OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SYSTEM DESCRIPTION DOCUMENT COVER SHEET

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Monitored Geologic Repository Operations Monitoring and Control System Description Document

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SYSTEM DESCRIPTION DOCUMENT REVISION HISTORY

1. SDD Title
Monitored Geologic Repository Operations Monitoring and Control System Description Document

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3. Revision	4. Description of Revision
00	The Monitored Geologic Repository Operations Monitoring and Control System Description Document (SDD) represents a combining of three earlier identified SDDs; Subsurface Safety and Monitoring SDD (DI# BCA000000-01717-1705-00015), Subsurface Operations Monitoring and Control SDD (DI# BCA000000-01717-1705-00001), and the Surface Operations Monitoring and Control SDD (not issued). This document supersedes the documents with the identifiers BCA000000-01717-1705-00015 and BCA000000-01717-1705-00001.
ICN 01	The purpose of ICN 01 is to incorporate initial design description input into Section 2 of the SDD. The document has been updated to comply with the latest approved "System Description Document Development Plan" (TDP-MGR-MD-000013, Rev. 04). All changes in the document that have been made as a result of this ICN are indicated by revision bars. The following major changes have been made to the document: • Added Section 2. • Deleted Sections 1.4.1 and 1.4.2. Reason for deletion - management direction. • Revised Tables 1 and 2, added Table 4. • Added/deleted references. • Editorial changes and changes to comply with current procedures have been made as needed.

DISCLAIMER

CONTENTS

Page

TABLES

Page

FIGURES

Page

SUMMARY

The Monitored Geologic Repository Operations Monitoring and Control System provides supervisory control, monitoring, and selected remote control of primary and secondary repository operations. Primary repository operations consist of both surface and subsurface activities relating to high-level waste receipt, preparation, and emplacement. Secondary repository operations consist of support operations for waste handling and treatment, utilities, subsurface construction, and other selected ancillary activities. Remote control of the subsurface emplacement operations, as well as, repository performance confirmation operations are the direct responsibility of the system. In addition, the system monitors parameters such as radiological data, air quality data, fire detection status, meteorological conditions, unauthorized access, and abnormal operating conditions, to ensure a safe workplace for personnel. Parameters are displayed in a real-time manner to human operators regarding surface and subsurface conditions. The system performs supervisory monitoring and control for both important to safety and non-safety systems. The system provides repository operational information, alarm capability, and human operator response messages during emergency response situations. The system also includes logic control to place equipment, systems, and utilities in a safe operational mode or complete shutdown during emergency response situations. The system initiates alarms and provides operational data to enable appropriate actions at the local level in support of emergency response, radiological protection response, evacuation, and underground rescue. The system provides data communications, data processing, managerial reports, data storage, and data analysis.

This system's primary surface and subsurface operator consoles, for both supervisory and remote control activities, will be located in a Central Control Center (CCC) inside one of the surface facility buildings. The system consists of instrument and control equipment and components necessary to provide human operators with sufficient information to monitor and control the operation of the repository in an efficient and safe manner. The system consists of operator consoles and workstations, multiple video display terminals, communications and interfacing equipment, and instrument and control software with customized configuration to meet the needs of the Monitored Geologic Repository (MGR). Process and logic controllers and the associated input/output units of each system interfaced with this system will be configured into Remote Terminal Units (RTU) and located close to the systems to be monitored and controlled. The RTUs are configured to remain operational should communication with CCC operations be lost. The system provides closed circuit television to selectively view systems, operations, and equipment areas and to aid in the operation of mechanical systems. Control and monitoring of site utility systems will be located in the CCC. Site utilities include heating, ventilation, and air conditioning equipment; plant compressed air; plant water; firewater; electrical systems; and inert gases, such as nitrogen, if required.

This system interfaces with surface and subsurface systems that either generate output data or require remote control input. The system interfaces with the Site Communications System for bulk storage of operational data, on-site and off-site communication, and a plant-wide public announcement system. The system interfaces with the Safeguards and Security System to provide operational status and emergency alarm indications. The system interfaces with the Site Operation System to provide site wide acquisition of data for analysis and reports, historical information for trends, utility information for plant operation, and to receive operating plans and procedures.

QUALITY ASSURANCE

The quality assurance (QA) program applies to the development of this document. The "SDD Development/Maintenance (Q SDDs) (WP# 16012126M5)" activity evaluation has determined the development of this document to be subject to "Quality Assurance Requirements and Description" requirements. This document was developed in accordance with AP-3.11Q, "Technical Reports."

1. SYSTEM FUNCTIONS AND DESIGN CRITERIA

The functions and design criteria for the system are identified in the following sections. Throughout this document the term "system" shall be used to indicate the Monitored Geologic Repository Operations Monitoring and Control System. The system architecture and classification are provided in Appendix B.

1.1 SYSTEM FUNCTIONS

1.1.1 The system monitors and controls facility operating systems.

1.1.2 The system provides supervisory control.

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

1.1.4 The system manages seismic data.

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

1.1.6 The system monitors the status of operational safety systems.

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

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

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

1.1.10 The system exchanges information with other MGR systems.

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

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

1.1.13 The system manages environmental data.

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

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

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

1.2 SYSTEM DESIGN CRITERIA

This section presents the design criteria for the system. Each criterion in this section has a corresponding Criterion Basis Statement in Appendix A that describes the need for the criterion as well as a basis for the performance parameters imposed by the criterion. Each criterion in this section also contains bracketed traces indicating traceability, as applicable, to the functions (F) in Section 1.1, the "Monitored Geologic Repository Requirements Document" (MGR RD), and "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada." In anticipation of the interim guidance being promulgated as a Code of Federal Regulation, it will be referred to as "10 CFR 63" in this system description document. For the applicable version of the codes, standards, and regulatory documents, refer to Appendix E.

1.2.1 System Performance Criteria

1.2.1.1 The system shall have an operational life of 40 years.

[F 1.1.1, 1.1.14, 1.1.15][MGR RD 3.2.C]

1.2.1.2 The system shall include provisions for upgrades and refurbishments designed to increase the system operational life to support a deferral of closure for up to 300 years.

[F 1.1.1, 1.1.15][MGR RD 3.1.C, 3.2.H][10 CFR 63.131(b), 63.132(e), 63.134(d)]

1.2.1.3 The system shall provide a minimum of two independent viewing angles for all remote control operations.

[F 1.1.1, 1.1.11, 1.1.14, 1.1.15][MGR RD 3.3.A]

1.2.1.4 The system shall monitor the location/position of equipment that inspects, handles, and transports waste forms.

[F 1.1.1, 1.1.5, 1.1.6, 1.1.11, 1.1.14, 1.1.15]

1.2.1.5 The system shall initiate local and remote alarms in response to detection of radiation levels exceeding safe levels within human accessible areas.

[F 1.1.8, 1.1.12][MGR RD 3.1.B]

1.2.1.6 The system shall be designed such that failure of the system's ability to transmit data will not affect the system's ability to receive parameter data or perform alarm initiation.

[F 1.1.9, 1.1.10, 1.1.11][MGR RD 3.1.C, 3.3.K][10 CFR 63.112(e)(7)]

1.2.1.7 The system shall monitor the handling of waste forms within the boundaries of the repository.

[F 1.1.1, 1.1.6, 1.1.14, 1.1.15][MGR RD 3.1.B, 3.1.D, 3.3.K]

1.2.1.8 The system shall monitor the status of the emplacement drift isolation doors and initiate alarms to warn control room operators when doors are open.

[F 1.1.2, 1.1.3, 1.1.8]

1.2.1.9 The system shall be designed to allow parameter (operating and configuration/setup) changes at both the CCC and from the RTUs.

[F 1.1.1, 1.1.5, 1.1.6, 1.1.8][MGR RD 3.3.A, 3.3.K]

1.2.1.10 The system shall provide acknowledgement (valid/invalid recognized responses) to the human operator (at the user interface) upon the initiation of control commands within 0.5 seconds.

[F 1.1.1, 1.1.5, 1.1.6, 1.1.8][MGR RD 3.3.A, 3.3.K]

1.2.1.11 The system shall confirm response to control actions from the master station to the RTU within 2.0 seconds.

[F 1.1.1, 1.1.5, 1.1.6, 1.1.8][MGR RD 3.3.A]

1.2.1.12 The system shall be designed to maintain a minimum of 50 percent margin of peak central processing unit (CPU) utilization for control processing, to allow for expansion.

[F 1.1.1, 1.1.6, 1.1.7][MGR RD 3.3.A]

1.2.1.13 The system shall be designed to maintain a minimum of 50 percent of spare memory capacity, to allow for expansion.

[F 1.1.1, 1.1.6, 1.1.7][MGR RD 3.3.A]

1.2.1.14 The system shall be designed to maintain a minimum of 50 percent unused data communication bandwidth, to allow for expansion.

[F 1.1.1, 1.1.6, 1.1.7, 1.1.11][MGR RD 3.3.A]

1.2.1.15 The system shall provide for simultaneous real-time monitoring and control of remotely controlled operations.

[F 1.1.1, 1.1.5, 1.1.6, 1.1.10, 1.1.11, 1.1.14, 1.1.15]

1.2.1.16 The system shall collect and provide backup storage for critical operational monitoring data, alarm status data, environmental data, and data related to important to safety systems.

[F 1.1.1, 1.1.10, 1.1.11, 1.1.13]

1.2.1.17 The system shall detect and display state changes of remote contact switches within 0.5 second.

[F 1.1.1, 1.1.2, 1.1.14, 1.1.15][MGR RD 3.3.A]

1.2.1.18 The system shall provide (as a minimum) human operators the capability to selectively modify the parameters listed below:

- Sampling rate
- Alarm threshold and deadband (a range through which an analog quantity can vary without initiating response) limits
- Remove or restore sensor signal from scan
- Scale factors
- Display engineering units
- Measurement identification (tag) numbers.

[F 1.1.9, 1.1.10, 1.1.11]

1.2.1.19 The system shall provide an engineering operator station with software features to reconfigure and develop new data displays, reports, alarm summaries, and alarm or operator messages.

[F 1.1.9, 1.1.11]

1.2.1.20 The system shall provide the human operator with the capability to generate operating reports and hard copy outputs for the following types of data, as a minimum.

- Measurement data
- Real-time monitored data
- Historical data logs and trend printouts
- Command/control instructions (historical and real-time logging)
- Alarm data
- Operational status data
- Calculated values
- Measurement lists
- Screen (display) data in graphic, trend (chart), and/or table format.
- Monitoring and location tracking of personnel.

[F 1.1.10, 1.1.11][MGR RD 3.1.C][10 CFR 63.132(a)]

1.2.1.21 The system shall be designed to provide data storage and recording capability to support continuous operations.

[F 1.1.1, 1.1.11]

1.2.1.22 The system shall acquire data at sampling rates a minimum of two times faster than the frequency of the signal responsible for detecting gradual and transient changes that exceed safe operating limits.

[F 1.1.1][MGR RD 3.3.K]

1.2.1.23 The system shall generate audible and visual alarms after alarm limit thresholds are exceeded.

[F 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.1.24 The system shall generate audible alarms with an overall sound pressure level of at least 75 dB and not less than 10 dB above the maximum ambient noise level typical in the area for which audio coverage is to be provided.

[F 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.1.25 The system shall log (record) and time-tag alarm conditions encountered in the facility.

[F 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.1.26 The system shall log (record) and prioritize alarm conditions such that unsafe conditions are visible to the safety operator.

[F 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.1.27 The system shall continue generation of audible alarms until alarm condition is acknowledged and visual alarm annunciation until the alarm condition is corrected.

[F 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.1.28 The system shall display the following measurements, based on input received from the Surface Environmental Monitoring System, with the stated accuracy:

- Wind Direction–instantaneous recorded values; accuracy: +/- 5 degrees of arc
- Wind Speed–time averaged values; accuracy: +/- 0.5 mph
- Temperature–time averaged values; accuracy: +/- 0.5 degrees C
- Dew Point–time averaged values; accuracy: +/- 0.5 degrees C.

[F 1.1.13][MGR RD 3.1.G]

1.2.2 Safety Criteria

1.2.2.1 Nuclear Safety Criteria

1.2.2.1.1 The system shall maintain positive control of important to safety systems during and after the occurrence of Category 1 and 2 (TBV-1246) design basis events.

[F 1.1.2, 1.1.7][MGR RD 3.1.C][10 CFR 63.112(e)(8)]

1.2.2.1.2 The system shall be designed with interlocks to prevent the inadvertent issuance of remote control commands.

[F 1.1.1, 1.1.7][MGR RD 3.3.A]

1.2.2.1.3 The system shall provide redundancy for remote control commands and status indications.

[F 1.1.1, 1.1.9][MGR RD 3.1.G]

1.2.2.1.4 The system shall provide control interlocks that prevent the movement of the disposal containers/waste packages unless positive confirmation from two independent indicators verify handling equipment is positioned properly and show the waste packages are in place and ready for movement.

[F 1.1.1, 1.1.6, 1.1.7, 1.1.14, 1.1.15]

1.2.2.1.5 The structures, systems, and components (SSCs) required to monitor or measure effluents and ambient radiation levels (direct radiation, gaseous, and airborne particulate), annunciate alarms, or maintain positive control of waste package transporter and gantry shall be designed to operate following a Frequency Category 1 (TBV-1246) design basis earthquake.

[F 1.1.4][MGR RD 3.1.C][10 CFR 63.111(a)(2), 63.111(b)(2), 63.112(e)(8)]

1.2.2.1.6 Upon loss of normal electrical power, the control system shall verify that all operations (except those that are connected to a standby power source) are brought to a safe and timely halt.

[F 1.1.5, 1.1.8][MGR RD 3.1.C][10 CFR 63.112(e)(10)]

1.2.2.1.7 The system shall provide diversity, separation, or other means to reduce the likelihood of common-cause failures of redundant controls and status indications for important to safety systems.

[F 1.1.1]

1.2.2.1.8 The system shall have the capability to estimate atmospheric diffusion during a radioactive release using meteorological data received from the Surface Environmental Monitoring System.

[F 1.1.13][MGR RD 3.1.G]

1.2.2.1.9 The system shall provide the means for manual initiation of each protective action at the system level.

[F 1.1.1, 1.1.2, 1.1.9][MGR RD 3.1.G]

1.2.2.1.10 The system shall be configured to display selected process variables, alarms, and status of each system important to safety that is needed to help mitigate the consequences of Category 1 and 2 (TBV-1246) design basis events.

[F 1.1.6, 1.1.10, 1.1.11, 1.1.12][MGR RD 3.1.C, 3.1.G][10 CFR 63.112(e)(8)]

1.2.2.1.11 The system shall be capable of annunciating at the CCC the output of any free-field or foundation level time-history accelerograph, in accordance with the applicable guidelines in "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12) after a Frequency Category 1 (TBV-1246) design basis earthquake.

[F 1.1.4][MGR RD 3.1.B, 3.1.G]

1.2.2.1.12 The system shall process and display, at the CCC, seismic data received from any free field or foundation level time-history accelerograph in accordance with the applicable guidelines in "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12) after a Frequency Category 1 (TBV-1246) design basis earthquake.

[F 1.1.4][MGR RD 3.1.G]

1.2.2.1.13 The system shall be designed such that a single failure of communications between the CCC and the RTU will not affect monitoring and remote control of important to safety systems.

[F 1.1.1, 1.1.8][MGR RD 3.3.A]

1.2.2.1.14 The system shall monitor the delta pressure between the emplacement and development areas (received as input from the Subsurface Ventilation System) and initiate alarms when the delta pressure is below the operating limit of 62.2 Pa (0.25 in. of water).

[F 1.1.2, 1.1.8]

1.2.2.1.15 The system shall be designed to ensure that alarms activated as a result of input from the Site Radiological System are maintained upon loss of normal electrical power.

[F 1.1.2, 1.1.8, 1.1.12][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.2.1.16 The system shall be designed in accordance with the project ALARA (as low as is reasonably achievable) program goals (TBD-406) and the applicable guidelines in "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable" (Regulatory Guide 8.8).

[F 1.1.8, 1.1.12, 1.1.16][MGR RD 3.1.B, 3.1.C, 3.3.A][10 CFR 63.111(a)(1)]

1.2.2.1.17 The system shall provide the operator with alarm indications of the following off-normal conditions:

- Loss of power provided by off-site utilities
- Transfer to standby power
- Startup/shutdown of emergency generators
- Power distribution (load shedding).

[F 1.1.2, 1.1.7, 1.1.8]

1.2.2.1.18 The portions of the system exposed to the external environment shall be designed to function following a design basis tornado with a maximum wind speed of 189 mph, a corresponding pressure drop of 0.81 psi, and a rate of pressure drop of 0.3 psi./sec.

[F 1.1.10][MGR RD 3.1.C][10 CFR 63.112(e)(8)]

1.2.2.1.19 The portions of the system exposed to the external environment shall be designed to function following a design basis tornado that generates either Spectrum I or Spectrum II missiles identified in "MGR Design Basis Extreme Wind/Tornado Analysis," Section 6.3.

[F 1.1.10][MGR RD 3.1.B, 3.1.C][10 CFR 63.111(a)(1), 63.111(b)(2), 63.112(e)(8)]

1.2.2.1.20 The portions of the system that provide remote control of the waste emplacement system shall be designed to maintain positive control of waste transport and emplacement operations during and following a Frequency Category 1 (TBV-1246) design basis earthquake.

[F 1.1.14, 1.1.15][MGR RD 3.1.C][10 CFR 63.112(e)(8)]

1.2.2.2 Non-nuclear Safety Criteria

1.2.2.2.1 The system shall monitor/control the safe start-up sequence of all operating systems.

[F 1.1.1, 1.1.7][MGR RD 3.3.A]

1.2.2.2.2 The system alarm monitors shall be isolated such that failure of a single monitoring channel will not render the entire detection system inoperable or trigger a false alarm condition.

[F 1.1.6, 1.1.8][MGR RD 3.3.A]

1.2.3 System Environment Criteria

1.2.3.1 The system components shall be designed to withstand and operate in the temperature environment defined in Table 1 for the areas of the Waste Handling Building in which the system components are located.

Table 1. Temperature Environment

Location of System Component	Normal Environment	Off-Normal Environment
Normally Occupied Areas (e.g., Offices, Maintenance Areas, Access Control)	70 - 78°F	(TBD-395) °F for (TBD-395) Hours
Normally Unoccupied Areas (e.g., Mechanical & Electrical Equipment Rooms, Cask Receiving & Handling Areas, Pool Areas)	63 - 92°F	(TBD-395) °F for (TBD-395) Hours
Unoccupied Areas (e.g., Assembly Cells, Canister Transfer Cells, DC Handling Cells, Emergency Generator Room)	63 - 106°F	(TBD-395) °F for (TBD-395) Hours
Electronics Equipment Areas (e.g., Control Rooms, Computer Rooms, Communications Equipment Rooms, Data Processing and Recording Equipment Rooms)	70 - 74°F Note 1	70 - 74°F Note 1

Note 1: It is intended to maintain these areas at the specified temperature under all anticipated conditions. However, due to economic or design impracticability, areas that house less sensitive electronic components may not be maintained at this temperature. In these cases, cooling will be provided for the electronic components, but not necessarily the entire area.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.2 The system components shall be designed to withstand and operate in the humidity environment defined in Table 2 for the areas of the Waste Handling Building in which the components are located.

Table 2. Humidity Environment

Location of System Component	Normal Environment
Normally Occupied Areas (e.g., Offices, Maintenance Areas, Access Control)	30% - 60%
Normally Unoccupied Areas (e.g., Mechanical & Electrical Equipment Rooms, Cask Receiving & Handling Areas, Pool Areas)	Humidity Not Controlled (TBD-409) Note 1
Unoccupied Areas (e.g., Assembly Cells, Canister Transfer Cells, DC Handling Cells Emergency Generator Room)	Humidity Not Controlled (TBD-409) Note 1
Electronics Equipment Areas (e.g., Control Rooms, Computer Rooms, Communications Equipment Rooms, Data Processing and Recording Equipment Rooms)	40% - 50%

Note 1: Humidity control is not provided in most of these areas. Therefore, components susceptible to extreme humidity conditions must be evaluated for low and/or high humidity environments since special provisions (e.g., heater strips, humidifier) may be necessary.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.3 The system shall be designed to operate and safely store data during and after exposure to the environments identified in Table 3.

Table 3. Electrical Related Operating Environments

Environment	Range
Vibration	<3 (mm/sec.) for a frequency range of 1 to 150 Hz (typical control room)
Shock	Height of fall 250 (mm)
Electromagnetic Interference	(TBD-204) (V/m)/MHz
High Magnetic Fields	(50 to 70)X10^{-4} Tesla

[F 1.1.1][MGR RD 3.3.A]

1.2.3.4 The system shall be designed such that components susceptible to radiation can withstand and operate in the radiation environment (TBD-405) in which the component is installed.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.5 The affected system components and outside structures shall be designed for a maximum wind speed of 121 mph.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.6 The system design shall be based on the outside design conditions as indicated in Table 4.

Table 4. Outside Design Conditions

Parameter	Design Data
Site: Mercury, Nevada	Latitude: 36° 37' 12" Longitude: 116° 01' 12" Elevation: 3310 ft
Heating Dry-Bulb	99.6%: 24° F (Note 1) 99%: 28° F (Note 2)
Cooling Dry-Bulb	0.4%: 102° F (Note 1)(Note 4) 1%: 100° F (Note 2)
Cooling Mean Coincident Wet-Bulb	0.4%: 65° F (Note 1) 1%: 64° F (Note 2)
Wet-Bulb	1%: 67° F (Note 3)
Dew-Point	0.4%: 64° F 1%: 60° F
Mean Coincident Dry-Bulb	0.4%: 72° F 1%: 77° F
Range of Dry-Bulb Temperature	25.9° F

Note 1: Use where close temperature and humidity control is required.
Note 2: Use for personnel comfort systems.
Note 3: Use for cooling towers.
Note 4: Use this value plus 5 °F for air-cooled condensers.
For definition of acronyms, symbols, and units, see Appendix C.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.7 The system components located outside shall be designed for an external environment with a maximum daily snowfall of 10 inches and maximum snowfall accumulation of 17 inches.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.8 The system components located outside shall be designed for the ambient relative humidity environment defined in Table 5.

Table 5. Ambient Relative Humidity Environment

Parameter	Value
Annual mean value	28%
Minimum summer mean value	13%
Maximum winter mean value	46%

Note: For definition of acronyms, symbols, and units, see Appendix C.

[F 1.1.1][MGR RD 3.3.A]

1.2.3.9 The system components located outside shall be designed for an external environment with a maximum annual precipitation of 10 inches and maximum daily precipitation of 5 inches.

[F 1.1.1][MGR RD 3.3.A]

1.2.4 System Interfacing Criteria

1.2.4.1 The system shall receive monitored inputs from and send control outputs to the dependent systems, as defined in Table 6.

Table 6. Monitored Inputs and Controlled Outputs

System	Monitored Inputs				Control Outputs	
		Indication Function				
	Alarm Function	Equipment Status	Interlock Status	Analog Function	Supervisory (Emergency Stop)	Control Function (Remote)
Performance Confirmation Waste Isolation Verification/Validation				X		
Ground Control	X			X		
Subsurface Ventilation	X	X	X	X	X	X
Subsurface Electrical Distribution	X	X	X	X		X
Subsurface Compressed Air	X	X	X	X	X	X
Subsurface Water Distribution	X	X		X	X	X
Performance Confirmation Emplacement Drift Monitoring	X	X	X	X	X	X
Muck Handling	X	X	X	X	X	
Subsurface Development Transportation	X	X	X	X	X	
Waste Emplacement/Retrieval	X	X	X	X	X	X
Subsurface Water Collection/ Removal	X	X		X		X
Subsurface Emplacement Transportation	X	X	X	X	X	X
Subsurface Excavation	X	X	X	X	X	
Subsurface Fire Protection	X	X		X	X	
Waste Handling Building	X	X		X		
Waste Treatment Building	X	X		X		
Carrier Preparation Building	X	X		X		
Carrier Preparation Building Materials Handling	X	X	X	X	X	
Carrier/Cask Handling	X	X	X	X	X	
Assembly Transfer	X	X	X	X	X	
Canister Transfer	X	X	X	X	X	
Waste Package Remediation	X	X	X	X	X	
Disposal Container Handling	X	X	X	X	X	
Waste Handling Building Electrical	X	X	X	X	X	
Waste Handling Building Ventilation	X	X	X	X	X	
Waste Treatment Building Ventilation	X	X	X	X	X	
Site Radiological Monitoring	X			X		
Waste Handling Building Fire Protection	X	X		X	X	

Table 6. Monitored Inputs and Controlled Outputs (Continued)

	Monitored Inputs				Control Outputs	
		Indication Function			Supervisory (Emergency Stop)	Control Function (Remote)
System	**Alarm Function**	**Equipment Status**	**Interlock Status**	**Analog Function**		
Site Communications	X	X		X		
Site Generated Radiological Waste Handling	X	X	X	X	X	
Site Water	X	X	X	X		X
Site Electrical Power	X	X	X	X		X
Site Compressed Air	X	X	X	X		X
Site Generated Hazardous, Nonhazardous, and Sanitary Waste Disposal	X	X	X	X	X	
Surface Environmental Monitoring	X			X		
Off-Site Utilities	X		X	X	X	
General Site Transportation	X	X	X	X	X	
Performance Confirmation Data Acquisition and Monitoring	X	X	X	X		X
Carrier Cask Handling	X	X	X	X	X	
Pool Water Treatment and Cooling	X	X	X	X		
Safeguards and Security	X					
Site Fire Protection	X	X		X	X	

[F 1.1.1, 1.1.2][MGR RD 3.3.A]

1.2.4.2 The system shall interface with the Safeguards & Security System (as a minimum) to transmit and receive the following data:

- Shipment arrivals
- Storage and acquisition of material control and accountability data
- Security alerts
- Alarm status
- Access to radiological areas

[F 1.1.1, 1.1.10, 1.1.11][MGR RD 3.3.K]

1.2.4.3 The system shall interface with the Site Operations System to receive information and provide historical data defined below, as a minimum.

- Provide control system status
- Provide utility status
- Provide radiation status
- Provide surface and subsurface environmental status
- Provide site communications status
- Provide status of fire detection and suppression systems.
- Provide ground control status
- Provide air quality status
- Provide alarm conditions

- Provide type of emergency condition
- Location of emergency condition
- Provide time of event
- Receive waste handling and emplacement schedules
- Receive maintenance schedules
- Receive site-wide alarm conditions
- Receive logistical status
- Provide/Receive performance confirmation data

[F 1.1.1, 1.1.10, 1.1.11][MGR RD 3.2.C]

1.2.4.4 The system shall interface with the Site Communication System for on-site and off-site voice, audio, and data communications.

[F 1.1.1, 1.1.10, 1.1.11][MGR RD 3.2.C]

1.2.4.5 The system shall receive normal and standby power from the Site Electrical Power System.

[F 1.1.1, 1.1.10, 1.1.12][MGR RD 3.1.C, 3.2.C][10 CFR 63.112(e)(8)]

1.2.4.6 The system shall monitor airflow direction, as reported by the Subsurface Ventilation System, between all emplacement drifts and the related emplacement drift turn-outs and initiate local/remote alarms as required.

[F 1.1.2, 1.1.8]

1.2.4.7 The system shall provide the means to notify the Emergency Response System of an off-normal condition and/or design basis event.

[F 1.1.1, 1.1.10]

1.2.4.8 The system shall monitor the subsurface air quality levels, based on input received from the Subsurface Ventilation System (including operational occurrences and accidents), and initiate local/remote alarms as required.

[F 1.1.2, 1.1.13][MGR RD 3.1.C][10 CFR 63.112(e)(7)]

1.2.5 Operational Criteria

1.2.5.1 The system shall be designed with Fault Detection/Fault Isolation capability that will operate in the background.

[F 1.1.9][MGR RD 3.1.C][10 CFR 63.112(e)(13)]

1.2.5.2 The system shall provide built-in-test capabilities.

[F 1.1.9][MGR RD 3.1.C][10 CFR 63.112(e)(13)]

1.2.5.3 The system shall have a minimum inherent availability of 0.9375 (TBV-4655).

[F 1.1.1, 1.1.10][MGR RD 3.2.C, 3.3.A]

1.2.5.4 The system shall have a means to bypass instrumentation and control SSCs to enable maintenance personnel to remove components without shutting down the entire system.

[F 1.1.1][MGR RD 3.1.C, 3.3.A][10 CFR 63.112(e)(13)]

1.2.5.5 The system shall have the capability to perform system calibration and operability testing.

[F 1.1.3, 1.1.8, 1.1.12][MGR RD 3.1.C, 3.3.A][10 CFR 63.112(e)(13)]

1.2.5.6 The system shall provide the operator with the capability to perform remote diagnostics.

[F 1.1.9][MGR RD 3.1.C][10 CFR 63.112(e)(13)]

1.2.6 Codes and Standards Criteria

1.2.6.1 The system shall comply with the applicable provisions of "Occupational Safety and Health Standards" (29 CFR 1910).

[MGR RD 3.1.E]

1.2.6.2 The system data communications shall be designed in accordance with the applicable provisions of "Information Technology - Open Systems Interconnection - Basic Reference Model: The Basic Model" (ISO/IEC 7498-1).

[MGR RD 3.3.A]

1.2.6.3 The system shall be designed in accordance with applicable sections of the "Department of Defense Design Criteria Standard, Human Engineering" (MIL-STD-1472E).

[MGR RD 3.3.A]

1.2.6.4 The system shall be designed in accordance with applicable sections of "Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities" (UCRL-15673).

[MGR RD 3.1.G, 3.3.A]

1.2.6.5 The system shall be designed in accordance with applicable sections of "Human-System Interface Design Review Guideline" (NUREG-0700).

[MGR RD 3.1.G, 3.3.A]

1.2.6.6 The system shall be designed in accordance with applicable sections of "Safety Color Code" (ANSI Z535.1-1998), "Environmental and Facility Safety Signs" (ANSI Z535.2-1998), "Criteria for Safety Symbols" (ANSI Z535.3-1998), "Product Safety Signs and Labels" (ANSI Z535.4-1998), and "Accident Prevention Tags (for Temporary Hazards)" (ANSI Z535.5-1998).

[MGR RD 3.3.A]

1.2.6.7 The system shall be designed in accordance with applicable sections of "Accessible and Usable Buildings and Facilities" (CABO/ANSI A117.1-1992) and "Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities" (36 CFR 1191, Appendix A).

[MGR RD 3.3.A]

1.2.6.8 The system shall be designed in accordance with applicable sections of "American National Standard For Human Factors Engineering of Visual Display Terminal Workstations" (ANSI/HFS 100-1988), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 3: Visual Display Requirements" (ISO 9241-3), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 8: Requirements for Displayed Colours" (ISO 9241-8).

[MGR RD 3.3.A]

1.2.6.9 The system shall be designed in accordance with applicable sections of "Guidelines for Designing User Interface Software" (ESD-TR-86-278), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 10: Dialogue Principles" (ISO 9241-10), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 14: Menu Dialogues" (ISO 9241-14), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 15: Command Dialogues" (ISO 9241-15).

[MGR RD 3.3.A]

1.2.6.10 The system shall be designed in accordance with the applicable sections of "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources" (IEEE Std 518-1982).

[MGR RD 3.3.A]

1.2.6.11 The system shall be designed in accordance with the applicable sections of the "National Electrical Code" (NFPA 70).

[MGR RD 3.3.A]

1.2.6.12 The system shall be designed in accordance with the applicable sections of "Standard for the Protection of Electronic Computer/Data Processing Equipment" (NFPA 75).

[MGR RD 3.3.A]

1.2.6.13 The system shall be designed in accordance with the applicable sections of "IEEE Recommended Practice for Powering and Grounding Electronic Equipment" (IEEE 1100-1999).

[MGR RD 3.3.A]

1.2.6.14 The system shall be designed in accordance with the applicable sections of "IEEE Standard for Information Technology – Open Systems Interconnection (OSI) Abstract Data Manipulation – Application Program Interface (API) [Language Independent]" (IEEE 1224-1993).

[MGR RD 3.3.A]

1.2.6.15 The system shall be designed in accordance with the applicable sections of "Application of Safety Instrumented Systems for the Process Industries" (ANSI/ISA-S84.01-1996).

[MGR RD 3.3.A]

1.2.6.16 The system shall be designed in accordance with the applicable sections of "Criteria for Accident Monitoring Functions in Light-Water-Cooled Reactors" (ANSI/ANS-4.5-1980).

[MGR RD 3.1.G, 3.3.A]

1.2.6.17 The system shall be designed in accordance with the applicable sections of "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations" (IEEE Std 7-4.3.2-1993).

[MGR RD 3.3.A]

1.2.6.18 The system shall be designed in accordance with the applicable sections of "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (IEEE Std 323-1983), with the exception of adopting the single failure criterion and the use of Class 1E related design considerations.

[MGR RD 3.3.A]

1.2.6.19 The system shall be designed in accordance with the applicable sections of "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits" (IEEE Std 384-1992), with the exception of adopting the single failure criterion and the use of Class 1E related design considerations.

[MGR RD 3.3.A]

1.2.6.20 The system shall be designed in accordance with the applicable sections of "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" (IEEE Std 603-1998).

[MGR RD 3.3.A]

1.2.6.21 The system shall be designed in accordance with applicable sections of "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS-57.7-1988).

[MGR RD 3.3.A]

1.2.6.22 The system shall be designed in accordance with applicable sections of "Design Criteria for an Independent Fuel Storage Installation (Dry Type)" (ANSI/ANS-57.9-1992).

[MGR RD 3.3.A]

1.2.6.23 The system shall be designed in accordance with applicable sections of "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800).

[MGR RD 3.1.G]

1.2.6.24 The system shall be designed in accordance with applicable section of "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12).

[MGR RD 3.1.G]

1.2.6.25 The system shall comply with the applicable assumptions contained in the "Monitored Geologic Repository Project Description Document."

1.3 SUBSYSTEM DESIGN CRITERIA

There are no subsystem design criteria for this system.

1.4 CONFORMANCE VERIFICATION

This section will be completed in a future revision.

2. DESIGN DESCRIPTION

Section 2 of this SDD summarizes information which is contained in other references. By assembling system specific information contained elsewhere (i.e., analyses, technical reports, etc.), Section 2 provides insight into the current state of the design of this system. However, due to the nature of design development, the information contained in this section will continue to change as the design matures.

The information contained in this section has been obtained from "Engineering Files for Site Recommendation" (Attachment II, Section 1.1.11), "WHB/WTB Space Program Analysis for Site Recommendation" (Section 6.2.2.1), and "Subsurface Repository Integrated Control System Design" (Section 6).

2.1 SYSTEM DESIGN SUMMARY

The Monitored Geologic Repository Operations Monitoring and Control System will be used to provide monitoring, supervisory control, and selected remote control functions for the entire repository area surface and subsurface facilities. The system will be completely bounded and housed by the North Portal repository area. The system will provide for monitoring and control functions for the radiologically controlled area (RCA), the balance of plant (BOP) area, and the subsurface repository area. The system and system interfaces are shown on Figure 1. Operation of the system will be conducted in the central control center (CCC) which is located within the WHB. System operations will be conducted throughout the RCA. Typical operations handled by the system will include: receiving input signals from other surface and subsurface systems, material control and accountability, WHB utility operations, waste emplacement, and radiation containment door control.

A satellite control center (SCC) will be located in the computer center in the Administration Building to provide automatic control and monitoring of BOP surface facility for primary operations. The SCC will also provide monitoring and limited emergency control functions for the RCA secondary operations. Because control functions from a non-seismic, qualified building (Administration Building) may be limited by regulatory licensing practices, control functions will be further defined as the design of the system matures.

The subsurface portion of the system will interface with other systems requiring supervisory monitoring and control for both repository development and waste emplacement operations. These systems include waste emplacement, waste retrieval, ventilation, radiological and air monitoring, rail transportation, construction development, utility systems (electrical, lighting, water, compressed air, etc.), backfill emplacement, and performance confirmation. Each of these systems involves some level of instrumentation and control and will typically be integrated with the system over a data communications network installed throughout the subsurface facility.

A redundant safe shutdown control (RSSC) console, located in the WHB, is currently being considered in the conceptual design to provide a backup control center for the CCC. The RSSC console will perform safe shutdown operations normally provided by the control consoles in the CCC.

2.2 DESIGN ASSUMPTIONS

The principal assumptions that were used, in addition to the design criteria described in Section 1, to develop the system features are provided below:

2.2.1 The system will be located on the surface and will be used to control and monitor activities in both the surface in subsurface.

2.2.2 The boundaries between the surface and subsurface portions of the system are not clearly defined at this point in the development of this system.

2.2.3 The CCC will monitor and control the operations and building systems in the RCA.

2.2.4 The building where the CCC and the RSSC are located is designed to withstand Design Basis Events.

2.2.5 There will be a physical separation between the CCC and the RSSC to prevent a common cause failure of the redundant safety functions.

2.2.6 The subsurface interfaces identified in Figure 1 will be further developed as work in the respective MGR system progresses.

2.3 DETAILED DESIGN DESCRIPTION

The system will be located primarily within the surface facilities, although it will include subsurface components in addition to surface components. The system will consist of a network of control centers/consoles, located inside of or adjacent to various structures on the surface. The control centers/consoles will communicate with both surface and subsurface systems. Communications (for the purposes of both monitoring and control) with connected surface and subsurface systems will be accomplished by equipment or human operators, as appropriate

2.3.1 Control Centers/Consoles

2.3.1.1 Central Control Center

The CCC will perform monitoring and control of WHB specific operations, subsurface operations, and other operations throughout the RCA. Operations such as door control and access to various parts of the WHB, WHB utility systems, and material control and accountability (MC&A) functions will be controlled and monitored from the CCC. All subsurface operations and monitoring, such as waste emplacement, ventilation control, and environmental monitoring will also be accomplished from this control center. Shift operators in the CCC will perform operations such as daily reports, shift operating logs, and administrative time keeping activities. Door and access control and waste emplacement operations will be operated from control consoles with the aid of closed circuit television (CCTV) monitors. The CCC will contain the PA system and communications equipment to make WHB and subsurface area announcements and to afford communications to the local control console operators and operators in the computer building SCC. The CCC will have the capability to perform limited emergency functions including PA announcements and radio communications for the computer center SCC in the event the SCC becomes inoperable.

The CCC will monitor the operation and status of the local control consoles of the WHB and will provide limited emergency response to local off-normal events. The CCC will not normally perform emergency response control functions in the event of local controller malfunction. However, the CCC has the capability to perform those functions if control from the local control consoles of the WHB is not possible (e.g. the operating gallery becomes uninhabitable). Communications between local console operators and the CCC operators will be performed by secured communication lines. Operator headsets or console speakers are some of the design options to be considered.

A number of human-machine interface (HMI) workstation computers will provide real-time feedback to subsurface operations personnel, giving them a global perspective on the overall operational status and performance of various subsurface process systems. These workstations will provide operators with the capability to control and/or shutdown key processes under both normal and off-normal conditions. These same workstations will also allow operators to initiate a recovery sequence or a re-start of these same systems. Operator input and data output devices can be control switches that would typically accompany the workstation computers to enable operations personnel to perform their monitoring and control activities. Operator input devices will be items such as keyboards and mouse controls, while data output devices generally include video monitors and printers. Data storage devices, which are computer workstation and network server components such as disk and tape drives used for application program storage and data archiving, will also be housed in this facility. Process monitoring and control devices such as distributed control systems (DCSs), programmable logic controllers (PLCs), and specialty monitoring panels and process controllers will be furnished under the appropriate MGR systems and will be located throughout the subsurface facility. It is through these components that primary process monitoring and control will take place.

The CCC will have the capability to perform limited emergency functions, such as PA announcements, and radio communications for the SCC in the event the SCC becomes inoperable. In addition to the 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. The CCC will monitor the operation and status of the local control consoles and will provide limited emergency response to local off normal events. The CCC will not normally perform emergency response control functions in the event of local controller malfunction. However, the 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 CCC operators will be performed by secured communication lines. Operator headsets or console speakers are some of the design options to be considered.

2.3.1.2 Satellite Control Center

The conceptual design of the SCC in the computer center is to monitor and control the operations, status, and alarms of the BOP facilities. Remote control and monitoring of some site and building systems can be accomplished in the SCC including the site utility systems and BOP building systems. Site utility system includes water, sewage, electrical, air, etc. Building system includes HVAC, lighting, computers, air, etc. The SCC will also monitor activities, status and alarms of the CCC. Limited emergency response capability, such as PA announcements, and mobilization of personnel to respond to off-normal events are some of the activities envisioned from the SCC.

2.3.1.3 WHB Operating Galleries Local Control Console

The primary control functions for control of waste handling operations will be handled from the operating galleries where operating personnel will have direct line of sight views of the nuclear operations and hands-on remote control of waste handling equipment. LCC operators will control and monitor all handling operations from consoles located in front of viewing windows. CCTV monitors will also be provided to allow operators close-up views of the operations. Local control of mechanical systems (e.g., overhead cranes and manipulators) with control consoles located in the operating galleries provides operators with the opportunity to view hot cell operations from strategically located windows. Many operations will be controlled from the LCC only. Both CCTV and visual observation from the operating gallery windows will be required for most remote operations.

In emergency response situations, control of systems normally operated from LCCs may be transferred to the CCC to ensure a safe shutdown. When control is transferred to the CCC (by LCC generated manual control signals), audible and visual alarms will be generated at the LCCs and at the CCC. Restart of these systems can only be accomplished at the LCC.

Ergonomically designed operator control consoles capable of rapid response to off normal operations, with emphasis on human factors engineering, will be provided for operator use.

2.3.1.4 Redundant Safe Shutdown Control Console

The RSSC console will provide the control capability to bring the WHB systems important to safety to a safe operating or shutdown condition. RSSC console will interface only with the equipment required for orderly safe operation or shutdown of the systems. The RSSC console will normally be in a power off (unused) mode of operation. It will only be operated if the CCC system is unavailable or inaccessible/uninhabitable. The RSSC console will have the capability to transfer control of the safety related control systems from both the CCC and WHB local control systems.

2.3.2 System Arrangement

Physical arrangement of control centers/consoles discussed above is not available at this stage of system development.

Figure 1 identifies both the site-wide and subsurface system interfaces. At this time, design analysis has not been completed sufficiently to describe surface system features and will be addressed in future revisions of this SDD as the design of the system matures. The physical architecture design for subsurface process data communications employs two subsurface-wide fiber distributed data interface (FDDI) local area networks (LANs) is presented in Figures 2 through 7. The network structures shown in Figure 8 collectively represent the overall physical architecture system (shown in Figures 2 through 7) that identifies the controls for the various subsurface process systems into the system.

As can be seen in Figure 2, the supervisory control equipment is grouped into supervisory consoles according to the types of process systems for which each is responsible. As shown in Figure 2, Node #1 on each of the two FDDI LANs provides a link to an Ethernet star topology LAN which, in turn, is linked to supervisory control equipment for the subsurface portion of the system.

As shown in Figure 3, one FDDI LAN is a single-ring network (one cable, two fibers) made up of a number of nodes that link area specific Ethernet LANs which, in turn, are connected to those subsurface process systems that are of a non-critical nature with respect to safety. As shown in Figure 4, the other FDDI LAN is a dual-ring network (two cables, two fibers per cable) composed of a number of distributed nodes linking area-specific Ethernet and specialty LANs which, in turn, are connected to subsurface processes regarded as important to safety. In the case of the FDDI LAN for important to safety systems, all links to the Ethernet LANs shown on the subsurface supervisory layer are dual redundant. Furthermore, all links to personal computers (PCs), PLCs, DCSs, and other control devices shown on the monitoring/control layer are also dual redundant. Due to the conceptual nature of the FDDI LAN network design, complete equipment/cabling redundancy requirements and details between the LAN hubs on the subsurface supervisory layer and the various input/output devices on the process layer have not been fully developed.

2.3.3 Subsurface Repository Data Communications Design

This section discusses the data communication networks for the subsurface repository facility. This data communications network links the process devices, controllers, control computers, and supervisory workstations together and connects them with other computer and data communications networks. Data communications in a control system play a major role not only in getting information to and from human operators, but also in providing commands and signals that are required for process systems to function. Also, the reliability and safe operation of the integrated control system relies on the integrity of the data communications network.

A preliminary conceptual design for the data communications network for the subsurface portion of the system is presented in Figure 8. While specific types of communications equipment are shown on the diagram, the final decisions concerning the exact nature of these devices will necessarily depend upon further definition of the MGR design as well as evolutionary trends among hardware and software products within the data communications industries. Thus, the data communication technologies and protocols offered by this diagram are subject to change or refinement.

2.3.3.1 FDDI LAN Design

The subsurface repository data communications network basically consists of two FDDI ring backbone LANs linked together in a redundant manner—one link at each of two separate nodes. One FDDI backbone is a single-ring network (one cable, two fibers) made up of a number of nodes that link area-specific Ethernet LANs, which, in turn, are connected to those subsurface process systems that are considered to be of a non-critical nature with respect to safety. The other FDDI backbone is a dual-ring network (two cables, two fibers per cable) comprising a number of distributed nodes linking area-specific Ethernet and specialty LANs, which, in turn, are connected to subsurface processes regarded as critical to safety. The number of nodes on each FDDI LAN, as well as the number of devices attached to each node, will depend upon the required physical distribution of process monitoring and control equipment throughout the subsurface.

It is important to note in Figure 8 that the Ethernet LAN (along with its attached devices) that is connected to Node #5 of each FDDI LAN is representative of similar equipment connected at FDDI Nodes #2, #3, and #4, and at Nodes #6 through *n*. Furthermore, the various subsurface process systems associated with each Ethernet LAN, and listed under Node #5 of each FDDI LAN, are also typical for each of the other FDDI nodes mentioned previously.

As mentioned earlier, the subsurface data communications system consists of two FDDI ring backbone LANs linked together in a redundant manner, one configured as a single ring for commercial quality data and the other configured as a dual ring for important to safety data. The single ring uses two fiber optic strands, each transmitting the same data in opposite directions at the same time. This gives the ring the ability to heal itself in the event of a cable break at some point on the ring. The two rings in a dual-ring configuration each work as a single ring. Like the first ring, the second ring consists of two fiber optic strands usually contained within a separate cable, and is simply used as a backup to the first in the event of a major communication failure. A dual ring operates in a dual counter-rotating manner. This means that they transmit the same data in opposite directions simultaneously. That is, the counter-rotating design ensures that all nodes attached to the rings will not be cut off from network services regardless of the location of the cable failure. Furthermore, the dual counter-rotating design allows the ring to wrap itself around any failed node on the ring. Also, by using concentrators at node locations, multiple nodes may fail without disrupting ring integrity. The two FDDI rings are linked together at two separate nodes in order to effect a redundant data path between the two backbone networks. The reason for this link is information sharing between the important to safety and commercial quality systems, primarily for the purpose of providing control interlocks between the two different classes of systems.

Most of the individual nodes attached to the two FDDI ring backbones are each linked to an Ethernet LAN configured in a star topology. That is, the different devices on each Ethernet LAN are each connected to an intelligent central wiring hub by an individual segment of fiber optic cable. Through the use of intelligent hubs, Ethernet star topologies have been developed that are able to manage data flow and provide deterministic data transmissions. Such hubs provide data buffering and are capable of determining which network segments have devices that want data. As a result, data collisions and, thus, data retransmissions, are minimized. Perhaps the principal advantage of a star topology is that the failure of any individual node on the hub will not affect the remainder of the network. Moreover, it is a relatively simple matter to accommodate new devices or move existing devices from one location to another in a start topology. It is also less difficult to troubleshoot and isolate networking problems on a star LAN than many other topologies. Devices that are star-connected to each of the Ethernet LANs linked to each node of the important to safety systems FDDI ring have redundant data paths in order to further improve the overall fault tolerance of the important to safety systems network throughout.

2.3.3.2 Subsurface Systems Associated with LAN

The commercial quality systems FDDI LAN includes the Subsurface Emplacement Transportation System, the Subsurface Electrical Distribution System, the Subsurface Ventilation System, the Subsurface Water Distribution System, the Subsurface Water Collection System, the Subsurface Compressed Air System, the Subsurface Excavation System, the Muck Handling System, the Ground Control System, and the Performance Confirmation Data Acquisition/Monitoring System.. The important to safety systems FDDI LAN includes are: the Subsurface Fire Protection System, the Subsurface Radiological Monitoring System, and the Subsurface Air Monitoring System.

The subsurface leaky feeder network, shown connected to Node #1 of the commercial quality systems FDDI LAN in Figure 8, is unique to that same node. This is also true of the various subsurface process systems associated with this leaky feeder network. These systems include the Waste Emplacement/Retrieval System, the Subsurface Development Transportation System, the Performance Confirmation Systems, and the Backfill Emplacement System. Finally, the LAN and supervisory computer equipment shown residing within the control room for the system is unique to Node #1 of each FDDI LAN.

2.3.3.3 FDDI-based LAN Selection Criteria

The primary reasons for choosing FDDI-based LANs for the two backbones making up the subsurface data communications system are inherent fault tolerance (due, in part, to the ring configuration), transmission speed, and ability to cover long distances. The fault tolerant characteristics of FDDI LANs were discussed briefly above. The data rate achieved by a typical FDDI ring is one hundred million bits per second (100 Mbps), which is a much higher data rate than standard Ethernet or other data communication technologies such as Token Ring. Although other communication services such as asynchronous transfer mode (ATM) offer data rates of 155 Mbps or better and possess greater bandwidth, FDDI is presently recommended as the data communications backbone for the MGR subsurface primarily because of its current widespread use, strong vendor support, and mature set of standards. On the other hand, ATM is a relatively new and somewhat unproven technology at this time and its future is unclear. Asynchronous transfer mode standards are still maturing and industry is just beginning to gain experience with ATM in production environments. Moreover, ATM solutions have few and somewhat precarious relationships with communications equipment vendors. Because of the use of fiber optic cable inherent in FDDI design, FDDI rings span greater distances than its wire-based counterparts. The total maximum ring length for a FDDI ring is one hundred kilometers (100 km) and the maximum distance between nodes is two kilometers (2 km). The FDDI rings also allow a maximum number of one thousand attached nodes.

2.3.3.4 Data Communications Technology Options

At the present time, Ethernet is primarily used for information networks. However, Ethernet is rapidly emerging as a natural choice for data communications in the process control and automation industries, largely because transmission control protocol/internet protocol, known as TCP/IP, its most popular LAN protocol, is widely supported by most computer and industrial control product manufacturers. Recent innovations in Ethernet technology have improved the deterministic features and performance of Ethernet.

The subsurface leaky feeder network attached to Node #1 of the commercial quality systems FDDI ring backbone represents just one of two candidate data communication technologies being considered for the monitoring and control of the transport locomotives and other specialized rail vehicles. The other data communication technology under consideration at this time is slotted microwave. The selection and depiction of a leaky feeder network shown in Figure 8 for the remote control of mobile rail equipment is strictly for illustrative purposes only. Although not shown in Figure 8, the communication links from the FDDI backbone to the other types of networks being considered for this purpose will be similar. The final selection of the actual data communication networks to be employed for the subsurface mobile rail vehicles has yet to be determined. Additional details for these different communication technologies and a comparative evaluation are presented in Sections 7.4.2 and 7.4.4 of the "Subsurface Waste Package Handling – Remote Control and Data Communications Analysis."

2.3.4 Other System Features or Characteristics

Figure 9 presents a preliminary design layout for the control room within the CCC for the subsurface portion of the system. Subsurface monitoring and/or control functions can be conducted by operations personnel from seven supervisory consoles, each consisting of several HMI workstation computers, telephone handsets, video monitors and recorders, and data printers. Generally speaking, each supervisory console will be responsible for multiple process systems throughout the subsurface.

The ventilation system supervisory console will be singularly used to monitor for the Subsurface Ventilation System. The waste transportation, emplacement, and retrieval operations supervisory console will be dedicated to the Subsurface Emplacement Transportation System, the Waste Emplacement System, and the Waste Retrieval System, respectively. The supervisory console for the construction development and backfill operations will be used to oversee the Subsurface Excavation System, the Muck Handling System, the Subsurface Development Transportation System, the Ground Control System, and the Backfill Emplacement System. The utilities and energy management supervisory console will be dedicated to the Subsurface Compressed Air System, the Subsurface Water Distribution System, the Subsurface Water Collection System, and the Subsurface Electrical Distribution System. The performance confirmation supervisory console will be dedicated to the Performance Confirmation Data Acquisition/Monitoring System and the Performance Confirmation Emplacement Drift Monitoring System. Finally, the safety and fire protection supervisory console incorporates the Subsurface Radiological and Air Monitoring Systems, and the Subsurface Fire Protection System.

The number of modular sections that make up each console are conceptual only. The actual quantities of the various devices within a given console will be determined by the complexity of the processes to be monitored and/or controlled from that console. Furthermore, the quantity of operators assigned to a given console will be determined by the amount of information and decisions that must be processed at that console. Also shown in the figure, in an area separate from the subsurface operations floor, is an equipment room containing various data, voice, and video communications equipment not normally accessed by operations personnel.

A number of video monitors for viewing subsurface operations will be distributed among several subsurface process monitoring and control supervisory consoles. For example, the supervisory console for waste transportation, emplacement, and retrieval operations will house video monitors to assist remote operators overseeing or directly controlling these system activities. For similar reasons, video monitors will also be required for the supervisory console for the construction development, and at the supervisory console for performance confirmation.

2.4 COMPONENT DESCRIPTION

Section 2.3 includes description of system components. A more detailed description will be provided in a future revision.

2.5 CRITERIA COMPLIANCE

Although this system includes aspects of subsurface monitoring and control, it will be located on the surface and is considered primarily a surface system. This surface facility is developed conceptually at this time without criteria compliance analyses. The criteria compliance for this system will be addressed in future issues of this SDD as the design of the system matures.

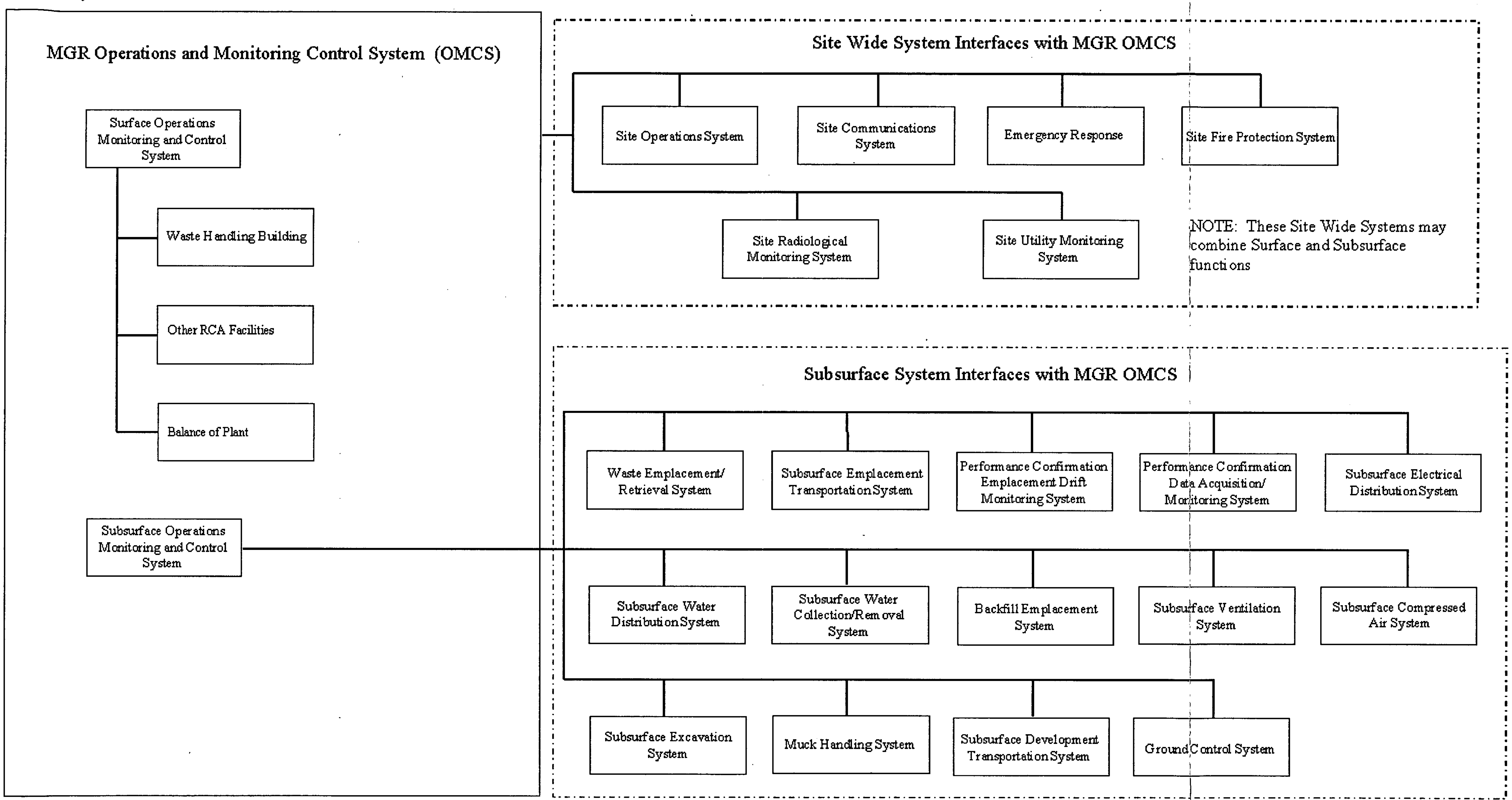
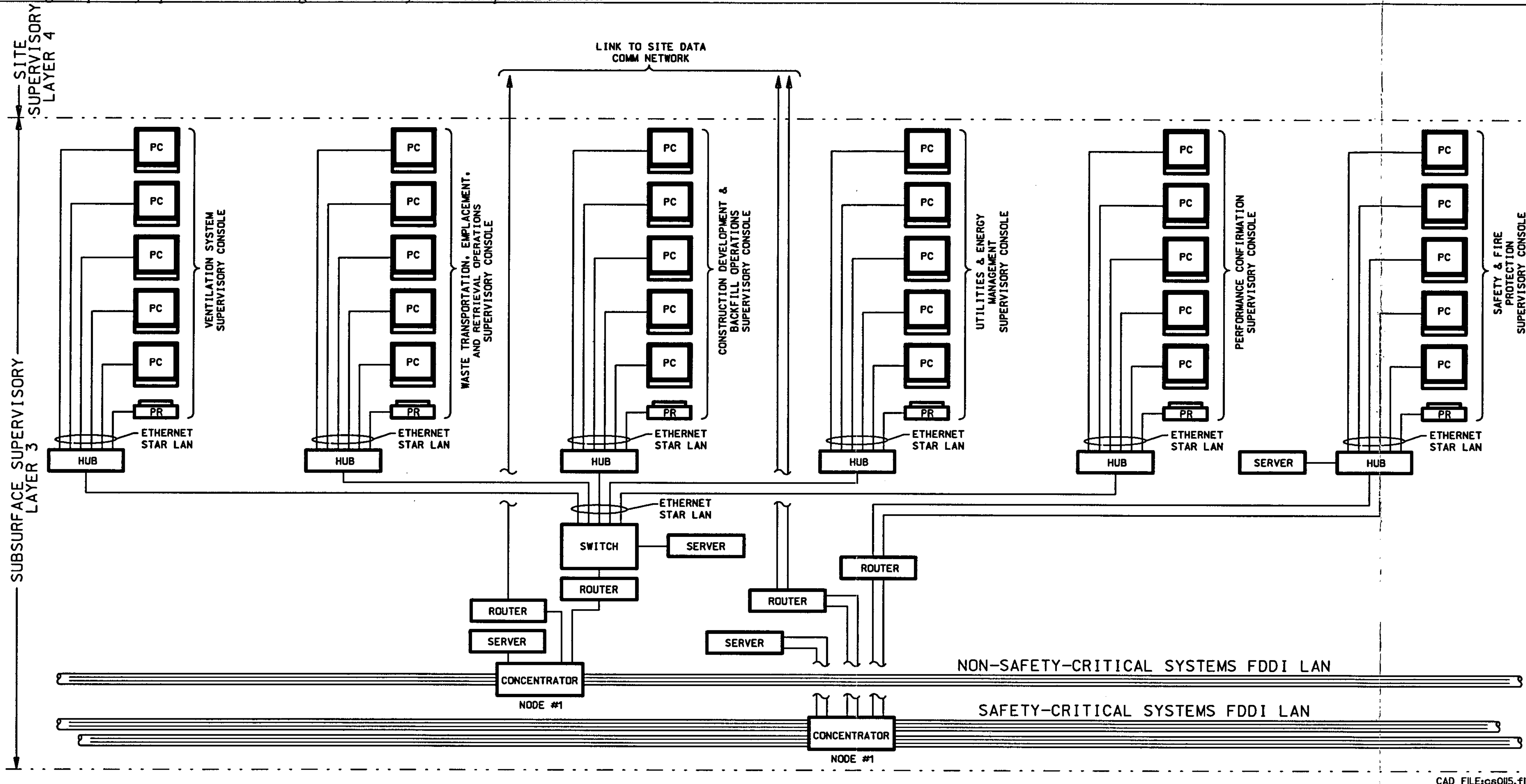


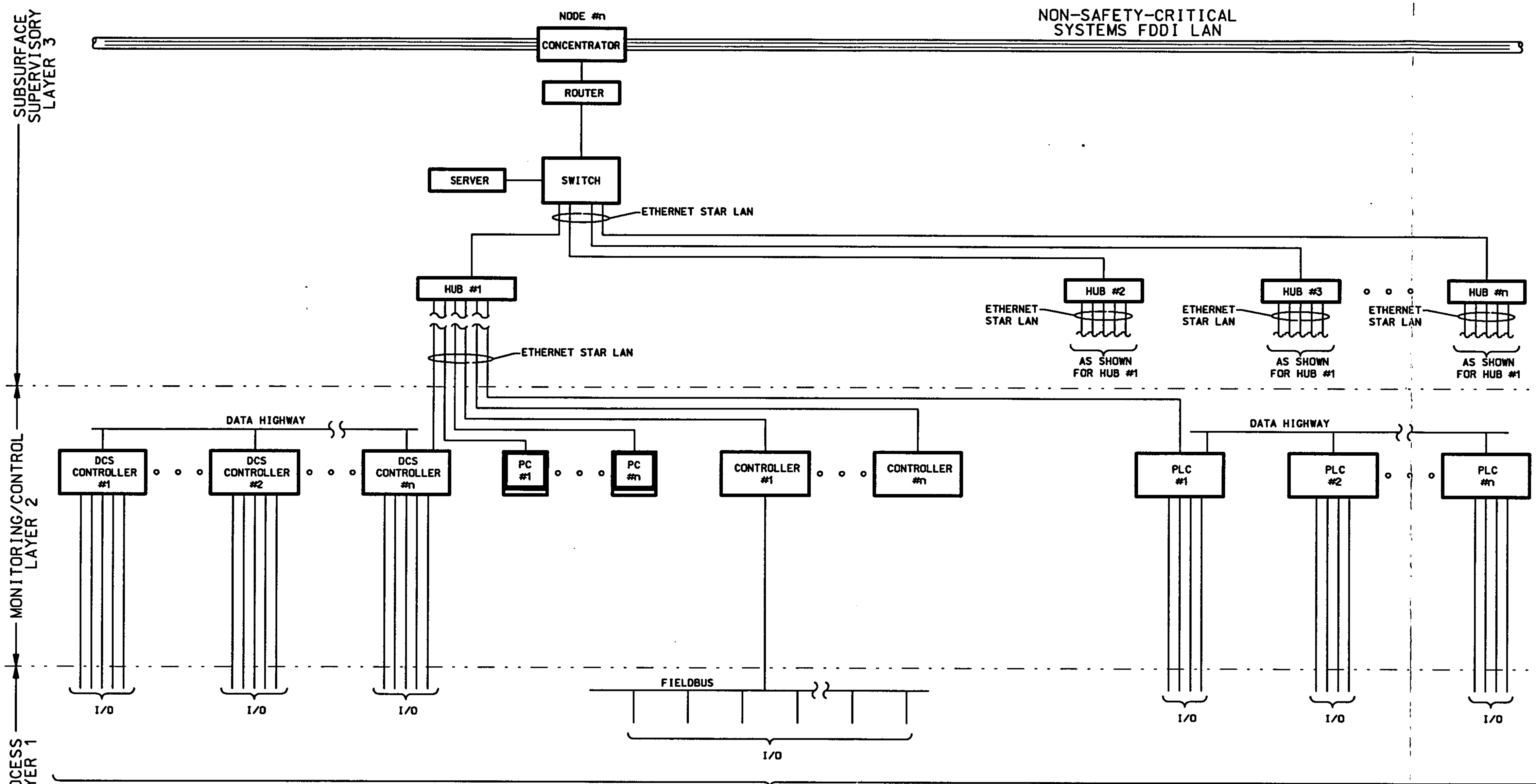
Figure 1. MGR OMCS Interfaces



LEGEND:
DCS - DISTRIBUTED CONTROL SYSTEM
I/O - INPUT/OUTPUT
MON - VIDEO MONITOR
MUX - MULTIPLEXER
PA - PUBLIC ADDRESS
PABX - PRIVATE AUTOMATIC BRANCH EXCHANGE
PC - PERSONAL COMPUTER (HMI WORKSTATION)
PLC - PROGRAMMABLE LOGIC CONTROLLER
PR - PRINTER
RF - RADIO FREQUENCY

Note: Items listed on the drawing as "NON-SAFETY CRITICAL" refer to Commercial Quality SSCs
Items listed on the drawing as "SAFETY CRITICAL" refer to Important To Safety SSCs

Figure 2. MGR OMCS Subsurface Physical Architecture – Sheet 1 of 6



LEGEND:

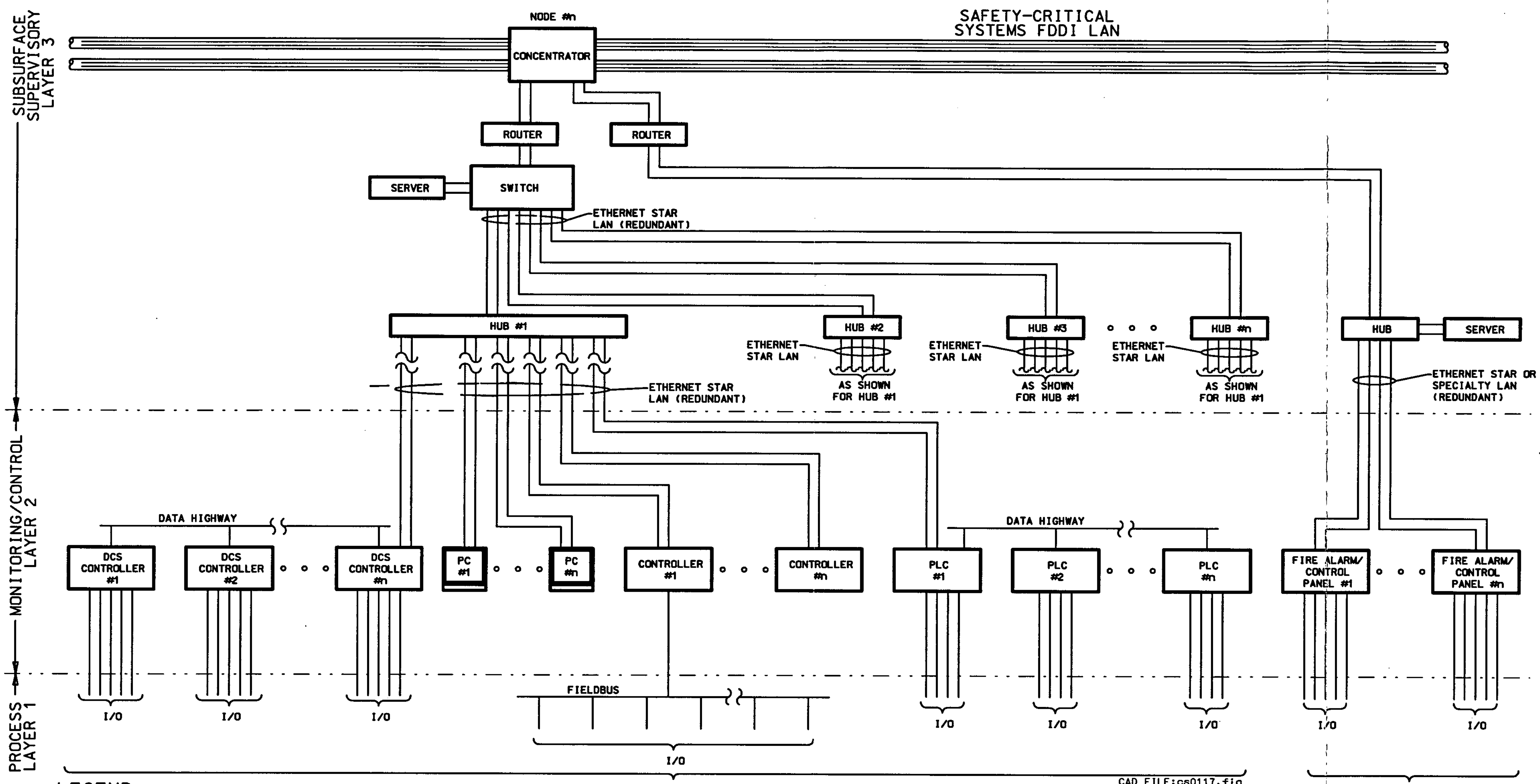
DCS – DISTRIBUTED CONTROL SYSTEM
I/O – INPUT/OUTPUT
MON – VIDEO MONITOR
MUX – MULTIPLEXER
PA – PUBLIC ADDRESS
PABX – PRIVATE AUTOMATIC BRANCH EXCHANGE
PC – PERSONAL COMPUTER (HMI WORKSTATION)
PLC – PROGRAMMABLE LOGIC CONTROLLER
PR – PRINTER
RF – RADIO FREQUENCY

INCLUDED SYSTEMS

- SUBSURFACE EMPLACEMENT TRANSPORTATION SYSTEM
- SUBSURFACE ELECTRICAL DISTRIBUTION SYSTEM
- SUBSURFACE VENTILATION SYSTEM
- SUBSURFACE UTILITIES
- SUBSURFACE EXCAVATION SYSTEM
- MUCK HANDLING SYSTEM
- GROUND CONTROL SYSTEM
- PERFORMANCE CONFIRMATION DATA ACQUISITION/ MONITORING SYSTEM

Note: Items listed on the drawing as "NON-SAFETY CRITICAL" refer to Commercial Quality SSCs

Figure 3. MGR OMCS Subsurface Physical Architecture – Sheet 2 of 6



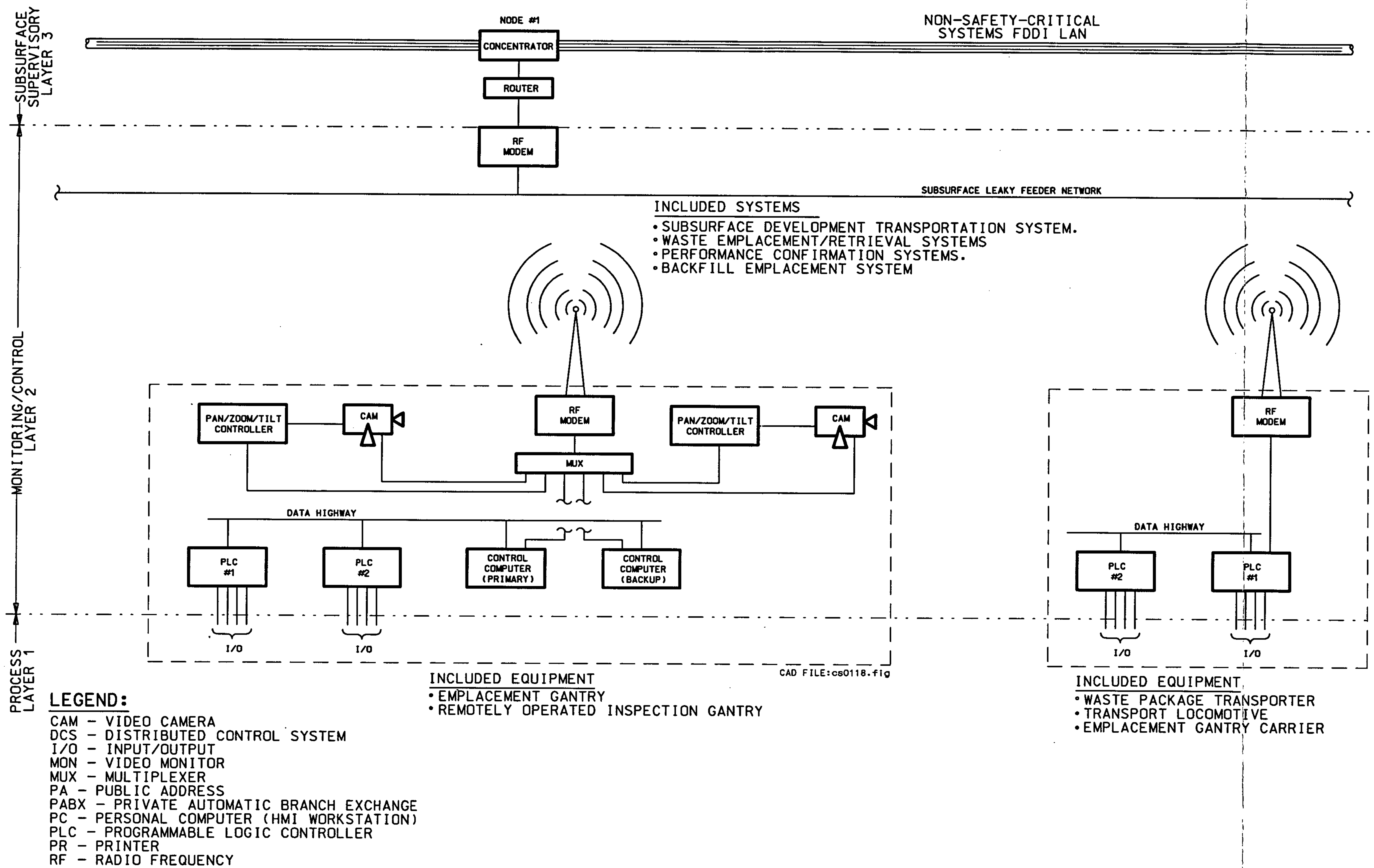
LEGEND:
DCS - DISTRIBUTED CONTROL SYSTEM
I/O - INPUT/OUTPUT
MON - VIDEO MONITOR
MUX - MULTIPLEXER
PA - PUBLIC ADDRESS
PABX - PRIVATE AUTOMATIC BRANCH EXCHANGE
PC - PERSONAL COMPUTER (HMI WORKSTATION)
PLC - PROGRAMMABLE LOGIC CONTROLLER
PR - PRINTER
RF - RADIO FREQUENCY

INCLUDED SYSTEMS
- SUBSURFACE RADIOLOGICAL MONITORING SYSTEM.
- SUBSURFACE AIR MONITORING SYSTEM

INCLUDED SYSTEMS
- SUBSURFACE FIRE PROTECTION SYSTEM.

Note: Items listed on the drawing as "SAFETY CRITICAL" refer to Important To Safety SSCs

Figure 4. MGR OMCS Subsurface Physical Architecture – Sheet 3 of 6



Note: Items listed on the drawing as "NON-SAFETY CRITICAL" refer to Commercial Quality SSCs

Figure 5. MGR OMCS Subsurface Physical Architecture – Sheet 4 of 6

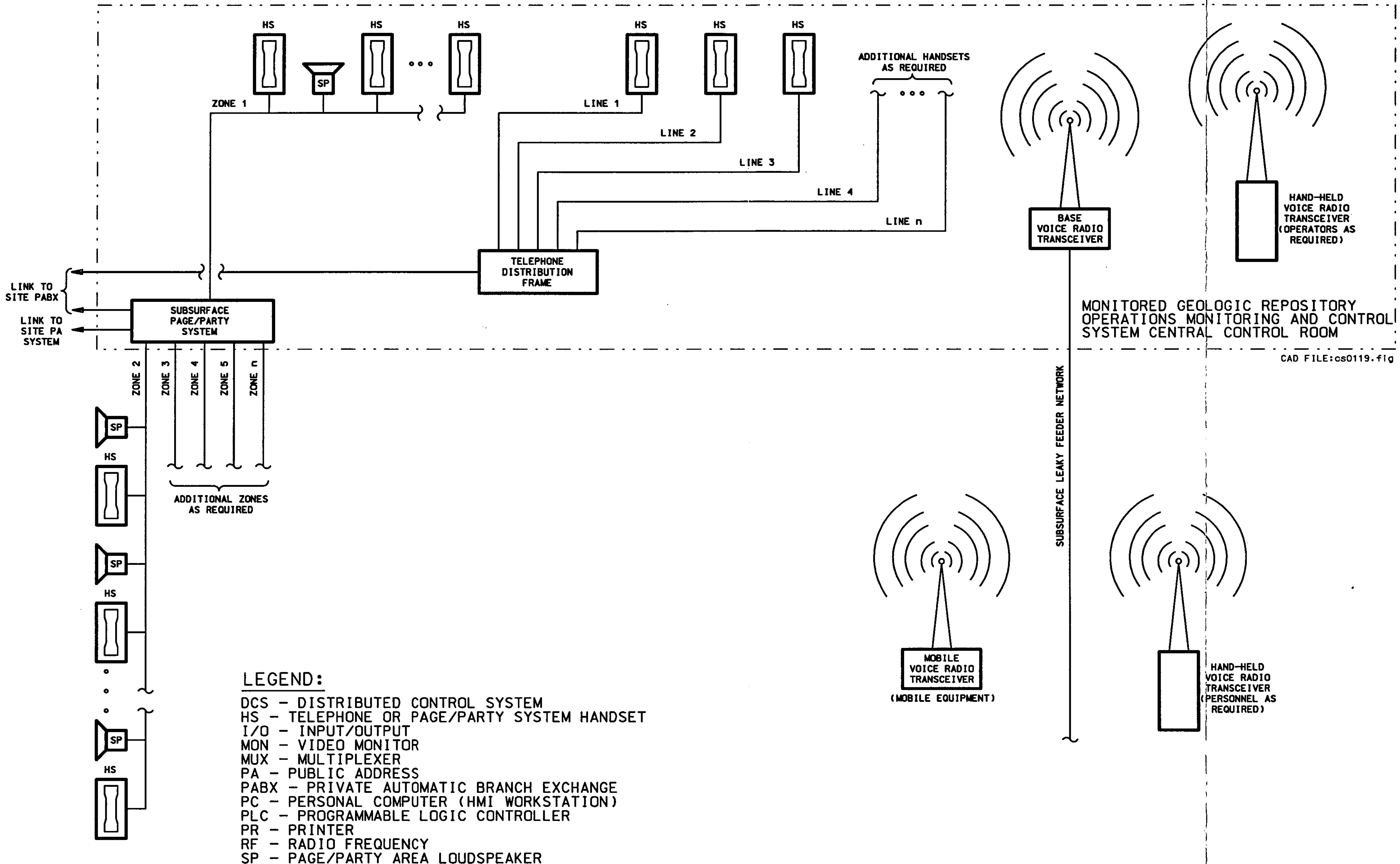
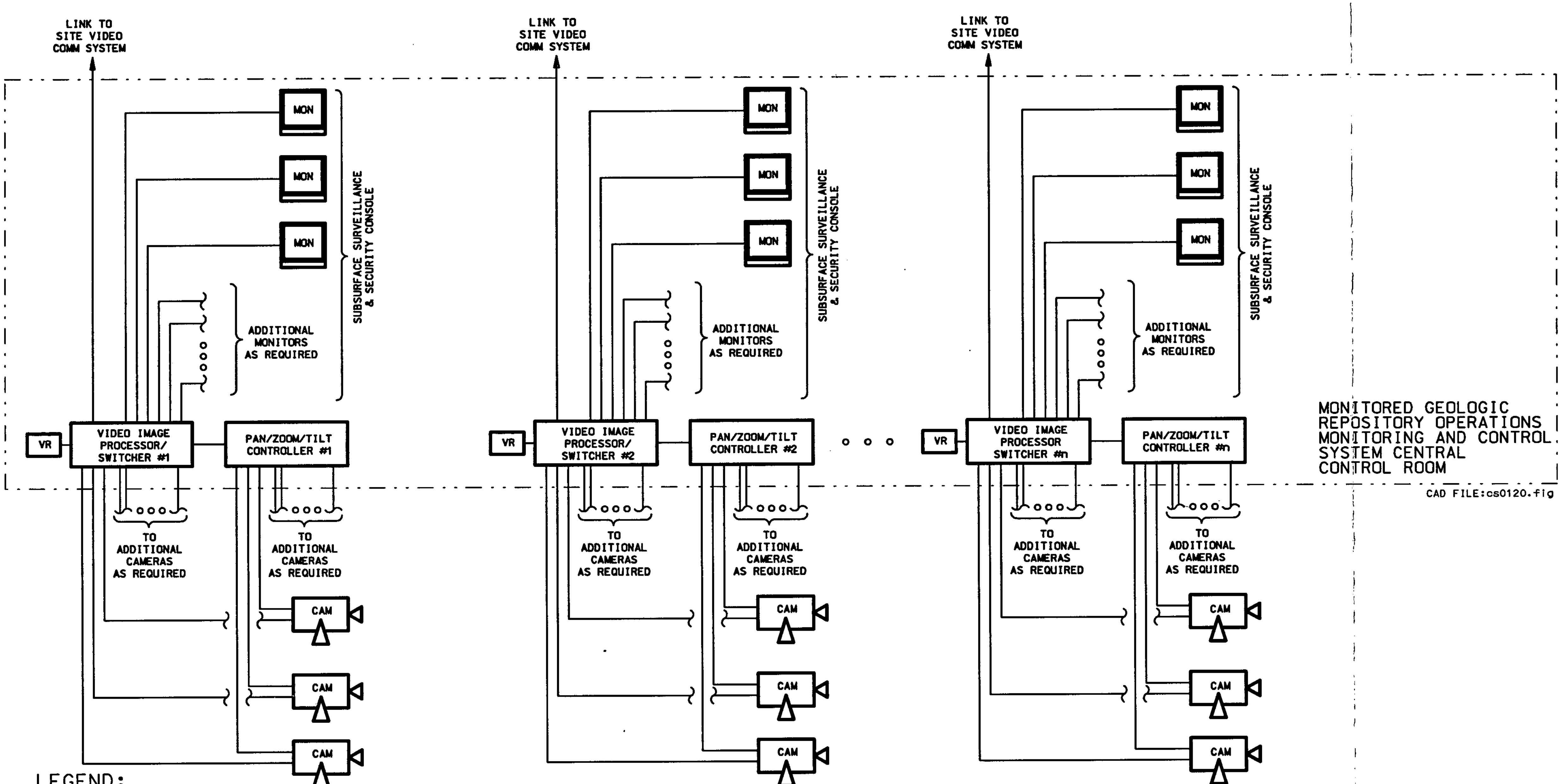


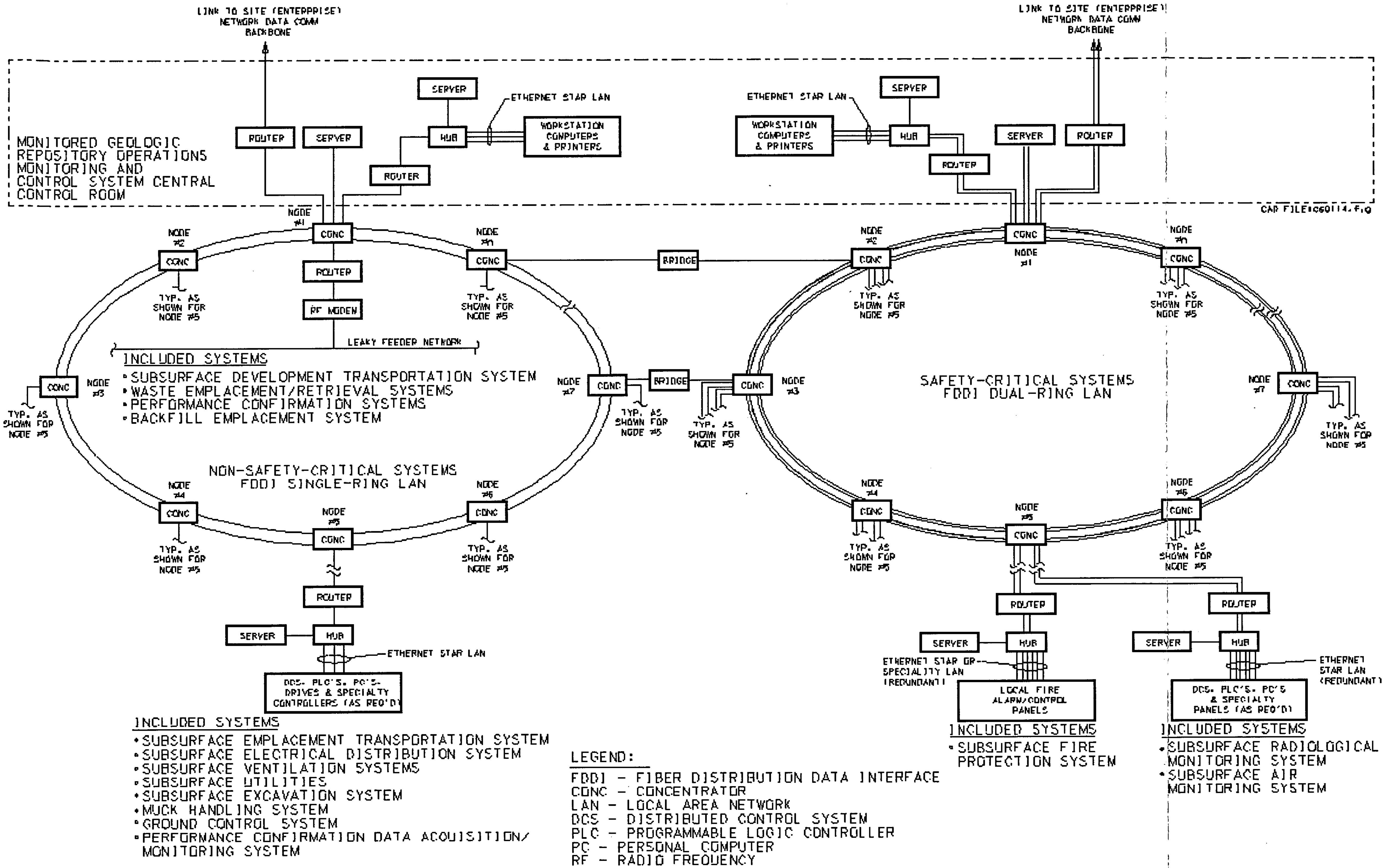
Figure 6. MGR OMCS Subsurface Physical Architecture – Sheet 5 of 6



LEGEND:

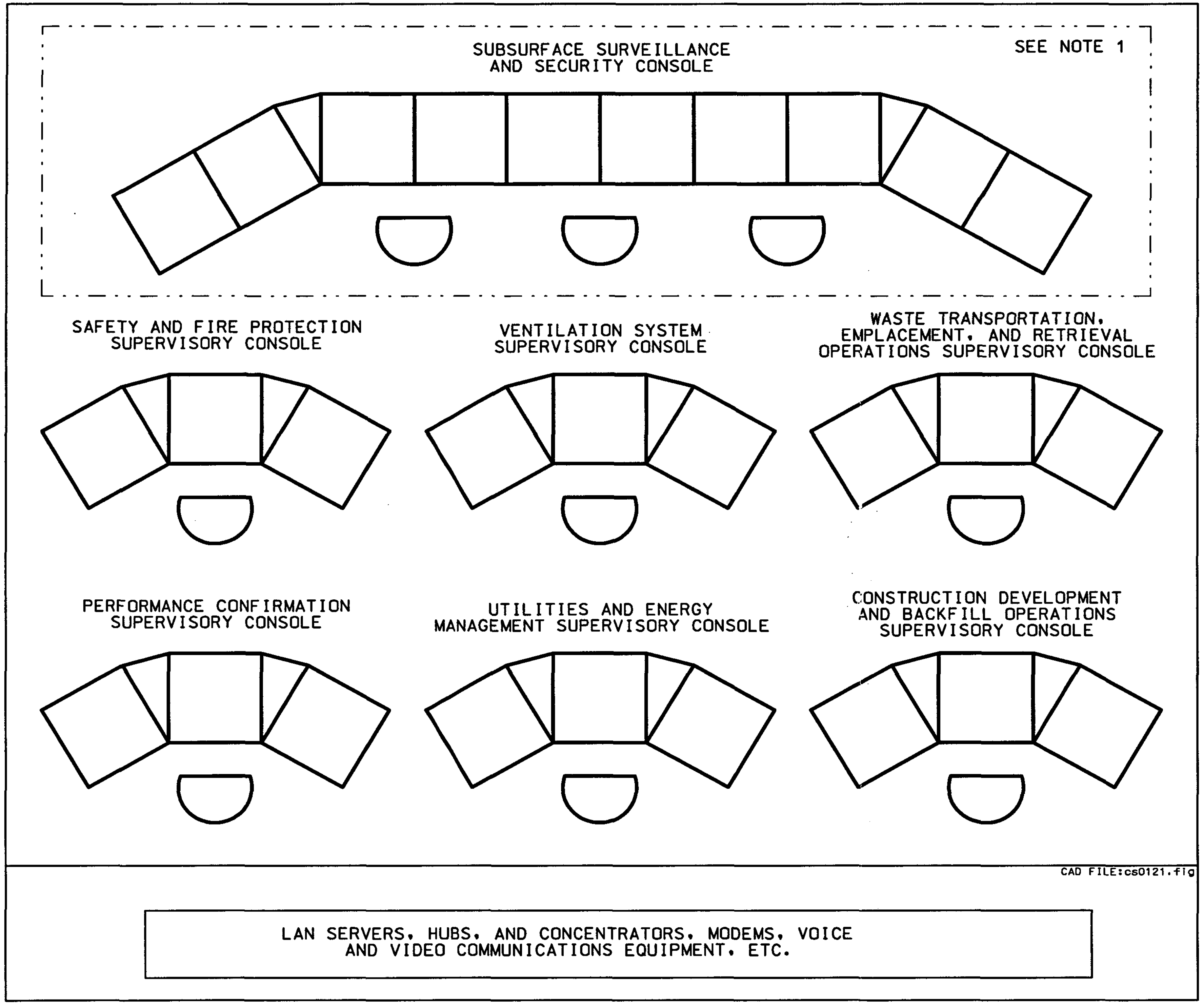
CAM – VIDEO CAMERA
DCS – DISTRIBUTED CONTROL SYSTEM
I/O – INPUT/OUTPUT
MON – VIDEO MONITOR
MUX – MULTIPLEXER
PA – PUBLIC ADDRESS
PABX – PRIVATE AUTOMATIC BRANCH EXCHANGE
PC – PERSONAL COMPUTER (HMI WORKSTATION)
PLC – PROGRAMMABLE LOGIC CONTROLLER
PR – PRINTER
RF – RADIO FREQUENCY
VR – VIDEO RECORDER

Figure 7. MGR OMCS Subsurface Physical Architecture – Sheet 6 of 6



Note: Items listed on the drawing as "NON-SAFETY CRITICAL" refer to Commercial Quality SSCs
Items listed on the drawing as "SAFETY CRITICAL" refer to Important To Safety SSCs

Figure 8. Subsurface Data Communications Network



NOTES:

1. EQUIPMENT LOCATED IN A SEPARATE AREA OF CONTROL ROOM OR SEPARATE ROOM IN THE CONTROL CENTER.

Figure 9. Subsurface OMCS Control Room Layout

3. SYSTEM OPERATIONS

This section will be completed in a later revision.

4. SYSTEM MAINTENANCE

This section will be completed in a later revision.

APPENDIX A CRITERION BASIS STATEMENTS

This section presents the criterion basis statements for criteria in Section 1.2. Descriptions of the traces to "Monitored Geologic Repository Requirements Document" and "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada" are shown as applicable. In anticipation of the interim guidance being promulgated as a Code of Federal Regulations, it will be referred to as "10 CFR 63" in this system description document.

1.2.1.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the operational life of the system and is required because the system supports waste handling operations at the repository, as required by MGR RD 3.2.C. Additional system operating life that may be needed to support performance confirmation or retrieval operations conducted after cessation of waste emplacement operations is not covered by this criterion. To meet the operational life requirement, system components may require replacement in addition to any required preventive maintenance program.

II. Criterion Performance Parameter Basis

MGR RD 3.2.C requires the MGR to be capable of receiving, packaging, emplacing, and isolating nuclear waste at the annual rates specified in Table 3-2 of the MGR RD. Table 3-2 indicates that waste receipt will commence in the year 2010 and is expected to be completed by the year 2041, spanning a total of 32 years. To account for future potential schedule fluctuations caused by uncertainties in waste remediation, early receipt, or plant life extensions, a 25 percent margin is added, resulting in an operational life of 40 years.

1.2.1.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion directly supports MGR RD 3.2.H by establishing the additional length of time the system may be required to operate to allow future generations to continue monitoring the repository

This criterion also supports MGR RD 3.1.C and the implementation of 10 CFR 63.131(b), 10 CFR 63.132(e), and 10 CFR 63.134(d) by providing the means with which data to support the performance confirmation program is gathered , handled and stored during the operational lifetime of the repository.

II. Criterion Performance Parameter Basis

The maximum operational life of 300 years after the initiation of MGR emplacement is taken directly from MGR RD 3.2.H.

1.2.1.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A which requires that all SSCs be designed and fabricated in accordance with applicable industry codes and standards.

This criterion is needed to establish the minimum human-machine interface requirements for remote visual monitoring systems. Conventional video monitoring systems typically provide flat, two-dimensional feedback information to a human operator. Multiple viewing angles are needed to provide human operators with a degree of depth perception. Typically, providing the human operator with front and side or front and top views increases operational efficiencies, performance, and safety. This will be particularly needed during loading, unloading, and docking operations.

II. Criterion Performance Parameter Basis

The minimum number of independent viewing angles that will provide a degree of depth perception to the human operators is two. The minimum number of viewing angles was estimated from typical engineering practices. General guidance is obtained from ASTM E 1808-96, "Standard Guide for Designing and Conducting Visual Experiments."

1.2.1.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to properly monitor and position the material handling and transporting equipment to ensure safe remote operation.

II. Criterion Performance Parameter Basis

N/A

1.2.1.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.B. This criterion establishes the requirements for monitoring alarms for each of the radiation monitors in the facility. The need for this functional requirement is to alert personnel of sudden changes to the radiological environment to prevent exposure of personnel in excess of the dose limits established in "Standards for Protection Against Radiation" (10 CFR 20.1201).

II. Criterion Performance Parameter Basis

N/A

1.2.1.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). This functional criterion is needed to establish a fault tolerant system such that the failures in the transmittal of data will not affect the system's ability to initiate alarms and monitor critical safety parameters. For design precedence supporting this criterion and for additional background information, refer to "Digital Controls for Safety Related Systems" (Section 8.1.2).

This criterion supports MGR RD 3.3.K

II. Criterion Performance Parameter Basis

N/A

1.2.1.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports 3.1.B, 3.1.D, and 3.3.K. This criterion is needed to monitor the handling of nuclear waste for personnel safety specified in "Standards for Protection Against Radiation" (10 CFR 20.1201) and to monitor the performance of protection systems as specified in "Physical Protection of Plants and Materials" (10 CFR 73.45).

II. Criterion Performance Parameter Basis

N/A

1.2.1.8 Criterion Basis Statement

I. Criterion Need Basis

The criterion is needed to ensure that the operators in the control room are notified when an emplacement drift isolation door is open.

II. Criterion Performance Parameter Basis

N/A

1.2.1.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion establishes a key software design feature that allows flexibility to the operator at the CCC as well as the RTU. This criterion provides for operational and maintenance efficiency in operating the overall repository. The criterion also provides for emergency system access from multiple locations throughout the data communication network system. For design precedence supporting this criterion and for additional background information, refer to "Digital Controls for Safety Related Items" (Section 7.2.3.2).

This criterion also supports the internal communications and control capabilities required by MGR RD 3.3.K.

II. Criterion Performance Parameter Basis

N/A

1.2.1.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion establishes the system response time necessary to ensure control commands are acknowledged and feedback is provided to the system operator.

This criterion also supports the internal communications and control capabilities required by MGR RD 3.3.K.

II. Criterion Performance Parameter Basis

The response time of 0.5 seconds was derived from "IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control" (IEEE C37.1-1994, Section 5.6.2).

1.2.1.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion establishes the system response time to confirm control actions from the RTU and transmit back to the to the system operator. The need for this criterion is based on the need to receive timely response for all remote control commands, such that operator errors will be minimized. This criterion is required to define, quantify, and establish the maximum system response time for executing commands and receiving feedback responses.

II. Criterion Performance Parameter Basis

The response time of two seconds was derived from "IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control" (IEEE C37.1-1994, Section 5.6.2).

1.2.1.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is required to establish the minimum margin of safety needed to ensure that central processor unit utilization does not inhibit the system's capability to execute critical control operations as demands on the system increase over time due to expansion.

II. Criterion Performance Parameter Basis

The margin of 50 percent peak central processing unit utilization for control processes was estimated from typical engineering practices. Smaller margins may be used when the control processes are very well defined; however, the 50 percent margin is reasonable for this phase of system development.

1.2.1.13 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is required to ensure that adequate storage capacity is factored in to support future unforeseen growth changes in the system operations.

II. Criterion Performance Parameter Basis

The 50 percent margin in spare main memory capacity will allow enough expansion for new functions, enhancement of existing functions, and growth of the control system. The 50 percent margin was derived from "IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control" (IEEE C37.1-1994, Section 7.7.1).

1.2.1.14 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is required to ensure that adequate data communication bandwidth is factored in to support future unforeseen growth changes in the system operations.

II. Criterion Performance Parameter Basis

The value of 50 percent for unused data communication bandwidth is based on engineering judgement. The logic to support estimating a value for this parameter is derived from "Data Communications" (NUREG/CR-6082, Sections 2.1.3 and 2.1.4).

1.2.1.15 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to establish the dependability, timeliness, and predictability of control systems employed within the surface and the subsurface repository. More than one event may occur simultaneously. This criterion will also establish the rules and protocols for simultaneous processing to ensure that all critical system deadlines will be met within the required response times.

The timeliness of control and feedback information is an important parameter that needs to be specified for each individual system. The maximum response/reply time may be different for each individual system and, therefore, will need to be established accordingly. The real-time performance criteria suitable for each surface and subsurface operation will be established based on further analysis as the design progresses. Real-time performance parameters include establishment of timeliness, predictability, dependability (or system reliability), and response to simultaneous events.

For design precedence supporting this criterion, and for additional background information, refer to "Review of Safety-Related Data Communication Systems" (Section 7.3, p. 16).

II. Criterion Performance Parameter Basis

N/A

1.2.1.16 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to establish the data storage requirements for repository operations. For design precedence supporting this criterion, and for additional background information, see "Digital Controls For Safety Related Systems" (Section 7.3).

II. Criterion Performance Parameter Basis

N/A

1.2.1.17 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to establish the requirements for detecting state changes in a variety of monitored parameters associated with remote control operations. The timeliness of detecting changes is important to the operations being controlled remotely.

II. Criterion Performance Parameter Basis

The response time to detect state changes within 0.5 seconds was a preliminary estimate that sets a reasonable minimum sampling rate for the communication (data) network subsystem. The typical adjustable range for electromechanical outputs (contacts) can vary depending on the application from 0.1 to 30 seconds, as defined in "IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control" (IEEE C37.1-1994, Table 8, p. 32).

1.2.1.18 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to establish the requirements for flexibility in the software programs that enable modification to be made by competent system operators. This ensures that a programmable data acquisition and monitoring system is designed.

II. Criterion Performance Parameter Basis

N/A

1.2.1.19 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to establish the requirements for software features that allow flexibility to display data in a variety of formats to accommodate the operational and human factor needs of the user.

II. Criterion Performance Parameter Basis

N/A

1.2.1.20 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.132(a). This criterion is needed to provide data for a required continuing program designed to ensure that parameters used in the performance assessment are confirmed and in the event of changes in field conditions, provide actual operational data to support any changes that may be needed.

II. Criterion Performance Parameter Basis

N/A

1.2.1.21 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support the data storage and recording capability requirements of a continuous operation.

II. Criterion Performance Parameter Basis

N/A

1.2.1.22 Criterion Basis Statement

I. Criterion Need Basis

This criterion also supports the internal communications and control capabilities required by MGR RD 3.3.K.

This criterion establishes the need to sample the safety parameters at a sampling rate that is commensurate with the signal characteristics being measured.

This criterion is needed to provide data for a required continuing program designed to ensure that parameters used in the performance assessment are confirmed and, in the event of changes in field conditions, provide actual operational data to support any changes that may be needed.

II. Criterion Performance Parameter Basis

The minimum sampling requirement of twice the frequency is standard industry practice for data acquisition and telemetry monitoring.

1.2.1.23 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and implementation of 10 CFR 63.112(e)(7). This criterion is needed to ensure prompt warning to operators and other personnel of the occurrence of an off-normal condition and/or design basis event so that appropriate worker response and recovery actions can be initiated in a timely manner.

II. Criterion Performance Parameter Basis

As part of a defense-in-depth strategy to prevent/mitigate radiological accidents and exposure of personnel, it is appropriate to provide alarms to annunciate deviations from normal operating conditions.

1.2.1.24 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). This criterion is needed to establish the minimum audible characteristics for the safety alarm annunciation system. The criterion was derived from "Criticality Accident Alarm System" (ANSI/ANS-8.3-1997, Section 4.3.6). Based on the similarity between criticality and radiological alarm characteristics, this has been determined to be an applicable criterion.

II. Criterion Performance Parameter Basis

The decibel levels identified were derived from ANSI/ANS-8.3-1997 (Section 4.3.6).

1.2.1.25 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). The criterion is needed to ensure that all alarms that occur can be analyzed to provide a sequence of alarm events. The sequence of alarm events will provide a "first out" indication that will help to identify the source of equipment failures and events.

II. Criterion Performance Parameter Basis

N/A

1.2.1.26 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). The criterion is needed to ensure all alarms are recorded and prioritized for emergency response considerations.

II. Criterion Performance Parameter Basis

N/A

1.2.1.27 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). The criterion is needed to ensure all alarms remain active (including after an audio alarm is acknowledged by operations personnel) until operations personnel respond to the alarm condition and take the necessary corrective action.

II. Criterion Performance Parameter Basis

N/A

1.2.1.28 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G. "Onsite Meteorological Programs" (Regulatory Guide 1.23) provides guidance acceptable to the NRC for satisfying the requirements for monitoring weather conditions as related to off-normal or accident conditions.

The purpose of the guidance contained in Regulatory Guide 1.23 is to ensure the health and safety of the general public. Current knowledge of weather conditions will be required to facilitate the site's actions to mitigate any release of radioactive substances. Knowing the pattern of weather conditions, the direction and force of the wind patterns, and the expected duration of the current weather will better equip the Emergency Response System to cope with offsite releases.

II. Criterion Performance Parameter Basis

Accuracy values for wind direction, wind speed, temperature and dew point are taken from "Onsite Meteorological Programs" (Regulatory Guide 1.23, Section C.).

1.2.2.1.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(8). This criterion is needed to prevent exacerbation of any off-normal condition and/or design basis event that would cause damage to any waste receipt, handling, processing, transport, or emplacement activity or exposure of personnel. For example, after the occurrence of an event, there should be no loss of control of a bridge crane, manipulator, or transfer cart, or damage to a transportation medium such that conditions can be exacerbated toward potential conditions that result in a dose to personnel from an unshielded waste container, or in a need to perform recovery operations in a radiation field.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to prevent the initiation of an off-normal or design basis accident condition during waste receipt, handling, or processing, and transport or emplacement operations.

Specific examples of operations that require interlocks that are under the remote control of this system include: waste emplacement and retrieval operations, operation of the transporter, and performance confirmation emplacement drift monitoring operations.

"DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities" performed analyses of the frequencies of off-normal occurrences for transport and emplacement operations including the contribution of human errors with and without interlocks. Interlocks were shown to significantly reduce the frequency of occurrence of such events. For example, it is shown that the frequency of an ejection of the waste package from the transporter car is reduced from about 1.1E-1/yr (without interlock) to 1.2E-4/yr (with interlock).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G. This criterion is needed for defense-in-depth to prevent initiation of an off-normal or design basis accident condition during important to safety operations. For example, redundancy in status indications will reduce the likelihood of improper actions by human operators and automatic controllers. Redundancy should be provided in some or all of the paths for remote control of waste receipt, waste handling, processing, and systems transport or emplacement of waste packages, especially those signals that halt operations, apply brakes, or pickup or move waste and/or waste containers.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to ensure that safety inhibits are designed to prevent movement of the waste packages until positive feedback is received to confirm the controlled operation.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.5 Criterion Basis Statement

I. Criterion Need Basis

MGR RD 3.1.C requires compliance with 10 CFR 63. This criterion establishes the requirement for the system to withstand a design basis earthquake. This criterion is based on 10 CFR 63.112(e)(8), which requires the performance analysis of SSCs that are important to safety to include consideration of the "Ability of structures, systems, and components to perform their intended safety functions, assuming the occurrence of design basis events."

This requirement is also intended to help meet the overall geologic operations area performance objectives in 10 CFR 63.111(a)(2) and 10 CFR 63.111(b)(2).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(10). This criterion is needed to ensure a timely and orderly halt of all operations with all waste elements in safe and sustainable positions. This criterion supports the defense-in-depth strategy to limit uncontrolled operations by the system. The system must be capable of monitoring and controlling the completion of such operations that may be in progress when a loss of power occurs.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed for defense-in-depth by providing additional insurance against loss of control or event initiation of systems that could result in an off-normal condition. Adding diversity for important to safety systems will minimize the risks associated with single-point failures and common mode failures as identified in "Digital Controls For Safety Related Systems" (Section 8.1.1.8).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G. "Onsite Meteorological Programs" (Regulatory Guide 1.23) provides guidance acceptable to the U.S. Nuclear Regulatory Commission (NRC) for satisfying the requirements for monitoring weather conditions as related to off-normal or accident conditions.

The purpose of the guidance contained in Regulatory Guide 1.23 is to ensure the health and safety of the general public. Current knowledge of weather conditions will be required to facilitate the site's actions to mitigate any release of radioactive substances. Knowing the pattern of weather conditions, the direction and force of the wind patterns, and the expected duration of the current weather will better equip the Emergency Response System to cope with off-site releases.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G. "Manual Initiation of Protective Actions" (Regulatory Guide 1.62) provides guidance acceptable to the NRC. Specifically, Regulatory Guide 1.62 indicates that there should be the means for manual initiation of each protective action at the system level, regardless of whether means are also provided to initiate the protective action at the component level.

Because there will be various safety-related systems within the MGR designed for the sole purpose of mitigating or preventing the release of nuclear materials, providing the capability for manual initiation on a system level is an appropriate measure to ensure the health and safety protection of the general public.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(8). "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and

Environs Conditions During and Following an Accident" (Regulatory Guide 1.97) provides guidance acceptable to the NRC.

The purpose of the design guidance contained in Regulatory Guide 1.97 is to ensure there are means for mitigating the consequences of an accident by providing operating personnel with operating status of each safety related system and the ability to determine effluent discharge pathways. Consequently, MGR personnel will also require similar capabilities and information in the event of an accident. This capability will limit undue risk to the health and safety of the public. Therefore, provisions of Regulatory Guide 1.97 are applicable to the design of the system.

This criterion also supports MGR RD 3.1.G.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.B and 3.1.G. "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12) provides guidance acceptable to the NRC. Suitable instrumentation must be provided so that the seismic response of nuclear power plant features important to safety can be evaluated promptly after an earthquake.

The purpose of the guidance contained in Regulatory Guide 1.12 is to ensure there is capability to determine if those SSCs important to safety are still able to perform their intended safety function following a seismic event. There will be certain components such as the equipment monitoring and control devices within this system that will be safety related and, therefore, necessary for preventing or mitigating the release of radioactive substances from the MGR (therefore ensuring the protection of the health and safety of the general public).

II. Criterion Performance Parameter Basis

The capability to annunciate in the CCC the output of accelerographs after triggering is specified in "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12, Section C7).

1.2.2.1.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G. "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12) provides guidance acceptable to the NRC. Suitable instrumentation must be provided so that the seismic response of nuclear power plant features important to safety can be evaluated promptly after an earthquake.

The purpose of the guidance contained in Regulatory Guide 1.12 is to ensure there is capability to determine if those SSCs important to safety are still able to perform their intended safety function following a seismic event. There will be certain components such as the equipment monitoring and control devices within this system that will be safety related and, therefore, necessary for preventing or mitigating the release of radioactive substances from the MGR (therefore ensuring the protection of the health and safety of the general public).

II. Criterion Performance Parameter Basis

The capability to process data after a seismic event is specified in "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12, Section C1.1).

1.2.2.1.13 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to establish safe communications between the RTU and the master control unit. This criterion will ensure that a fault tolerant communication protocol is designed into the system. For design precedence supporting this criterion, and for additional background information, see "Review of Safety-Related Data Communication Systems" (Section 7.3.2) and "Digital Controls For Safety Related Systems" (Sections 8.1.1.6 and 8.1.1.7).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.14 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to ensure ventilation flow is providing a safe path for clean air to travel within the subsurface facility. Inadequate delta pressure between the two ventilation areas could cause air to flow from the emplacement area to the development area. Should such a situation develop, the system should alert operations personnel of the condition so that appropriate action can be taken.

II. Criterion Performance Parameter Basis

The value of 62.2 Pa (0.25 in. of water) for the pressure drop operating limit is obtained from Criterion 1.2.1.7 in the "Subsurface Ventilation System Description Document."

1.2.2.1.15 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). This criterion is needed to ensure continuous safety monitoring and alarm processing in the event of power loss.

"DBE/Scenario Analysis for Preclosure Repository Subsurface Facilities" provides a failure modes and effects analysis for the MGR subsurface facilities in a loss of off-site power event. The analysis concluded that most operations would safely pause in the loss of power, but that backup power should be provided to ensure the continuation of safety monitoring. Hence, the system must be capable of safety monitoring and alarm processing when the loss of power occurs.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.16 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.1.C, which requires compliance with 10 CFR 63. This criterion also supports MGR RD 3.1.B and 10 CFR 63.111(a)(1), which require compliance with "Standards for Protection Against Radiation" (10 CFR 20). 10 CFR 20.1101(b) states: "The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to the members of the public that are as low as is reasonably achievable (ALARA)."

This criterion also supports MGR RD 3.3.A, which requires compliance with the applicable industry codes and standards. Compliance with "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable" (Regulatory Guide 8.8), is invoked because this regulatory guide is one of the primary regulatory documents that address ALARA. Regulatory Guide 8.8 provides guidelines on achieving the occupational ALARA goals during the planning, design, and operations phases of a nuclear facility. According to Section B of this guide, "Effective design of facilities and selection of equipment for systems that contain, collect, store, process, or transport radioactive material in any form will contribute to the effort to maintain radiation doses to station personnel ALARA." Section C.2 addresses facility and equipment design features. The design process of each system must include an evaluation of the applicable requirements in Section C.2 of Regulatory Guide 8.8.

In addition to compliance with the applicable guidelines in Regulatory Guide 8.8, the design of the system must meet the project ALARA program goals. The project ALARA program will include both qualitative and quantitative goals. Regarding the ALARA program of a licensee, Section C.1.a.(2) of Regulatory Guide 8.8 states: "The policy and commitment should be reflected in written administrative procedures and instructions for operations involving potential exposures of personnel to radiation and should be reflected in station design features. Instructions to designers, constructors, vendors, and station personnel specifying or reviewing station features, systems, or equipment should reflect the goals and objectives to maintain occupational radiation exposures ALARA."

II. Criterion Performance Parameter Basis

The project ALARA program goals are to be determined.

1.2.2.1.17 Criterion Basis Statement

I. Criterion Need Basis

The system monitors the distribution of electrical power as received from the Site Electrical Power System. The purpose of this criterion is to provide alarm indications to CCC operations personnel should off-normal conditions affecting the distribution/stability of electrical power occur.

This capability is also needed to support emergency response operations.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.18 Criterion Basis Statement

I. Criterion Need Basis

The system controls operations that are directly related to QL-1 system (WP transporter and emplacement) and is required for monitoring after DBEs and therefore must be designed for tornadic winds.
MGR RD 3.1.C requires compliance with 10 CFR 63. This criterion establishes the requirement for the system to have the capability to perform its important to safety functions during and after design basis events, as required. This criterion is based on 10 CFR 63.112(e)(8) which requires the performance analysis of SSCs that are important to safety to include consideration of the "Ability of structures, systems, and components to perform their intended safety functions, assuming the occurrence of design basis events." The specific design basis event is the Tornado winds.

II. Criterion Performance Parameter Basis

The maximum Tornado wind speed, pressure drop, and pressure drop rate were obtained from "MGR Design Basis Extreme Wind/Tornado Analysis," Section 7.

1.2.2.1.19 Criterion Basis Statement

I. Criterion Need Basis

The system controls operations that are directly related to QL-1 system (WP transporter and emplacement) and is required for monitoring after DBEs and therefore must be designed for tornadic winds.

This criterion is needed to support MGR RD 3.1.C. The criterion establishes the requirement for the Monitored Geologic Repository Operations Monitoring and Control System to withstand the dynamic effects from external missiles. This criterion is based on 10 CFR 63.112(e)(8), which requires the performance analysis of the SSCs that are important to safety to include consideration of the "Ability of structures, systems, and components to perform their intended safety functions, assuming the occurrence of design basis events." The specific design basis event is a tornado-generated missile. This requirement is also intended to help meet the overall geologic operations area performance objectives in 10 CFR 63.111(a)(1) and 10 CFR 63.111(b)(2). This criterion supports MGR RD 3.1.B and the implementation of 10 CFR 20, "Standards for Protection Against Radiation."

II. Criterion Performance Parameter Basis

The tornado generated missile parameters are obtained from "MGR Design Basis Extreme Wind/Tornado Analysis," Section 7, which recommends the use of the missile spectra specified in Section 6.3 of the analysis.

1.2.2.1.20 Criterion Basis Statement

I. Criterion Need Basis

MGR RD 3.1.C requires compliance with 10 CFR 63. This criterion establishes the requirement for the system to have the capability to perform its important to safety functions during and after design basis events, as required. This criterion is based on 10 CFR 63.112(e)(8) which requires the performance analysis of SSCs that are important to safety to include consideration of the "Ability of structures, systems, and components to perform their intended safety functions, assuming the occurrence of design basis events." The design basis event is a Frequency Category 1 design basis earthquake.

II. Criterion Performance Parameter Basis

N/A

1.2.2.2.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to ensure that the system is designed to allow the operators to monitor/control the safe start up all surface and subsurface operations.

II. Criterion Performance Parameter Basis

N/A

1.2.2.2.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to preclude the failure of monitoring channels from inhibiting the detection and alarm monitoring function.

II. Criterion Performance Parameter Basis

N/A

1.2.3.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. Temperature can directly affect the performance or result in advanced degradation of a component. To ensure proper performance, many equipment manufacturers specify the normal temperature environment in which the component must operate. Manufacturers may also specify the maximum off-normal temperature environment that the components can be exposed to or operate in for a limited time. The off-normal condition may be caused by loss of electric power or failure of the ventilation system.

II. Criterion Performance Parameter Basis

Temperature values are obtained from Criterion 1.2.1.1 in the "Waste Handling Building Ventilation System Description Document."

1.2.3.2 Criterion Basis Statement

I. Criterion Need Basis

Humidity can affect performance of computers, electronic, electrical, and mechanical components. Low humidity may result in static discharge in electrical and electronic equipment. High humidity can result in advanced corrosion or biological growth within the component. High humidity may also affect the operation of recorders that use paper. High humidity is not expected to be a major concern at the MGR due to the generally dry climate; however, depending on the nature of the operations, some areas may exhibit high humidity conditions. To ensure proper performance, many equipment manufacturers specify the humidity environment in which the component must operate. This criterion establishes the indoor humidity environment in which components are expected to operate based on the intended installation location.

Humidity is not controlled during off-normal conditions because of the generally mild humidity environment at the repository, and the expected short-term duration of off-normal conditions, such as loss of power or ventilation system failure.

This criterion supports MGR RD 3.3.A.

II. Criterion Performance Parameter Basis

Humidity values are obtained from Criterion 1.2.1.2 in the "Waste Handling Building Ventilation System Description Document."

1.2.3.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to establish the environments in which the system must operate and identifies environments that must be considered when designing surface and subsurface electrical systems. Electronic data storage equipment and media in particular is very sensitive to vibration, shock, electromagnetic interference, and the influence of magnetic fields.

II. Criterion Performance Parameter Basis

The vibration, shock, and high magnetic field environments were derived from "IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control" (IEEE C37.1-1994). The vibration levels were taken from Table 11 (V.S.1 class vibration severity). The shock levels were taken out of Table 12, (normal handling, heavy material). The high magnetic fields levels were taken from Section 6.6.2.2. Electromagnetic Interference levels are to be determined.

1.2.3.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. Radiation from fuel assemblies, high-level waste canisters, or other radioactive sources can affect electrical and electronic components. Accumulated doses of radiation (also referred to as Total Integrated Dose) can cause eventual degradation of components containing organic compounds, such as electrical insulation and lubricants. In addition to the material degradation issue, real-time operation of an electronic device may be compromised by the type of radiation received, such as neutrons colliding with the lattice atoms of the semiconductor.

Most of the electrical and electronic components will be located in mild environments with small radiation doses. Components that will be installed in radiation environments should be evaluated for the radiation doses that they can receive, and, where applicable, susceptibility to the type of radiation (X-ray, Gamma, and Neutron) should also be considered.

Shielding, distance, and duration of exposure can significantly reduce the radiation dose and type of radiation that a component receives. Therefore, detailed analyses on a case by case basis will determine the economic feasibility and practicability of providing shielding, distance from the source, minimizing exposure time, frequent replacement of the affected component, or qualification of the component for the radiation environment.

It should be emphasized that this criterion addresses the radiation doses that can affect operability of the components during normal operations, and is not intended to invoke environmental qualification requirements for post-accident operability.

II. Criterion Performance Parameter Basis

N/A

1.2.3.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.3.A, which requires compliance with applicable industry codes and standards.

Wind is one of the primary external environmental parameters that can affect buildings and structures located outside. Proper consideration of wind is required to ensure that buildings and structures can withstand the wind forces, and that system components are adequately protected from the wind. This criterion establishes the wind environment for the system's safety related buildings and structures located outside.

According to Section 6.5.2 of the standard for "Minimum Design Loads for Buildings and Other Structures" (ANSI/ASCE 7-95), the basic wind speed is to be used in the determination of the design wind loads for all buildings and structures. Also, based on the requirements in Section 3.3.1 of "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800), safety related buildings or structures must also be evaluated for the maximum wind speed. Section 3.3.1.II.1 of NUREG-0800 states: "The wind used in the design shall be the most severe wind that has been historically reported for the site and surrounding area with sufficient margin for the limited accuracy, quantity, and period of time in which historical data has been accumulated."

II. Criterion Performance Parameter Basis

The maximum wind speed is obtained from "MGR Design Basis Extreme Wind/Tornado Analysis," Section 7.

1.2.3.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.3.A, which requires compliance with applicable industry codes and standards.

Temperature is considered to be one of the primary environmental parameters that can affect component performance or result in advanced degradation. To ensure proper performance, many equipment manufacturers specify the temperature environment in which the component must operate. This criterion establishes the outdoor temperature environment in which SSCs are expected to operate.

II. Criterion Performance Parameter Basis

Values for outside design conditions are obtained from Criterion 1.2.1.3 in the "Waste Handling Building Ventilation System Description Document."

1.2.3.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.3.A. Snowfall is one of the primary design parameters needed to account for external loadings on exposed structures.

II. Criterion Performance Parameter Basis

The "Engineering Design Climatology and Regional Meteorological Conditions Report," includes snowfall information for sites in the general area of the Yucca Mountain that are deemed adequate for bounding the snowfall environment for the Yucca Mountain site. The closest of these sites is Desert Rock Airport, south of Mercury. Snowfall data are also included for Tonopah. Although Desert Rock is closer to Yucca Mountain, the elevation of Tonopah is more representative of the elevation at the Yucca Mountain site (5,426 ft for Tonopah based on Table 1 of Chapter 24 of "Fundamentals," and 4,850 ft for Yucca Mountain based on Table 2-1 of the climatology report). Therefore, data for Tonopah is considered to be the conservative bound for Yucca Mountain.

Table A-14 of the "Engineering Design Climatology and Regional Meteorological Conditions Report" provides daily maximum and monthly maximum snowfall data. The maximum daily snowfall for Tonopah is 10 in. (rounded up from 9.7 in.). The monthly snowfall is used to establish and bound the maximum snowfall accumulation. This is based on the conservative nature of the maximum monthly snowfall and the consideration that all of the monthly snowfall occurs in a short period of time with no reduction for melting. The maximum monthly snowfall for Tonopah is 17 inches (Table A-14).

1.2.3.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.3.A. Humidity is a primary environmental parameter that can affect component performance and anticipated life expectancy. This criterion establishes the external humidity environment at the site.

II. Criterion Performance Parameter Basis

The humidity values are taken from "Engineering Design Climatology and Regional Meteorological Conditions Report," Table A-1, Site 1 (NTS-60). Using Site 1 data is appropriate because the site is the closest and most representative of the North Portal, South Portal, and ventilation shafts. The annual mean humidity for Site 1 is 28 percent which is the average of the yearly averages for each of the time periods (Hour 0400, 1000, 1600, 2200) from Table A-1. The minimum summer mean humidity for Site 1 is 13 percent, which occurred in the month of June at hour 1600 from Table A-1. The maximum winter mean humidity for Site 1 is 46 percent (rounded up from 45.9), which occurred in the month of December at hour 0400 from Table A-1.

1.2.3.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to support MGR RD 3.3.A. Precipitation is an environmental parameter that can affect site drainage and erosion, buried utilities, outdoor equipment seals, and roof drain system sizing. This criterion establishes the rainfall rates through which the affected systems must be able to endure and function.

II. Criterion Performance Parameter Basis

The maximum annual precipitation is derived from "Engineering Design Climatology and Regional Meteorological Conditions Report" (p. 4-10 and Figure 4-3). The report identifies a maximum annual precipitation that ranges from approximately 1 to 10 in. for the period of 1949 to 1995. The bounding maximum annual precipitation of approximately 10 in. is taken from the Amargosa Farms site. The Amargosa Farms site is deemed appropriate in the report based on its proximity to Yucca Mountain (p. 2-5, second paragraph).

The maximum daily precipitation is derived from "Engineering Design Climatology and Regional Meteorological Conditions Report" (p. 4-21, last paragraph). The reference paragraph states, "The conclusion from the statistical analyses of observed and estimated precipitation data performed for this report indicate that the maximum daily precipitation within 50 km of Yucca Mountain is not expected to exceed five inches."

1.2.4.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion is needed to define the relationship between the system and all of the surface and subsurface systems to which it is connected. To perform a Supervisory Control function, as defined in "The IEEE Standard Dictionary of Electrical and Electronics Terms" (IEEE 100-1996, p. 1062), the system will monitor alarm status, equipment status, interlock status, and appropriate process variable data received from each system that is dependent on this system for supervisory output. Systems that require direct real-time remote control, whose equipment is controlled from the CCC, are also defined.

II. Criterion Performance Parameter Basis

N/A

1.2.4.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.K. This criterion is needed to define the data interface between the Security and Safeguards System and this system. The detailed communications message and data protocol will be developed as the design concept matures.

II. Criterion Performance Parameter Basis

N/A

1.2.4.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.2.C. This criterion is needed to define the data interface between the Site Operations System and this system. The detailed communications message and data protocol will be developed as the design concept matures.

II. Criterion Performance Parameter Basis

Future interface analysis will be performed to establish bounding design parameters for this interface criterion.

1.2.4.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling requirements of MGR RD 3.2.C. This criterion is needed to define the interface between the Site Communications System and this system. The detailed communications interface network criteria and message protocol will be developed as the design concept matures.

II. Criterion Performance Parameter Basis

N/A

1.2.4.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(8). This criterion is needed to establish the requirements for the electrical interfaces to the surface facilities' electrical power system.

This criterion supports the waste handling requirements of MGR RD 3.2.C.

II. Criterion Performance Parameter Basis

N/A

1.2.4.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to ensure ventilation flow is providing a safe path for clean air to travel within the subsurface facility. Should such a situation develop, the system should alert operations personnel of the condition so that appropriate action can be taken.

II. Criterion Performance Parameter Basis

N/A

1.2.4.7 Criterion Basis Statement

I. Criterion Need Basis

Once the CCC has received, verified, recorded, and prioritized input that an off-normal condition or design basis event has occurred, the Emergency Response System will be notified if the situation warrants the need.

II. Criterion Performance Parameter Basis

N/A

1.2.4.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGDS RD 3.1.C and the implementation of 10 CFR 63.112(e)(7). This criterion is needed to establish the monitoring requirements for ensuring the air quality within the facility is within safe operating limits.

II. Criterion Performance Parameter Basis

N/A

1.2.5.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(13).

II. Criterion Performance Parameter Basis

N/A

1.2.5.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(13).

II. Criterion Performance Parameter Basis

N/A

1.2.5.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.2.C and 3.3.A. This criterion is needed to establish the availability for the system.

II. Criterion Performance Parameter Basis

This system represents a combination of the following three systems. An availability was determined for each system in the "Bounded Minimum Inherent Availability Requirements for the System Description Documents."

Subsurface Safety and Monitoring System - 0.9941

Subsurface Operations Monitoring and Control System - 0.9711

Surface Operations Monitoring and Control System - 0.9711

Note that the "Bounded Minimum Inherent Availability Requirements for the System Description Documents" referred to the Subsurface Operations Monitoring and Control System by the earlier title of Subsurface Central Control System and referred to the Surface Operations Monitoring and Control System by the earlier title of Central Command and Control Operations System.

When two or more systems are combined into a larger system, the chances of a failure increase due to the increase in complexity of the combined system. Therefore, to apply conservative engineering judgement, a value of 0.9375 (which is the product of the above availabilities) will be used until a new or revised availability study can be completed. This value is from an uncontrolled source and is therefore TBV.

1.2.5.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C, 3.3.A and the implementation of 10 CFR 63.112(e)(13). The criterion is needed to ensure system maintenance can be performed without interrupting overall system performance.

II. Criterion Performance Parameter Basis

N/A

1.2.5.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C, 3.3.A, and the implementation of 10 CFR 63.112(e)(13) for the inspection, testing and maintaining of QL-2 systems.

II. Criterion Performance Parameter Basis

N/A

1.2.5.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C and the implementation of 10 CFR 63.112(e)(13). This criterion is needed to establish the requirements for diagnostic tests for the remote operation functions.

II. Criterion Performance Parameter Basis

N/A

1.2.6.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.E. The MGR RD requires compliance with the applicable provisions of "Occupational Safety and Health Standards" (29 CFR 1910). This criterion invokes applicable sections of 29 CFR 1910 on this system.

II. Criterion Performance Parameter Basis

N/A

1.2.6.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the requirement cited in MGR RD 3.3.A. This criterion invokes the applicable provisions of "Information Technology - Open Systems Interconnection - Basic Reference Model: The Basic Model" (ISO/IEC 7498-1), standard for an "Open System" data communications architecture. The inclusion of this industry standard was evaluated and deemed to be applicable in "Subsurface Repository Data Communication Standards" (Section 7.4, p. 32).

II. Criterion Performance Parameter Basis

N/A

1.2.6.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3A. Design, selection, arrangement, configuration, and integration of SSCs involve many elements, including monitoring, operating, maintaining, and observing the facilities and systems. To accomplish an effective and safe work environment, the human-system interface must incorporate human factors engineering (HFE) criteria. Use of the "Department of Defense Design Criteria Standard, Human Engineering" (MIL-STD-1472E), in conjunction with the other HFE standards and guidelines cited in this system description document (SDD), will provide a human-system interface that maximizes performance and minimizes risk to personnel.

This criterion ensures that the system will be designed to be safely and effectively used by all expected users. The U.S. Department of Energy (DOE) Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) endorses the use of MIL-STD-1472E (GPG-FM-027 references the earlier version of MIL-STD-1472).

II. Criterion Performance Parameter Basis

N/A

1.2.6.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G and 3.3.A. Maintainability of system equipment involves many factors, including the human-machine interface. This interface must address the design for maintainability through the incorporation of HFE criteria. This criterion ensures that the system will be designed to be safely and effectively maintained through compliance with applicable industry standards. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) endorses the use of "Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities" (UCRL-15673) for addressing HFE maintainability design criteria.

II. Criterion Performance Parameter Basis

N/A

1.2.6.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G through compliance with "Human-System Interface Design Review Guideline" (NUREG-0700). Design, selection, arrangement, configuration, and integration of control rooms, operating galleries, and related SSCs (e.g., controls, displays, labels, workspaces, human-computer interfaces) involve many factors, including the human-machine interface. By complying with "Human-System Interface Design Review Guideline" (NUREG-0700), in conjunction with other HFE standards and guidelines, this criterion ensures that control rooms, operating galleries, and related SSCs will be designed in a safe and effective manner.

This criterion supports MGR RD 3.3.A. The U.S. Department of Energy (DOE) Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) supports the use of NUREG-0700. NUREG-0700 (Sections 6.1 through 6.9) provide specific HFE design guidelines for control room elements.

II. Criterion Performance Parameter Basis

N/A

1.2.6.6 Criterion Basis Statement

I. Criterion Need Basis

Information being communicated by safety signs and tags must be quickly and easily read and uniformly understood. The ANSI Z535 series (i.e., "Safety Color Code" (ANSI Z535.1-1998), "Environmental and Facility Safety Signs" (ANSI Z535.2-1998), "Criteria for Safety Symbols" (ANSI Z535.3-1998), "Product Safety Signs and Labels" (ANSI Z535.4-1998), and "Accident Prevention Tags (for Temporary Hazards)" (ANSI Z535.5-1998) are recognized standards in the nuclear industry for the design and use of safety signs and tags. In support of MGR RD 3.3.A, this criterion ensures that, when used in conjunction with other HFE standards and guidelines, the design of safety signs and tags will help provide a safer working environment.

II. Criterion Performance Parameter Basis

N/A

1.2.6.7 Criterion Basis Statement

I. Criterion Need Basis

In support of MGR RD 3.3A, the "Americans With Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities" (36 CFR 1191, Appendix A) provides specific HFE design guidelines for providing personnel with physical disabilities access to and use of system resources. In addition, "Accessible and Usable Buildings and Facilities" (CABO/ANSI A117.1-1992) also establishes configurations and design criteria for allowing accessibility to and usability of system components by persons with physical disabilities. When used in conjunction with other HFE standards and guidelines, these codes and standards will ensure a safe and efficient design.

This criterion is not applicable to facility workspaces and activities (e.g., walking underground) where physical disabilities endanger the individual or other personnel, preclude execution of tasks, or cannot be economically accommodated.

II. Criterion Performance Parameter Basis

N/A

1.2.6.8 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, and integration of computer display terminals and workstations, equipment, and workspaces involve many factors including the human-computer interface. "American National Standard For Human Factors Engineering of Visual Display Terminal Workstations" (ANSI/HFS 100-1988), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 3: Visual Display

Requirements" (ISO 9241-3), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 8: Requirements for Displayed Colours" (ISO 9241-8) support MGR RD 3.3.A by ensuring that HFE criteria will be incorporated into the selection and design of computer equipment and workspaces through compliance with applicable industry standards. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) endorses use of the ISO 9241 standard. When used in conjunction with other HFE standards and guidelines, these codes and standards will ensure a safe and efficient design.

II. Criterion Performance Parameter Basis

N/A

1.2.6.9 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, and integration of software supporting the user interface in computer systems must consider the characteristics of the user population. In support of MGR RD 3.3.A, the application of "Guidelines for Designing User Interface Software" (ESD-TR-86-278), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 10: Dialogue Principles" (ISO 9241-10), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 14: Menu Dialogues" (ISO 9241-14), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 15: Command Dialogues" (ISO 9241-15) ensures that HFE criteria will be incorporated into the selection, design, and integration of user interface software.
The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) endorses the use of the ISO 9241 standard. When used in conjunction with other HFE standards and guidelines, these codes and standards will ensure a safe and efficient design implementation.

II. Criterion Performance Parameter Basis

N/A

1.2.6.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A. This criterion defines the engineering and installation practices that will be used in the design of the MGR to protect against electromagnetic interference as provided by the "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources" (IEEE Std 518-1982).

The ability of the control system to perform according to the manufacturer's guarantees is dependent on the quality of the signal of the attached transducer. The signal quality will depend on the elimination or attenuation of noise on the transducer's signal. Two types of external noise that will be picked up on the signal leads are normal mode and common mode. Engineering practices do not intend to recommend an internal design of equipment for the prevention of the generation of electrical noise resulting from equipment operation. All electrical noise can be protected against with proper installation. Most noise will be eliminated by following industry guides (such as those published by the Institute of Electrical and Electronics Engineers (IEEE)) that suggest a systematic approach to eliminate noise interference with electrical controllers. Most popular guides on noise elimination follow simple industry rules such as spacing recommendations, shielded cable, separate instrument and safety ground systems. A large percentage of noise interference will be eliminated with adequate design guides and proper planning. However, even in the most stringent installations, a small percentage of signals will be affected by external noise usually due to ground loops, improper installation, or an unshielded signal. The small percentage of affected signals are caught and corrected during system checkout.

II. Criterion Performance Parameter Basis

N/A

1.2.6.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. The "National Electrical Code" (NFPA 70) contains provisions considered necessary for safeguarding of personnel and SSCs from hazards arising from the use of electricity.

II. Criterion Performance Parameter Basis

N/A

1.2.6.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. The "Standard for the Protection of Electronic Computer/Data Processing Equipment" (NFPA 75) provides minimum requirements for the protection of electronic computer/data processing equipment from damage by fire or its associated effects; i.e. smoke, corrosion, heat, water.

II. Criterion Performance Parameter Basis

N/A

1.2.6.13 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. The "IEEE Recommended Practice for Powering and Grounding Electronic Equipment" (IEEE Std 1100-1999) provides a consensus of recommended practices in an area where conflicting information and confusion, stemming primarily from different view points of the same problem, have dominated. IEEE Std 1100-1999 addresses electronic equipment performance issues while maintaining a safe installation.

II. Criterion Performance Parameter Basis

N/A

1.2.6.14 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. The "IEEE Standard for Information Technology - Open Systems Interconnection (OSI) Abstract Data Manipulation - Application Program Interface (API) [Language Independent]" (IEEE Std 1224-1993) provides a language-independent specification of an interface and environment to support application portability at the source code level.

II. Criterion Performance Parameter Basis

N/A

1.2.6.15 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. The "Application of Safety Instrumented Systems for the Process Industries" (ANSI/ISA-S84.01-1996) provides design requirements for safety instrumented systems for process industries.

II. Criterion Performance Parameter Basis

N/A

1.2.6.16 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G and 3.3.A. The purpose of this standard is to establish criteria for the selection of variables to meet the above requirement. This standard presents criteria for monitoring the response of the various systems to a given accident. "Criteria for Accident Monitoring Functions in Light-Water-Cooled Reactors" (ANSI/ANS-4.5-1980) also contains criteria for determining the variables to be monitored by the control room operator, as required for safety, during the course of an accident including long-term stable shutdown. Additional criteria are presented for determining the requirements for the equipment used to monitor those variables.

The purpose of the design guidance contained in ANSI/ANS-4.5-1980 is to ensure there is means for mitigating the consequences of an accident by providing the control room personnel with operating status of each safety related system and the ability to determine effluent discharge pathways. MGR personnel will also require similar capabilities and information in the event of an accident, although the high-pressure systems of a nuclear reactor are not present for MGR application. This capability will limit undue risk to the health and safety of the public. Therefore, some provisions of ANS/ANSI-4.5-1980 are applicable to the design of the system.

This criterion is supported by Guidance Statements 6.4g1 and 7.1g1 contained in the "MGR Compliance Program Guidance Package for the Operations Monitoring and Control System."

II. Criterion Performance Parameter Basis

N/A

1.2.6.17 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations" (IEEE Std 7-4.3.2-1993) specifies additional computer requirements incorporating hardware, software, firmware, and interfaces that supplement the criteria and requirements of "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" (IEEE Std 603-1998). IEEE Std. 7-4.3.2-1993 requires that the computer application used in a safety system be protected from failures in non-safety computers.

This criterion is supported by Guidance Statements 6.6g1 and 7.4g1 contained in the "MGR Compliance Program Guidance Package for the Operations Monitoring and Control System."

II. Criterion Performance Parameter Basis

N/A

1.2.6.18 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (IEEE Std 323-1983) describes the basic requirements for qualifying Class 1E equipment with interfaces that are used in nuclear power generating stations. This IEEE standard focuses on the principles, procedures, and methods of qualification.

The purpose of IEEE Std 323-1983 is to ensure the designer takes into consideration the types of environments that components within safety related systems might be exposed to. This may include elevated temperatures, intense radiation exposure, high degree of humidity, or other industrial phenomena such as constant vibration, noise, or other physical challenges. Many of the components comprising the MGR safety related systems could be challenged by some of these harsh environments. Given that there could be environmental concerns, critical components comprising safety related systems must be available to perform the intended safety function, thereby ensuring the health and safety of the general public.

II. Criterion Performance Parameter Basis

N/A

1.2.6.19 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits" (IEEE Std 384-1992) describes the independence requirements of the circuits and equipment comprising or associated with Class 1E systems. It sets forth criteria for the independence that can be achieved by physical separation and electrical isolation of circuits and equipment that are redundant, but does not address the determination of what is to be considered redundant. This standard establishes the criteria for implementation of the independence requirements of "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" (IEEE Std 603-1998).

This criterion is supported by Guidance Statement 7.6g1 contained in the "MGR Compliance Program Guidance Package for the Operations Monitoring and Control System."

II. Criterion Performance Parameter Basis

N/A

1.2.6.20 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.3.A. "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" (IEEE Std 603-1998) establishes the minimum functional and design requirements for the power, instrumentation, and control portions of safety systems for nuclear power plants. The safety system criteria established by this standard shall be applied to those systems required to protect the public health and safety by functioning to prevent or mitigate the consequences of design basis events.

The purpose of applying IEEE Std 603-1998 is to ensure those safety-related systems, components, or structures are designed, installed, and tested in an appropriate manner, thereby protecting the health and safety of the public. To ensure each MGR safety-related system will perform in accordance with its intended design function, a certain degree of component reliability, equipment qualification, and system testability will be necessary as part of the initial design and installation. Without ensuring these types of issues are included as part of the design process, adequate performance of these safety systems cannot be ensured.

This criterion is supported by Guidance Statements 6.7g1 and 7.7g1 contained in the "MGR Compliance Program Guidance Package for the Operations Monitoring and Control System."

II. Criterion Performance Parameter Basis

N/A

1.2.6.21 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the MGR RD 3.3.A. "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS-57.7-1988) provides design criteria for systems and equipment of a facility for the receipt and storage of spent fuel from light-water reactors in a water basin type of pool. This standard contains the requirements for the design of systems and structures required to accommodate these functions, including radiation monitoring, ventilation, and monitoring, as well as other instrumentation control related subsystems.

II. Criterion Performance Parameter Basis

N/A

1.2.6.22 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the MGR RD 3.3.A. "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS-57.9-1992) provides design criteria for systems and equipment of a facility for the receipt and storage of spent fuel from light-water reactors in a dry type storage, which includes vault, metal casks, concrete silo, and dry well. This standard also addresses the preparation and reshipment of spent fuel to a geological repository. This standard contains the requirements for the design of major buildings, systems, and structures required to accommodate these functions, including radiation monitoring, ventilation, criticality control, and monitoring as well as other instrumentation and control related subsystems.

II. Criterion Performance Parameter Basis

N/A

1.2.6.23 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.1.G. Although "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800) is intended to provide guidance for the NRC staff review of nuclear power plants, various sections are general in nature, and applicable to non-power plant applications.

This criterion is supported by Guidance Statements 6.15g1, 6.15g2, 6.15g3, and 6.15g4 contained in the "MGR Compliance Program Guidance Package for the Operations Monitoring and Control System."

II. Criterion Performance Parameter Basis

N/A

1.2.6.24 Criterion Basis Statement

I. Criterion Need Basis

This criterion responds to MGR RD 3.1.G. "Nuclear Power Plant Instrumentation for Earthquakes" (Regulatory Guide 1.12) provides guidance acceptable to the NRC for satisfying the requirement. Specifically, suitable instrumentation must be provided so that the seismic response of nuclear power plant features important to safety can be evaluated promptly after an earthquake.

The purpose of the guidance contained in Regulatory Guide 1.12 is to ensure there is capability to determine if those SSCs important to safety are still able to perform their intended safety function following a seismic event.

II. Criterion Performance Parameter Basis

N/A

1.2.6.25 Criterion Basis Statement

I. Criterion Need Basis

The "Monitored Geologic Repository Project Description Document" allocates controlled project assumptions to systems. This criterion identifies the need to comply with the applicable assumptions identified in the subject document. The approved assumptions will provide a consistent basis for continuing the system design.

II. Criterion Performance Parameter Basis

N/A

APPENDIX B ARCHITECTURE AND CLASSIFICATION

The system architecture and QA classification are identified in Table 7. The QA classification, established on the first line of Table 7, is from the "Classification of the MGR Operations Monitoring and Control System." The remaining lines present the assumed next level of architecture.

Table 7. System Architecture and QA Classification

Emplacement Drift System	QL-1	QL-2	QL-3	CQ
MGR Operations Monitoring and Control System		X		
Supervisory Control System		X		
Remote Control System		X		
Computer Equipment		X		
Communication (data) Network		X		
Software		X		

APPENDIX C ACRONYMS, SYMBOLS, AND UNITS

C.1 ACRONYMS

This section provides a listing of acronyms used in this document.

ALARA	as low as is reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ATM	asynchronous transfer mode
BOP	Balance of Plant
CCC	Central Control Center
CCTV	closed circuit television
CFR	Code of Federal Regulations
CPU	central processing unit
DC	disposal container
DCS	distributed control system
DOE	U.S. Department of Energy
F	function
FDDI	fiber distributed data interface
HFE	human factors engineering
HMI	human-machine interface
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronic Engineers, Inc.
LAN	local area network
LCC	Local Control Console
MC&A	material control & accountability
MGR	Monitored Geologic Repository
MGR RD	Monitored Geologic Repository Requirements Document
N/A	not applicable
NRC	U.S. Nuclear Regulatory Commission
OMCS	Operations Monitoring and Control System
PA	public address
PCs	personal computers
PLC	programmable logic controller
QA	Quality Assurance
RCA	Radiologically Controlled Area
RSSC	Redundant Safe Shutdown Control
RTU	Remote Terminal Unit
SCC	Satellite Control Center
SDD	System Description Document
SSCs	structures, systems, and components
TBD	to be determined
TBV	to be verified
TCP/IP	transmission control protocol/internet protocol
WHB	Waste Handling Building
WTB	Waste Treatment Building

C.2 SYMBOLS AND UNITS

This section provides a listing of symbols and units used in this document.

C	Celsius
dB	decibel
F	Fahrenheit
Hz	Hertz
in	inch
km	kilometer
m	meter
MHz	megahertz
mph	miles per hour
Mbps	Megabits per second
mm	millimeter
Pa	Pascal
psi	pounds per square inch
sec.	second
V	volt
yr	year
°	degree
%	Percent

APPENDIX D FUTURE REVISION RECOMMENDATIONS AND ISSUES

This appendix identifies issues and actions that require further evaluation. The disposition of these issues and actions could alter the functions and design criteria that are allocated to this system in future revisions to this document. However, the issues and actions identified in this appendix do not require TBDs or TBVs beyond those already identified.

Issue 1. Additional analysis related to the overall MGR architecture and allocation of functions should be considered.

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