report* (CRWMS M&O 1998l, Section 7.2):

- Administration Complex
- Standby Generators
- Electrical Switchgear Building
- Security Facilities
- Medical Facilities
- Boiler Facility
- Fire Station
- Computer Center
- Central Warehouse
- Central Shops
- Motor Pool and Facility Service Station
- Mockup building
- Cooling Tower
- Utility Building
- Waste Handling Building
- Waste Treatment Building
- Carrier Preparation Building
- Subsurface Facility
- North Portal Airlock Building

2.7 SITE RADIOLOGICAL PROTECTION SYSTEM

2.7.1 Functional Description

This system to be completed during the License Application design phase.

2.7.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.7.3 System Description

The radiological safety system will ensure that activities associated with operating, monitoring, and closing a repository will not expose workers or the public to radiation doses above applicable regulatory limits. Moreover, the DOE will implement its policy of keeping both occupational doses and possible doses to the public ALARA.

The radiological safety system will establish the controls for assuring that the repository and its operations will have appropriate and sufficient radiation protection features. The system will cover such aspects as facility designs, operational activities, and facility policies to assure radiation safety. The radiological safety system is part of the overall formal radiation protection program for controlling radiological areas, approving radiological work, and monitoring worker exposures. (Dyer 1999, Section 112)

This section to be completed during the License Application design phase.

2.8 SURFACE ENVIRONMENTAL MONITORING SYSTEM

2.8.1 Functional Description

The Surface Environmental Monitoring System (SEMS) includes the facilities, equipment, personnel, and instrumentation to support the following functions (CRWMS M&O 1998l, Section 7.1.4):

- Maintain environmental data quality objectives
- Acquisition of environmental (weather, seismic, air quality, and groundwater) and radiation data
- Distribution of environmental information
- Confirmation of compliance
- Detection of contamination

The functional operation of the SEMS will provide the data acquisition and analysis to support the functions listed above. The system will utilize the services of several contract special test laboratories across the United States, as well as an onsite environmental laboratory system.

2.8.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.8.3 System Description

The SEMS operates with monitors and test instrumentation located at selected strategic locations throughout the facility. A complete data management system for compliance purposes is included to store the analysis and reports required for distribution of environmental information. Data acquisition, real time process control, and analysis will be performed in a laboratory information management system (LIMS). (CRWMS M&O 1998l, Section 7.1.4)

The SEMS will support operational activities by providing Material Safety Data Sheets, Hazardous Material Management information, and reports of hazardous and toxic chemical inventory to meet the Environmental Planning and Community Right-to-Know Act (CRWMS M&O 1998l, Section 7.1.4).

The SEMS contains the following environmental monitoring systems (CRWMS M&O 1999h, Section 7.1):

- Meteorological Monitoring System
- Sample (Groundwater) Collection System
- Seismic Monitoring System

The Meteorological Monitoring System will collect the GROA site meteorological information. Support is provided through weather forecasting and distribution of climatological data.

The Sample (Groundwater) Collection System will collect groundwater samples and provide necessary information for site performance verification.

The Seismic Monitoring System will monitor and provide the seismic data to be used to conduct seismic surveys.

2.8.4 Operational Description

The Surface Environmental Monitoring System will be interfaced with the CCC and various laboratory systems where the necessary analyses and evaluation of the data will be performed.

2.8.5 Functional Description

This section to be completed during the License Application design phase.

2.8.6 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.9 SITE OPERATIONS SYSTEM

2.9.1 Functional Description

The Site Operations System (SOS) includes the facilities, equipment, personnel, and instrumentation to support the following site management and support the following functions (CRWMS M&O 1998k, Summary):

- Materials and Inventory Management
- Forecasting
- Production Planning and Scheduling
- Priority and Resource Planning
- Preventive and Corrective Maintenance
- Data Collection and Management
- Outside Communication Support

The functional operation of the SOS will provide the data acquisition and analysis to support the functions listed above. The system will perform the site management and support services required for planning and directing all repository facility operations at the site.

The system provides the necessary status and information to enable timely management decisions to maintain effective and safe operation of the repository. (CRWMS M&O 1998k, Summary)

2.9.2 Parameters and Assumptions

2.9.2.1 Parameters

This section to be completed during the License Application design phase.

2.9.2.2 Assumptions

This section to be completed during the License Application design phase.

2.9.3 System Description

The Site Operations System performs the site management and support services required to plan and direct all repository facility operations at the site, including waste handling, waste emplacement, subsurface development, and transportation dispatch. The system integrates the control systems involved with operating the facility processes with the systems involved in operation of the MGR as a whole. Site management and support services include activities such as materials management, forecasting, production planning, production scheduling, priority planning, inventory management, resource planning, preventative and corrective maintenance, collection and management of data, and support for communication required with outside agencies and organizations. The system also makes the facility status available for the emergency response system. The system provides the necessary status and information to enable timely management decisions to maintain effective and safe operation of the repository.

The system receives the top-level system status, such as operational system status, safety system status, security status, emergency response and event recovery status, and physical security status. The system includes the automated data processing equipment utilizing the network utilities, equipment, and control systems. The system receives status and performs trending, manipulation, and storage of historical data. The system provides for supervisory level operating messages and advisories to operators to initiate normal and corrective actions. The system utilizes voice and data as the basis communication method for onsite and offsite interfaces. The system is located in the WHB, central to the waste handling facilities.

The Site Operations System primary interfaces are with the Surface Operations Monitoring and Control System and Subsurface Operations Monitoring and Control System for lower level control of the repository operations. It should be noted that the system interfaces indirectly with all systems and subsystems associated with the repository operations through the Surface Operations Monitoring and Control System and Subsurface Operations Monitoring and Control System. The system also interfaces with the ERS for operational status. The system has external interfaces with the Regional Servicing Contractor for transportation, and with State and Federal agencies for coordination and reporting. Lastly, the system utilizes the Site Communications System for all data acquisition and communications. (CRWMS M&O 1998k, Summary Section i, Volume 1, p. 4)

2.9.4 Operational Description

This section to be completed during the License Application design phase.

2.10 MAINTENANCE AND SUPPLY SYSTEM

2.10.1 Functional Description

The Maintenance and Supply System maintains adequate supplies and repair capability to ensure the surface operations are able to operate with a minimum of downtime. The primary maintenance repair shops, storage, and equipment rooms are located within the WHB and the BOP facilities. This system procures, stores, distributes material, and maintains the WHB equipment and systems in optimum operating condition.

This system will be developed based on a planned maintenance program, and the appropriate quantity and type of maintenance spares and supplies required for planned and unplanned maintenance operations. The system will respond to schedules developed for corrective, preventive, repair, and replacement of WHB equipment.

This system interfaces with all system that requires supplies and maintenance as part of their operations. The system interfaces with the MGR Facility System and Site Utilities for surface locations and support to operate.

2.10.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.10.3 System Description

The Maintenance and Supply system maintains adequate supplies and repair capability to ensure the WHB operates with a minimum of downtime. This system receives, stores, and distributes material and equipment required for supporting WHB operations.

Two equipment transfer corridors are provided to access to the primary area hot cells where maintenance bays are used to provide equipment repair, replacement, and recovery operations. The first corridor traverses the ATS and CTS lines and passes directly over respective maintenance bays. The second corridor traverses the DCHS and WPRS hot cells and passes directly over the DC handling cell maintenance bay and multi-purpose WPRS work cell. The purpose of the equipment transfer corridors is to facilitate equipment movement in and out of the maintenance bays and adjacent hot cells. (CRWMS M&O 2000af, Section 6.2.2.2)

The WHB will be available approximately 70 percent (6,000 hrs per year) of the time with the remaining 30 percent available for the scheduled or planned maintenance. (CRWMS M&O 1998g, Section 4.3.6.4)

Scheduled maintenance is planned outages to perform preventive maintenance and repair/replacement of equipment or components.

Unscheduled maintenance for repair of failed equipment may cause a system or area to be down for corrective maintenance. These outages are accounted for by waste handling system simulation. (CRWMS M&O 1998g, Section 4.3.6.4) The failure frequencies for each equipment item are estimated using a MTBF and the outage times are estimated using an MTTR.

2.10.4 Operational Description

Assembly and Canister Transfer Corridor

The ATS and CTS provide access to the Assembly Handling Cell and Canister Handling Cell crane maintenance bays for equipment repair, replacement, and recovery operations. The purpose of the equipment transfer corridors is to facilitate equipment movement in and out of the maintenance bays and adjacent hot cells. Access for equipment and materials to be sent or received through the ATS and CTS are provided by the contaminated equipment decontamination room. (CRWMS M&O 2000af, Section 6.2.2.2)

DC Handling and WP Remediation Transfer Corridor

The DC handling and WP Remediation Transfer system provides access to the DC Handling Cell crane maintenance bay and WP Remediation cell for equipment repair, replacement, and recovery operations. The purpose of the equipment transfer corridors is to facilitate equipment movement in and out of the maintenance bays and adjacent hot cells. Access for equipment and materials to be sent or received through the DC handling and WPRS is provided by the contaminated equipment and staging room. (CRWMS M&O 2000af, Sections 6.2.2.2 and 6.2.2.3)

Contaminated Equipment Rooms

Two contaminated equipment rooms are provided to interface with the equipment transfer corridors (ATS, CTS, DC Handling, and WPRS). The ATS and CTS equipment transfer corridor connects to the first contaminated equipment room. The DC Handling and WPRS equipment transfer corridor connects to the second contaminated equipment room. A staging area adjacent to the second room is provided. This area is used for personnel and forklift access, step-off areas for radiation and contamination control, work areas for maintenance personnel, equipment removal and installation, and handling of low-level radioactive waste from the contaminated equipment rooms.

The equipment used in the contaminated equipment rooms includes portable cranes, forklift trucks, and manual tools. The purpose of these rooms is to stage contaminated equipment for repair, replacement, and decontamination. New equipment is moved into the rooms prior to transfer into the hot cell maintenance bays using the equipment transfer corridors. (CRWMS M&O 2000af, Section 6.2.2.3)

Maintenance Equipment Room

A maintenance equipment room is provided adjacent to the contaminated equipment rooms to support equipment removal, repair, and maintenance. The area contains space for storage, staging, and handling of replacement parts, components, and equipment installed in the WHB.

The area does not provide permanent warehousing or storage for WHB equipment and spare parts, but spare parts and equipment are received in this area from central stores and warehouse facilities. (CRWMS M&O 2000af, Section 6.2.2.5)

Tool Room Storage

The waste handling systems within the WHB employ a number of special tools, underwater tools, and portable hand tools to support the carrier unloading, cask unloading, cask preparation, cask de-lidding, cask handling, canister handling, and canister opening operations. The tool rooms also contain remote tools, hand tools, and special tools unique to the different carriers, casks, and canisters scheduled to be handled. (CRWMS M&O 2000af, Section 6.2.2.8)

Maintenance Shop

This shop services equipment that is used in the RCA of the WHB facility. The shop is equipped with a complement of hand and machine tools to allow repair of most items. These include a lathe, milling machine, band saw, etc. It also contains a basic array of electrical tools to permit the measurement of voltage, current, power, and waveform to facilitate electrical repairs as well. (CRWMS M&O 2000af, Section 6.2.2.7)

Forklift Staging and Servicing Rooms

The WHB facility needs a variety of forklifts to handle dock receipt of supplies, parts, materials, pallets of 55 gal drums, and waste handling-related hardware. This area is providing for staging and servicing forklifts. (CRWMS M&O 2000af, Section 6.2.2.9)

Welder Maintenance Hot Shop

The hot shop will be used to perform maintenance on the welders and any associated welding equipment or components. (CRWMS M&O 2000af, Section 6.2.2.11)

Welder Maintenance Bay

Welder Maintenance Bay receives remotely removed equipment from the DC Handling Cell for manual repair or replacement. (CRWMS M&O 2000af, Section 6.2.2.10)

Welder Material Storage

The Welder Material Storage Room is the local source for the consumable materials for DC inner and outer lid welds. Consumable materials are electrodes, weld wire, and miscellaneous weld material supplies. (CRWMS M&O 2000af, Section 6.2.2.6)

Instrument Maintenance Shop

The instrument maintenance shop is required for calibration and operational testing of radiation detection and other alarm system equipment. The shop provides testing for instruments located within the WHB and other surface nuclear facilities. It is located to provide access from the

Radiation Protection Portal, to the Personal Radiation Equipment Storage room, and to shipping/receiving from other facilities. (CRWMS M&O 2000af, Section 6.2.4.5.2)

2.11 MONITORED GEOLOGIC REPOSITORY SITE LAYOUT

2.11.1 Functional Description

The MGR Site Layout System incorporates the necessary civil engineering features and arrangements required for supporting the surface repository facilities and systems for safe and efficient operations. The site layout is organized around the subsurface accesses, and is configured considering owner and radiological exposure boundaries, flood/fault zones, topographic features, and meteorological patterns. In addition, it supports surface and subsurface operations and the required facility and transportation arrangements (CRWMS M&O 1999q, Summary).

The system layout is designed to locate and arrange the MGR systems located on the surface. The integrated layout of radiological and support facilities provides maximum efficiency for the MGR operations while minimizing environmental, endangered species, and archaeological impacts. The site layout is designed to maximize preclosure radiological safety and to deter postclosure human disturbance of the MGR. The site layout is also designed to limit impacts to the waste handling operations caused by worst case environmental conditions.

The repository surface facilities are located in four discrete operational areas: the North Portal Operations Area, the South Portal Development Operations Area, the Emplacement Shaft Surface Operations Area, and the Development Shaft Surface Operations Area. The North Portal Operations Area is the largest and most complex surface facility area, covering about 80 acres and including approximately 19 structures. This area is located adjacent to the North Portal, where the waste is transferred underground for emplacement. The operations area includes a protected area and a BOP area. The protected area is where the waste is received from offsite transportation and placed in DCs. The BOP area includes structures and systems that will support repository operations.

The South Portal Development Area is the second largest surface facility area, covering about 20 acres and including approximately 8 structures. This area is located adjacent to the South Portal to support the excavation of the underground and the operation of the development ventilation intake fans. This area supports the development of the subsurface repository and will be unmanned after underground excavation is complete.

The Emplacement Shaft Surface Operations Area covers about 3 to 4 acres located at the opening of the north shaft and includes approximately 2 structures. This area is provided for the emplacement side, ventilation exhaust fans and to support the maintenance of these fans.

The Development Shaft Surface Operations Area covers about a half-acre located at the opening of the south shaft and includes at least 1 structure. This area is provided for the head frame and shaft conveyance needed for underground emergency personnel egress and inspection access. The area also includes the exhaust for the underground ventilation system and electrical equipment.

The MGR Site Layout System interfaces with selected MGR surface and subsurface systems for their location and orientation. The MGR Site Layout System also interfaces with the ESF for the location of existing buildings and with Waste Acceptance and Transportation systems for the location of the transportation interface.

2.11.2 Parameters and Assumptions

2.11.2.1 Parameters

2.11.2.1.1 MGR Site Layout parameters used are from the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.1).

2.11.2.1.2 The size and configuration of the WHB will be as shown in the General Arrangements of the *WHB/WTB Space Program Analysis for Site Recommendation* (CRWMS M&O 2000af, Attachment 1).

2.11.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

2.11.2.2.1 MGR Site Layout assumptions used are from the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.1).

Basis: *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.1)

Used in: Section 2.11.3.2

2.11.2.2.2 Surface facilities utility assumptions used are from the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.2).

Basis: *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.2)

Used in: Section 2.11.3.3

2.11.2.2.3 Surface facilities transportation assumptions used are from the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.3).

Basis: *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.3)

Used in: Section 2.11.3.2

2.11.2.2.4 Surface facilities site condition assumptions used are from the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.4).

Basis: *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.4)

Used in: Section 2.11.3.1

2.11.3 System Description

2.11.3.1 Site Condition Before Repository Construction

This section describes the existing and planned ESF NPSFs that could impact the repository surface facilities layout. The facilities are shown in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment I, Figure 3), and are described in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Table 7-1), Table II-13 of this document. Table 7-1 in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f) includes a site plan building number, facility name, a list of the functional areas, type of construction, principle facility dimensions, and gross floor space.

In general, the ESF facilities are designed as non-qualified, non-permanent, non-nuclear facilities with a 25-year maintainable life. It is expected that these facilities could be used for non-nuclear operations at the repository. Assumptions in this section are from Section 2.11.2.2.4. These facilities could likely comply with the repository surface facility maintainable design life needs. Extending the life would require periodic replacement of limited life components (e.g., HVAC equipment, computer equipment, structural steel siding), and routine facility maintenance. The ESF power and water supply systems are non-qualified single source designs. If the repository requires more reliable utility systems, additional equipment may be required and the ESF systems may need to be qualified/upgraded. (CRWMS M&O 1998f, Section 7.1)

Table II-13. Existing ESF Surface Facilities at the North Portal

Site Plan Building Number	Facility Name	Functional Areas	Type of Construction	Principal Dimensions (ft)	Floor Space* (ft^2)
5010	Switchgear Building with Transformer	Electrical switchgear, IDCS control room, mechanical room, office, restrooms, external transformer	Single-story, pre-fabricated steel frame with insulated metal siding with concrete pad for transformer	140 x 60	8,400
	On Pad Substation	Transformer, switchgear	Concrete pad	60 x 80	4,800
	Standby Generators	Standby generators, above ground fuel storage	Concrete pad	100 x 30	3,000
	Power Line	Power line	Aboveground		
5008	Change House	Locker rooms, showers, restrooms, first aid, safety/fire control, garage, bullpen and training area	Single-story, pre-fabricated steel frame with insulated metal siding	110 x 127	13,970
	Sanitary Sewer	Septic tank, leach field,		200 x 175	35,000

Site Plan Building Number	Facility Name	Functional Areas	Type of Construction	Principal Dimensions (ft)	Floor Space* (ft²)
		sewer line			
	Water Supply	Well pump, booster pumps, raw water tank, firewater and potable water supply tanks, chlorine injection water lines	Pumps are in pre-fabricated steel building, tanks are on concrete support ring		
	Air Compressors	Air plant (compressors, cooler receiver, condensate tank and filter)	Concrete pad	100 x 55	5,500
	Modular Office Complex	Modular office buildings, trailers with pads, parking, portable power system	All structures are pre-fabricated for temporary construction use	1 @ 60x60 1 @ 24x60 1 @168x60 13@ 12x60	24,500

*Floor space is gross unless noted.
Source: CRWMS M&O 1998f, Table 7-1

Storm Water Drainage and Flood Control

- **Probable Maximum Flood Plain Determination**

A determination of the flood level for the probable maximum flood (PMF) is in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.4.1).

The North Portal pad intersects the flood levels, thereby causing the water to flow around the pad. It is recognized that the surface profiles of Midway Valley Wash will rise to account for constriction of flow caused by the pad area that is superimposed on the inundation zone. During final design, the floor elevation of the high-hazard buildings may be adjusted to reflect any changes in water profiles.

The potential North Portal pad configuration is shown in Attachment I, Figure I-21, this document; this compares with the existing pad as shown in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment I, Figure 3). The RCA and the BOP area are again above the inundation zone because the top of the pad is above the water level, causing the water to flow around the pad. The northeast corner of the floor of the WHB is set approximately 1.5 ft above the maximum elevation of the flood stage that intersects the building to allow for freeboard. The remaining buildings in the RCA are set at the same floor elevation as the WHB. The pad for the BOP area is set a minimum of 3 ft below the floor elevation of the WHB to account for the dock height at the southeast corner of the building.

A railroad will be constructed on a compacted fill embankment across the Midway Valley Wash and a bridge will be provided to allow for passage of drainage water. This bridge and embankment will also cause a flow restriction.

Additional studies based on economic consideration will be performed to determine the effects of constriction from the enlargement of the pad and the embankment, and whether the bridge needs to be enlarged to allow for a higher volume of drainage water or the buildings need to be set to a higher floor elevation.

The proposed North Portal pad slopes will be protected from erosion due to flooding by building retaining walls or by implementing stream bank stabilization.

- **Existing North Portal Pad Drainage**

The drainage design for the North Portal pad protects the portal from a PMF. Portal protection is accomplished by constructing two open channels around the perimeter of the pad.

The drainage basin for the pad is divided into two sub-basins. One sub-basin (approximately 11.5 acres in size) generates the runoff affecting the northernmost portion of the pad. Runoff flow from the other sub-basin (approximately 4 acres in size) affects the southernmost portion of the pad. Drainage basins are measured by scaling a 1 in. = 100 ft topographical map of the area and verifying by a field walkthrough.

Peak discharge of each sub-basin was determined in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Sections 7.4.2, 7.4.3, and 7.4.4), and the results indicate that the water will need to be diverted. Two channels were designed to protect the pad from estimated discharges.

One channel is designed to start from the southwest corner of the pad and to be built around the entire western and northern side of the pad for an approximate length of 2,230 ft. The channel is to be located 15 to 30 ft away from the top of the cut on the west side of the pad. This was determined to be the most suitable location considering the topography of the area, ease of construction, and the fact that blasting will be required for excavation into the rock in this area. A 15 to 30 ft distance will provide enough room for blasting and construction crews working on the pad, and at the same time will protect the east side of the proposed channel from vibrations due to blasting. All the channel cross-sections will be trapezoidal in shape. The side slopes will be at 2 horizontal to 1 vertical. Channel slope varies greatly and was used to minimize excavation and construction costs, while providing sufficient capacity to carry the runoff flow. For the first 350 ft, the channel's bottom width is designed to be 10-ft wide and the channel depth to be 2.5-ft deep including 1 ft of freeboard. Channel slope in this portion is steep, and high velocities are anticipated. However, the channel is not expected to be full in this portion, which would help keep the velocities in check. From Station 3 + 50 to Station 4 + 50 the channel will transition into a 20-ft wide bottom and 2.5-ft deep channel. Increasing the bottom width of the channel here would reduce flow velocity further. Channel dimensions stay the same, with channel slope being the only variable, from Station 3 + 50 to 22 + 30.

The second channel is designed to start from the southwest corner of the pad and to be built around the southern side of the pad for a length of approximately 820 ft. The channel is designed to be located a safe distance away from the edge of the pad and to protect the toe of

the fill on the lower half of the southern side of the pad from erosion. All the channel cross-sections will be of a trapezoidal shape. The side slope will be 2 horizontal to 1 vertical. Bottom width will be 10 ft and channel depth is calculated to be 1.5 ft. Both channels require the use of a rip rap apron for their entire length, except were there is excavation in rock.

Both channels have been constructed as part of the ESF. No modifications will be required to adapt these channels for protection of the Repository NPSFs from the PMF.

- **Radiologically Controlled Pad Drainage**

  The drainage design for the RCA will protect this pad from a PMF. Pad protection will be accomplished by providing an underground storm drainage collection system to contain the runoff from this area and prevent spillage over the fill slopes and the BOP area. A retention pond will be provided to prevent storm water pollution.

  The drainage basin for the RCA is approximately 38 acres, as shown in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.4.3). The drainage basin area was estimated using measurements taken by scaling a 1 in. = 100 ft topographic map of the area.

  The underground storm drainage system and retention pond will be sized for a flow of 1064 cfs, per the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.4.3). The retention pond will be designed for the duration of one hour.

- **Balance of Plant Pad Drainage**

  The drainage design for the BOP area will protect this pad from the 100-year storm. Pad protection will be accomplished by providing an underground storm drainage collection system to contain the runoff from this area and prevent spillage over the fill slopes.

  The drainage basin for the BOP area is approximately 37.5 acres, as shown in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.4.4). The drainage basin area was estimated using measurements taken by scaling a 1 in. = 100 ft topographic map of the area. A retention pond will be provided to prevent storm water pollution.

  The underground storm drain system and the retention pond will be sized for a flow of 144 cfs per the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.4.4). The retention pond will be sized for the duration of one hour.

- **Retention Pond**

  The size of the retention pond is determined by the volume of storm water runoff from the Radiological Controlled Pad generated by a storm of duration of one hour. The area of the retention pond is 29.3 acres (CRWMS M&O 1998f, Section 7.4.5). The pond will have a depth of 3 ft plus 1-ft freeboard. (CRWMS M&O 1998f, Attachment I, Figure 6)

2.11.3.2 North Portal Site Layout

The site plan for the North Portal area is shown in Figure I-20, Attachment I, this document. The *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.5, and Attachment I, Figure 6) provides an overview of the site including the relationship of the RCA and the BOP to the offsite utilities, transportation corridors, and natural features such as flood zones and late quaternary faults. Assumptions used in this section are based on Assumptions 2.11.2.2.1 and 2.11.2.2.3. This figure shows the following:

- The North Portal area is relatively flat (e.g., about 2 percent slope) and is located in Midway Valley between Midway Valley Wash and Exile Hill.
- Significant quaternary faults in the North Portal area do not lie under the waste handling facilities. Tertiary faults (not shown on either figures) exist but do not present a seismic hazard in the RCA.
- The surface facilities are currently located above the inundation zone for the PMF.
- The existing fill underneath the existing North Portal pad will require stabilization and additional compacted fill will be required for the BOP area.
- The North Portal is located in the easterly side of Exile Hill. This portal is currently being used for underground access to the ESF.
- Rail and truck access to the area will be from the east through Midway Valley, south of Alice Hill.
- Existing electrical power to the area from south of Alice Hill via a single existing 69 kV power line with a thermal rating of 20 Mva will be retained and continue to feed the existing booster pump station and any additional loads. Upgrading of existing electrical offsite power is under consideration.
- To provide adequate power to the repository, a new transmission line and a new substation will be provided.
- Raw well water is supplied to the site via existing NTS Well J-13 (Attachment I, Figure I-22, this document), which is located approximately 3.5 miles southeasterly from the North Portal. The water is pumped to a booster pump station a quarter mile south of the portal and then to the potable and non-potable storage tanks at the top of Exile Hill. The water flows by gravity to the North Portal Operations Area for potable water and firewater/construction water. The existing pumps at J-13 and the existing booster pump station will be upgraded from 150 gpm to 300 gpm capacity. The existing water storage tank at J-13 will be replaced by two 100,000-gal tanks. The piping from NTS Well J-12 that serves as backup to NTS Well J-13 will be replaced.

- To augment non-potable water requirements, an existing raw water well, known as C-Well, will be used. This well will require a new booster pump station housing 2-600 gpm pumps and two 50,000-gal forebay tanks.

- Sanitary sewage flows by gravity from the North Portal Operations Area to a septic tank and leach field. Based on the new population requirements the existing sanitary sewer system is adequate.

The *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment I, Figure 6) identifies the relationship between the RCA and BOP, while Attachment I, I-20 of this document, identifies the surface facilities by site reference number (e.g., 211 for the WHB). This figure shows the following:

- The RCA is located adjacent to the North Portal and extends northerly to enclose Security Station 3 (220-3C). The RCA includes four discrete nuclear facilities: the WHB (211), the WTB (215-1), the TMB (220-4C), and the CPB (215-2). The RCA also includes the parking areas for waste transportation trucks and rail cars. The RCA is secured by fencing. The distances between the WHB, CPB, and Security Station 3 are dictated by the spacing required for the rail line branches, or frogs, and the desire to keep the CPB out of the PMF.

- The WHB is located just east of the existing change house, placing the WHB as close as possible to the portal while preserving the change house. The WTB was located next to the WHB to facilitate and minimize the movement of personnel and materials between these related facilities. The TMB is located to be accessible to the waste transporter rail lines.

- The BOP area is located southeasterly and adjacent to the RCA. This BOP location was selected to promote radiological safety by considering the prevailing wind directions, as shown by the wind rose in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment I, Figure 6). The facilities within the BOP house the non-nuclear operations needed to support waste operations and site personnel.

2.11.3.3 Repository Site Layout

The repository surface facilities are located in four discrete operational areas as described below and as shown in the overall repository surface site plan in Attachment I, Figure I-19, this document. This figure also shows the relationship of these areas to the emplacement (North) and development (South) portals, subsurface ramps and emplacement areas, emplacement and development shafts, and muck conveyor routing, muck storage area, and lag storage area. (CRWMS M&O 1998f, Section 7.6)

- **North Portal Operations Area**

  The North Portal Operations Area is the largest and most complex surface facility area, covering approximately 80 acres and including 19 (17 new and 2 existing) structures. This

area is adjacent to the North Portal, where the waste is brought underground for emplacement. The operations area includes an RCA and a BOP area. The RCA is where the SNF and civilian and defense HLW materials are received from offsite transportation and placed in DCs. North of this area is a potential 300 to 400-acre site shown on Figure I-19 in Attachment I, this document, for potential onsite inventory.

The BOP area includes structures and systems that will support repository operations in all areas (e.g., general administration, medical center, training center, shops, motorpool, central warehouse, centralized utilities).

This area uses centralized utilities generated as needed because providing utilities from a single central area is cost prohibitive due to the distances between surface areas.

- **South Portal Development Operations Area**

  The South Portal Development Operations Area is the second largest surface facility area, covering approximately 20 acres and including 8 structures. This area is located adjacent to the South Portal to support the excavation of the underground and the operation of the development ventilation intake fans. The area functions independently and includes the basic facilities needed for personnel support, maintenance, warehousing, material staging, security, and transportation. This area will normally be staffed with support personnel, plus all subsurface construction personnel during the development/emplacement phase, and will be unmanned after underground excavation is completed. Most personnel will move directly from off site to this area. General supplies will be transferred from the North Portal operations area and transported by truck to the South Portal Development Operations Area.

  This area uses centralized utilities generated as needed because providing utilities from a single central area is cost prohibitive due to the distances between surface areas.

- **Development Shaft Surface Operations Area**

  There are a total of seven areas for Development, Intake, and Exhaust Shaft Surface Operations: one for Development, three for Intake, and three for Exhaust. (CRWMS M&O 2000r, Figure 1)

  Each area will be approximately 1.5 acres and will include fans, power supply, head frame, and hoist system. The area is normally unoccupied. Personnel and materials are dispatched as needed from the North Portal Operations Area to conduct inspections or maintenance.

- **Repository Muck Storage Area**

  An area of approximately 400 acres is available for the Repository Muck Storage Area. Minimal flood protection, in the form of drainage ditches, is sufficient to protect it from any local flooding caused by the 100-year storm.

- **Utilities**

Potable and non-potable water to the North Portal operations will be supplied by water storage tanks on Exile Hill. An alternate source for non-potable water will be supplied from a new pump house at C-Well. Potable and non-potable water will flow by gravity from the existing tanks to the North Portal area. Non-potable water will also flow by gravity from the storage tank at Exile Hill to fill or replenish the firewater storage tank located above the North Portal pad. Non-potable water will flow by pressure from the new pump house located at C-Well to feed the new fire storage tank located at the North Portal pad.

The firewater supply and storage system consists of two new 250,000-gal tanks and two new fire pump houses to conform to redundancy requirements. One of the tanks will be located above the North Portal Pad and the other tank will be located at the North Portal pad. Firewater will be supplied by gravity from the tank located above the North Portal pad to a pump house that will boost the pressure in case of a fire, and will also feed the fire loop distribution systems in the RCA and BOP areas. Firewater from the storage tank on the pad will be supplied by gravity to one of the pump houses, which in turn will boost the pressure in case of a fire, and will also feed the fire loop distribution system in the RCA and the BOP. Locating one storage tank on the hill above the North Portal will take advantage of gravity flow in case the BOP is supplied without a booster. By separating the two sources, hardening of the pump house on the pad is not required. See the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment IV) for firewater system.

Non-potable water to the South Portal Development Operations Area will be supplied from the existing Booster Pump Station to a potable water storage tank and a non-potable firewater storage tank located on top of a hill in the vicinity of the South Portal. A chlorination system to provide potable water will be provided. Water will flow by gravity to the South Portal area.

The sanitary sewer from the South Portal Operations Area will flow by gravity to a septic tank and leach field.

Electric power to the North Portal Operations Area will be provided from a substation located southeasterly of the North Portal area to feed the North Portal Operations Area.

Utility assumptions are from Section 2.11.2.2.2.

- **Potential Storage Area**

A potential storage area of 350 acres is available to provide the ability to retrieve and store all the waste that may be emplaced in the repository. Waste retrieval capability must be maintained for a period of time starting when the first WP is emplaced and extending until the start of the closure operation. The length of the retrievability period is set at 50 years. The retrieval period could be extended up to 300 years. The area is shown in Figure I-19 of Attachment I, this document.

- **Site Parking**

  Site parking will be provided to accommodate the minimum parking capacity for truck and rail equipment. Parking areas will be sized to provide buffer staging between the waste receipt gate and the CPB and between the CPB and WHB. (CRWMS M&O 1998f, Section 7.6.10)

- **Topsoil Storage Area**

  The existing topsoil storage area is shown in the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Attachment I, Figure 2). This area will be expanded to accept the additional repository volume needs.

- **Bridge Crossing**

  A bridge will be provided for railroad and highway crossing above the Midway Valley Wash. This bridge was located in a compacted fill embankment to allow passage of the PMF flood. The length of the bridge will be determined by future flood routing studies.

2.11.4 Operational Description

This section to be completed during the License Application design phase.

2.12 HEALTH SAFETY SYSTEM

2.12.1 Functional Description

The Health Safety System (HSS) monitors, tests, and manages personnel exposure to hazardous substances and radiation. The HSS monitors the operational personnel areas for hazardous materials and provides decontamination for personnel. The HSS also provides emergency and maintenance breathing air and controls the access to RCAs based on personnel radiation exposure histories. The HSS performs physical and radiological surveys and provides isolation areas for contaminated personnel. The HSS decontaminates personnel in response to emergencies involving hazardous material. (CRWMS M&O 1999b, Section 5)

The HSS monitors access to the radiological areas such that the personnel entering and leaving are scanned for contamination and verified to be below safe exposure thresholds. The HSS provides sufficient coverage for all radiological areas to protect the workers from exposure and emergency decontamination. The responsiveness of the HSS for monitoring and tracking personnel health safety records supports the operational needs of waste handling. (CRWMS M&O 1999b, Section 5)

The HSS interfaces with the Waste Handling Facility system, Waste Treatment Facility system, and Subsurface Facility system for physical space, hardware mounting and potential decontamination waste products. The HSS interfaces with the Administration System for the identification, training, and tracking of site personnel data. The HSS interfaces with the Central Command & Control Operations System for the controlling of work loads and assignments based on exposure limits and quarterly accumulations.

An access control system will be installed to control access to RCAs of the CPB, WHB, and WTB. A Radiation Protection Portal controls access to the radiological controlled areas of the CPB, WHB, and WTB. Personnel are required to have a radiation work permit or a special work permit to enter or leave the CPB, WHB, and WTB. (Regulatory Guide 8.8, p. 8.8-7)

The HSS is classified CQ in the *Classification of the MGR Health Safety System* (CRWMS M&O 1999b, Table 1).

2.12.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.12.3 System Description

This section to be completed during the License Application design phase.

2.12.4 Operational Description

This section to be completed during the License Application design phase.

2.13 GENERAL SITE TRANSPORTATION SYSTEM

2.13.1 Functional Description

The General Site Transportation System provides transportation of personnel and materials between the various facilities and areas of the surface repository. This system operates in and around the surface repository site where the system is loaded/unloaded. This system will provide the vehicles, parking, and the road/rail subsystem necessary to transport the expected personnel and materials. (CRWMS M&O 1998f, Section 3)

This system provides transport of personnel and materials in a certain amount of time. This system must be sized to the weight and handling required for the payloads it is expected to carry.

This system interfaces with the expected payload to be transported, the Maintenance and Supply system, the Administration system, and other surface facilities for the transport of personnel and materials. This system also delivers and receives personnel and materials from the Subsurface Emplacement Transportation system and the Subsurface Development Transportation system.

This system to be completed during the License Application design phase.

2.13.2 Parameters and Assumptions

2.13.2.1 Design Parameters

See the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.1) for site transportation parameters.

2.13.2.2 Assumptions

Assumptions used in this section do not require confirmation for the Site Recommendation phase of design.

See the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 4.3.3) for site transportation assumptions.

2.13.3 System Description

2.13.3.1 Access Roads

See the *Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998f, Section 7.6.7) for system description.

2.13.3.2 Rail

Rail access to the North Portal area will be from the northeast through Midway Valley south of Alice Hill. A railroad car storage spur will be provided before entering the security station to accommodate buffer and escort cars. Parking areas for rail carriers will be provided for buffer staging between the waste receipt gate and the CPB and between the CPB and the WHB (CRWMS M&O 1998f, Section 7.6.8).

2.13.4 Operational Description

This section to be completed during the License Application design phase.

2.14 EMERGENCY RESPONSE SYSTEM

2.14.1 Functional Description

The emergency response system (ERS) includes the facilities, equipment, personnel, and instrumentation to support the following functions (CRWMS M&O 1998l, Section 7.1.1):

- Emergency Response Center System
- Fire Detection, Annunciation, and Suppression Systems
- Medical Facility System
- On and Offsite Emergency Communications System

The functional operation of the ERS will provide the data acquisition and analysis to support the functions listed above. The ERS includes functions associated with detecting and responding to site, facility, personnel emergencies, emergency assessment, and notifications to onsite and offsite entities.

2.14.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.14.3 System Description

The ERS includes the facilities, equipment, personnel, and instrumentation to support the following functions (CRWMS M&O 1998l, Section 7.1.1):

- Emergency Response Center System
- Medical Facility System
- On and Offsite Emergency Communications System

The functional operation of the ERS will provide the data acquisition and analysis to support the functions listed above. The ERS includes functions associated with detecting and responding to site, facility, personnel emergencies, emergency assessment, and notifications to osite and offsite entities.

2.14.3.1 Emergency Response Center System

The Emergency Response Center System (ERCS) is supplemented by data from the fire station, S&S, health safety, radiological monitoring, site environmental monitoring, emergency communications, and site utilities.

The ERCS will provide the emergency analysis and dispatch of personnel to respond to site off-normal conditions.

The system includes an Emergency Technical Support Center (TSC), an Emergency Operations Center (EOC), and EDS. (CRWMS M&O 1998l, Section 7.1.1.1)

2.14.3.2 Fire Detection, Annunciation, and Suppression System

This system provides the staff, facilities, and equipment necessary to detect, annunciate, and respond to fires detected throughout the facility. This system monitors the various sprinkler and fire detection systems. (CRWMS M&O 1998l, Section 7.1.1.4)

2.14.3.3 Medical Facility System

The medical facility functions and staff will be integrated with other site monitoring and response organizations, as well as local and regional response facilities.

The medical facility system will provide medical emergency response and care, medical emergency assessment, and illness treatment. The facility must also accommodate the potential for level of care to radiologically contaminated personnel. (CRWMS M&O 1998l, Section 7.1.1.3)

2.14.3.4 Onsite and Offsite Emergency Communications System

Onsite emergency communications is an auxiliary system to the site communications system. The system responds to fire, security, medical evacuation, and health safety. There will be a separate and diverse site emergency phone system for reporting emergency events to the EOC or EDS.

Primary offsite emergency communications will utilize the conventional telephone system. This will be backed up with emergency radio systems to the county/state police and fire organizations. (CRWMS M&O 1998l, Section 7.1.1.5 and 7.1.1.6)

2.14.4 Operational description

This section to be completed during the License Application design phase.

2.15 ADMINISTRATION SYSTEM

This section to be completed during the License Application design phase.

2.15.1 Functional Description

This section to be completed during the License Application design phase.

2.15.2 Parameters and Assumptions

This section to be completed during the License Application design phase.

2.15.3 System Description

This section to be completed during the License Application design phase.

2.15.4 Operational Description

This section to be completed during the License Application design phase.

3. OPERATIONAL MAINTENANCE

The purpose of the repository operational maintenance program will be to keep all facilities and systems that are important to repository operations and safety in proper working order. The maintenance program will be based on applicable Federal regulations and nuclear industry standards for maintenance on similar facilities and systems at other nuclear sites. The maintenance program will include the necessary work processes, training, and equipment for inspecting, testing, and maintaining SSC ITS. The system will also maintain operational readiness (CRWMS M&O 2000o).

The repository maintenance program will assure that all maintenance personnel have the necessary qualifications, experience, applicable licenses, and training for specific maintenance tasks (CRWMS M&O 2000o). The program will also require these personnel to perform all routine and non-routine maintenance activities under administrative controls and according to established procedures and job-specific safety criteria. Health physics personnel will assist maintenance staff with all work within RCAs. The repository maintenance program will include a maintenance-activity database that will track information on maintenance actions, system failures, and corrective actions. The database will include detailed information such as the time and location of every failure, its type and cause, the repairs needed, and descriptions of any parts

needed to make the repairs. This information will be valuable for controlling material inventories and for establishing trends on equipment failures. (CRWMS M&O 2000o)

Maintenance program personnel will review all NRC reports on nuclear industry activities and incidents. They will then incorporate lessons-learned information from other sites into the repository's own maintenance program (CRWMS M&O 2000o).