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**Civilian Radioactive Waste Management System
Management and Operating Contractor**

Site Communications and Control Systems Technical Report

BCBC00000-01717-5705-00002, Revision 00

February 19, 1998

Prepared for:

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Under Contract Number
DE-AC01-91RW00134

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FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

BIC	building inside cabling
BICSI	Building Industry Consulting Service
CAD/CAE	computer-aided design/computer-aided engineering
CAD	computer-aided design
CCC	Central Command & Control
CD-ROM	compact disc – read only memory
CFR	Code of Federal Regulations
CIM	computer integrated manufacturing
CPB	Carrier Preparation Building
CPU	central processing unit
CRWMS	Civilian Radioactive Waste Management System
D&I	drop and insert
DBE	design basis event
DC	disposal container
DCS	distributed control system
DDE	direct digital eschange
DID	direct inward dialing
DOD	direct outward dialing
DOE	United States Department of Energy
DTMF	dual tone multi-frequency
EPABX	electronic private automatic branch exchange
EPC	engineering, procurement, and construction
FDDI	fiber distributed data interface
GIS	Geographic Information System
GPS	Global Positioning System
GSA	General Services Administration
HMI	human-machine interface
HRMS	Human Resource Management System
HTML	hyper text media language
HVAC	heating, ventilating, and air conditioning
I/O	input/output
IDF	intermediate distribution frame
ISO	International Standards Organization
ISP	Internet service provider
LA	License Application
LAN	Local Area Network
LCN	Local Control Network
MDF	main distribution frame
MGDS	Mined Geologic Disposal System
MSDS	material safety data sheet

NFPA	National Fire Protection Agency
NQ	non-quality (assurance)
ODBC	open data base connectivity
OLE	object link embedment
OSI	Open Systems Interconnect
PA	public address
PABX	Private Automatic Branch Exchange
PC	personal computer
PERA	Purdue Enterprise Reference Architecture
PERT	Program Evaluation and Review Technique
PSTN	public switched telephone network
QA	quality assurance
QAP	Quality Administrative Procedure
QARD	Quality Assurance Requirements and Description
QPSK	quadrature phase shift key
RAID	redundant arrays of independent drives
RAM	random access memory
RAN	Radio Area Network
RCU	remote control unit
RDRD	Repository Design Requirements Document
RSC	Regional Servicing Contractor
SC	Subscriber Connector
SCPCDR	Site Characterization Plan Conceptual Design Report
SONET	synchronous optical network
STO	station termination outlet
TBD	to be determined
TBV	to be verified
TCP/IP	transport control protocol/Internet protocol
UHF	ultra high frequency
UPS	uninterruptible power supply
VA	Viability Assessment
VHF	very high frequency
VSAT	very small aperture telemetry
WAN	Wide Area Network
WHB	Waste Handling Building
WTB	Waste Treatment Building

DEFINITIONS

Discrete Systems are logical or physical systems that are non-open and sometimes proprietary.

Enterprise is a term applied to an entity which provides a product or service and has a function of providing such product or service. The Enterprise has inputs, processes, and outputs. The processes are performed by personnel, financial, logical and physical resources within the entity.

Enterprise Solution for this technical report is based on the Purdue Reference Model for CIM. The model is a tool for developing a Master Plan. It includes in its methodology all of the functions and requirements for an Enterprise based on computer-integrated manufacturing systems. The model is applicable to any industry, because of its generic nature.

Enterprise Wide Systems integrate the systems involved with operating the manufacturing processes (process control systems) with those involved in operation of the business as a whole (control systems for all management functions, planning, scheduling, financials, etc.). Integration of the above is via a common protocol, and common data base functions of the systems.

Local Area Networks (LANs) are designed for data administration and operation. The LAN is normally contained within a building or small number of buildings and provides attachment to a common data network server or group of servers through a backbone connection consisting of copper wire or optical fiber. Wireless LANs, recently called Radio Area Networks (RAN) are becoming popular where computer workstations are moved frequently or where some personnel need their computer at various locations within the buildings.

Local Control Networks (LCNs) are designed for supervisory control and instrument data acquisition. LCNs are normally dedicated to a group of instruments and controls that are related to each other and dependent upon each other to make the respective equipment operate properly and safely. The grouping of instruments could range from a few hundred to several thousand. LCNs can also communicate with other LCNs to operate more complex facilities.

Master Plan provides the project early identification of the project architecture, scope, and opportunities for optimization of the project. Master planning use a total life cycle approach that can be used for engineering, procurement, and construction (EPC) as well as the permanent systems when the manufacturing Enterprise goes into operation is provided. This approach also includes the plant's management and operational logical and physical system solutions including the Computer Integrated Manufacturing (CIM) and personnel function development objectives for site-wide information and integration. Using a total life cycle approach, a methodology is provided for the migration of EPC systems to the permanent systems required for the Enterprise.

Protocols are rules applied to physical and logical components to allow them to communicate with each other and their respective operating platforms, operating systems, and data storage

systems. Protocols may consist of electronic constraints, timing constraints, definition of message addressing, data configurations, data string limitations, error coding methods, and various other parameters and properties.

Sitewide Applications are those logical components of the Enterprise Solution which perform the functions necessary to allow human-machine interface and the respective communications to the data bases and configuration parameters of the computer integrated manufacturing system from concept, through engineering, procurement, construction and into operation.

Sitewide Enterprise Solutions is that part of the Enterprise Solution which is specifically interactive with the work processes at the MGDS. The divisions between Sitewide Enterprise Solutions and Enterprise-Wide Systems will be seamless to users but can be distinguished with the configuration of the solution.

Wide Area Networks (WANs) provide voice/data/video services across an array of LANs, LCNs, RANs, by several communications means including radio, telephone, microwave, and satellite, to maintain contact with entities outside of a physical site location.

1. PURPOSE

The purpose of this technical report is to assess design criteria and quantify user needs for nuclear waste handling production, control, and communications in order to provide a conceptual system-level design for all of the surface repository site communications and control systems and their interfaces. To accomplish this, it is necessary to conceptualize all Yucca Mountain Project site communication and control systems.

This report will provide definitions for Enterprise Wide Systems (CRWMS), Sitewide Enterprise Solutions (MGDS), and Sitewide Applications (MGDS Production). This includes all of the communication and control systems and components down to the human-machine interface (HMI), and excludes the local controllers.

The primary objectives of this study are to:

- Develop a communications and control systems design concept

- Outline the primary features of each system

- Define the system design basis, including Mined Geologic Disposal System (MGDS) criteria and related codes and standards, as applicable

- Summarize the basic system features, utilization, and performance objectives.

- Provide the basis for preparations to start the master planning process for the repository. The intent is to facilitate the transition from the existing OCRWM site characterization systems through the license application (LA) and construction phase to the systems that will be required to support the MGDS emplacement operations.

Operability, maintainability, and reliability of the site communications and control systems, with an expected design life through the caretaker phase, are discussed.

Since this study is an effort to establish the basic elements of a preferred site concept for control and communication systems, the topics of off-normal and failure event recovery, as well as the response to design basis events (DBEs), are not addressed fully in this report, but will be addressed in subsequent design analyses.

This study has been prepared to provide the initial conceptual design for those support systems and facilities that have not been addressed since the preparation of the *Site Characterization Plan Conceptual Design Report* (SCPCDR) (Reference 5.8). The appropriate level of detail was included to provide a credible design concept and to support the preparation of a cost estimate for Viability Assessment (VA).

2. QUALITY ASSURANCE

An activity evaluation, *Sitewide Systems and Facilities Design* (Reference 5.7), has been performed in accordance with Quality Administrative Procedure (QAP) QAP-2-0, *Conduct of Activities* and has determined that this study is subject to the requirements of the *Quality Assurance Requirements and Description* (QARD) (Reference 5.1). In addition, review of the classification of permanent items described in *Classification of the Preliminary MGDS Repository Design* (Reference 5.2), prepared in accordance with QAP 2-3, *Classification of Permanent Items*, has been performed and indicates that for SDDs SU42, SU48, SU49, SU52, and SU54, some items are "Q". Therefore, items addressed in this study are to be considered "Q" items and, as specified in NLP-3-18, *Documentation of QA Controls on Drawing, Specifications, Design Analyses, and Technical Documents*, this analysis is documented as being subject to QA controls. Table 2-1 presents the quality classification assignment for the site communications and control systems.

Table 2-1. Site Communications and Control Systems Quality Classification Assignment

SDD	System	QA Classification(s)
SU40	**Emergency Response System**	
	Emergency Response System	Non-Q
SU41	**Health Safety Systems**	
	Health Monitoring and Records System	Non-Q
	Health Physics Laboratory System	Non-Q
	Instrumentation and Data Systems	Non-Q
	Occupational Safety and Health	Non-Q
SU42	**Site Communications System**	
	Fire and Emergency Response Communication	Non-Q
	Office and Data Systems	Non-Q
	Phone System	Non-Q
	Public Address and Central Alarm System	Non-Q
	Security Communication System	QA-6
	Microwave Systems – Earth Station	Non-Q
	Microwave Systems – Portable Mobile System	Non-Q
SU48	**Security and Safeguards Systems**	
	Safeguards Material Control and Accountability	QA-1, QA-6
	Security Badging & Records System	QA-6
	Security Intrusion Detection, Surveillance and Assessment System	QA-1, QA-6
SU49	**Surface Environmental Monitoring System**	

Table 2-1. Site Communications and Control Systems Quality Classification Assignment, cont.

SDD	System	QA Classification(s)
	Data Acquisition System	QA-1
	Laboratory Facility System	QA-1
	Meteorological Monitoring System	QA-1
	Sample Collection System	QA-1
	Seismic Monitoring System	QA-1
SU50	**Administrative System**	
	Engineering Systems	Non-Q
	Office Services and Records System	Non-Q
	Operations Management & Planning Computer System	Non-Q
	Training System	Non-Q
	Transportation Dispatch Computer System	Non-Q
SU51	**Maintenance & Supply System**	
	Equipment Storage & Retrieval System	Non-Q
	Inventory Planning & Management System	Non-Q
	Maintenance Planning & Management System	Non-Q
SU52	**Central Command & Control Operations System**	
	Central Computer System	QA-1
	Operator Station System	QA-1
SU53	**Off-site Utilities System**	Non-Q
SU54	**General Site Transportation Systems**	
	General Rail System	QA-5
	General Road System	Non-Q
	Motor Pool & Facility Service Station	Non-Q

Although the results from this technical report will describe communications and control systems for the MGDS, they are at a conceptual level and will not be used directly for procurement, fabrication, or construction. Therefore, the formal To Be Verified (TBV) and To Be Determined (TBD) tracking system described in NLP-3-15 *To Be Verified and To Be Determined Monitoring System,* is not applicable. Any data from this technical report that are used as design input must be treated as unconfirmed (TBV) and tracked per NLP-3-15 prior to inclusion in documents supporting procurement, fabrication or construction.

3. METHOD

The method used in this document consists of identifying communication and control system requirements for the site and proposing hardware and software available today to fulfill those requirements. This document provides a feasible basis for the sitewide communications and control systems.

An Enterprise Solution has been envisioned for use on the CRWMS project. The thought processes behind the selection of this approach encompassed many ideas.

Some of the major work process factors for the CRWMS project contain considerations such as:

- The project will have a lifetime of 30+ years for waste handling and long-term storage of nuclear waste products. The ability for the systems controlling operations to adapt and migrate in capability during this time is necessary.

- A need exists for systems to track and manage the supply chain of waste products from commercial nuclear power plants and from military sources to the site.

- Production management of the repackaging of the supply chain casks into those configured for long-term storage will be required for efficient operation of the facility.

- Administrative functions such as human resources management, health safety systems, finance, payroll personnel, procurement, and maintenance management will exist.

- The systems that manage the Enterprise need to have the ability to provide information connectivity to other systems.

After looking at the major work processes that the Enterprise must manage, an integrated Enterprise Solution option offered many advantages to the alternative of using multiple separate and discrete systems. The conclusion was that the best fit technology for CRWMS is an integrated Enterprise Solution.

There are a number of integrated Enterprise Solution package suppliers used (SAP, People Soft, BAAN, etc.). The technology is in widespread use in private industry for supply chain management and manufacturing facilities. These systems are increasing rapidly in use and are being enhanced by their suppliers as new technological developments occur.

Discrete and special purpose systems are rapidly being phased out in favor of integrated Enterprise Solutions. Discrete, special purpose systems have major disadvantages. They require a dedicated development staff to enhance their functionality as work processes are changed and improved. They require dedicated personnel to maintain the interface programs and tables for data exchange between

the specific applications. Due to the numerous interface programs, data integrity between each application data table must be continually cross checked to ensure accuracy. When any application is changed, all affected interface programs and their interface tables are required to be cross checked and changed where necessary. Checkout and validation of the changes are difficult and lengthy processes. These burdens will increase greatly with time and present an operating efficiency liability to CRWMS since substantial resources will have to be devoted to the development and maintenance issues noted above.

At this time, the basis for preparations to start the Master Planning process for the Repository has been identified (Reference 5.6).

The open systems interconnect (OSI) protocol standards will be employed in the specifications for the Enterprise Solution. It is a logical structure for the network operations defined into seven layers by the International Standards Organization (ISO). These standards provide for any OSI-compatible devices to communicate with any other OSI-compatible devices for information exchange.

4. DESIGN INPUTS

This document provides a conceptual level of design for the sitewide communications and control systems. Most of the design inputs used in this document are the criteria set forth in the Repository Design Requirements Document (RDRD) (Reference 5.3).

4.1   DESIGN PARAMETERS

Not applicable.

4.2   CRITERIA

The following design criteria were developed to respond to the RDRD to address the requirements that specifically apply to this document (Reference 5.3). The appropriate RDRD requirements are cited for each criterion statement.

4.2.1   The CRWMS Enterprise will use the best fit technology to ensure quality. High integrity and best fit technology systems consider factors such as reliability, maintainability, inspection, availability, and service life. (RDRD 3.2.5)

4.2.2   The CRWMS Enterprise site communications and control systems will be designed for a maintainable life through the caretaker phase. (RDRD 3.2.5.4 A)

4.2.3   The CRWMS Enterprise will have a single solution to meet the mission. (RDRD 1.3.1, 3.2.3, 3.2.5, and 3.3.10)

4.2.4   The CRWMS Enterprise will have, at a minimum, telephone and radio communication between all CRWMS entities. (RDRD 3.7.3.4)

4.2.5   The CRWMS Enterprise will have a material management system for all materials, parts, and components. (RDRD 3.3.8.1)

4.2.6   The CRWMS Enterprise will have an inventory control system. (RDRD 3.3.8.2)

4.2.7   The CRWMS Enterprise will have all the necessary tools to meet the mission. (RDRD 3.5)

4.2.8   The CRWMS Enterprise will have a training module. (RDRD 3.6.2)

4.2.9   The CRWMS Enterprise will have a record management module. (RDRD 3.7.4.4F)

4.3   ASSUMPTIONS

4.3.1   It is assumed that the logical systems described in Figure 7-1 and the functional requirements described in Sections 7.1 through 7.3 are required for the Enterprise. The basis for this assumption is that although the MGDS architecture (Reference 5.4) and the RDRD (Reference 5.3) do not specifically address areas of document control, data storage, and many other general components of an Enterprise, some of these functions have already been implemented to some extent. Previous experience with such entities indicates that such functional items will be required for engineering, procurement, and construction (EPC), and eventual operation of the Enterprise.

4.3.2   It is assumed that the third party software will be evaluated and employed into the Enterprise Solution using best fit technology where applicable, and /or no solutions are provided by the modules of the Enterprise Solution. It is known at this time that no software supplier provides an entire software solution for the Enterprise, and that the sum of software suppliers conceived for the CRWMS will not address all issues concerning the CRWMS. The basis for this assumption is to provide the least problematic path of migration from the "as is" OCRWM systems employed in the engineering phase to "to be" systems for facilities' operations.

4.3.3   It is assumed that certain portions of the CRWMS will require specialty configuration, programming, and interfaces, as there is no known software, firmware, or hardware supplier who directly provides all the services necessary to complete the logical and physical systems conceived in this technical report. Third party agencies who are experts at analyzing and completing systems may be utilized during construction and operation changes. Also included in this assumption is the observation that the third party interface needs are becoming fewer and less due to the development and acceptance of global standards

concerning open systems and well-defined connectivity. Identifying the third party needs is beyond the scope of this document.

4.3.4   It is assumed that the QA classifications shown in Table 2-1 have been correctly assigned. This is based on the work performed in *Classification of the Preliminary MGDS Repository Design* (Reference 5.2), which carries a TBV for these classifications (TBV).

4.4   CODES AND STANDARDS

4.4.1   National Fire Protection Agency (NFPA)

NFPA 70   National Electrical Code, 1996

4.4.2   U.S. Department of Energy (DOE) Orders

DOE Order 6430.1A   General Design Criteria, April 6, 1989

4.4.3   Code of Federal Regulations (CFR)

Title 10   Energy, Part 60 - Disposal of High Level Radioactive Wastes in Geologic Repositories, 1997

4.4.4   International Standards Organization

ISO/IEC 7498-4   OSI Reference Model – Open System Interconnect Reference Model, 1989 (E)

4.4.5   American National Standards Institute - ANSI, TIA/EIA Standards

Telecommunications Wiring Standards

4.4.6   Building Industry Consulting Service (BICSI)

Telecommunications Distribution Methods Manual, Tampa, Florida, 1995

5. REFERENCES

5.1   U.S. Department of Energy, *Quality Assurance Requirements and Description* (QARD), DOE/RW-0333P, Rev. 7.

5.2   Civilian Radioactive Waste Management System (CRWMS) M&O, *Classification of the Preliminary MGDS Repository Design*, B00000000-01717-0200-00134 Rev. 00.

5.3   U.S. Department of Energy, *Repository Design Requirements Document* (RDRD), YMP/CM-0023, Rev. 0, ICN 1.

5.4   CRWMS M&O, *Mined Geologic Disposal System Architecture*, B0000000-01717-5700-00011, Rev. 1.

5.5   Williams, T. J., Editor, Purdue Enterprise Reference Architecture, Report Number 154, *Purdue Laboratory for Applied Industrial Control*, Purdue University, West Lafayette, Indiana (1991).

5.6   Williams, T.J., Rathwell, G.A., Li, Hong, Editors, *A Handbook On Master Planning And Implementation For Enterprise Integration Programs based on the Purdue Enterprise Reference Architecture*, Report Number 160, Purdue Laboratory for Applied Industrial Control, Purdue University, West Lafayette, Indiana (1996).

5.7   CRWMS M&O, *Sitewide Systems and Facilities Design* (Work Package 12461016M1), January 11, 1998.

5.8   Sandia National Laboratories, *Site Characterization Plan Conceptual Design Report (SCPCDR)*, SAND84-2641, SNL 1987.

5.9   U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Draft RFP for Waste Acceptance and Transportation Services* (Appendix 7 to Section C, *Tracking System Requirements*) of Draft RFP Number DE-RP01-98RW00320, November 24, 1997.

6. USE OF COMPUTER SOFTWARE

Not applicable.

7. DESIGN ANALYSIS

The Enterprise Solution in this proposal is based on the Purdue University reference model for computer integrated manufacturing (CIM) (References 5.5 and 5.6). The model is a very valuable tool for developing a Master Plan because it includes in its methodology all of the functions and requirements for an Enterprise based on CIM systems. The model is applicable to any industry because of its generic nature.

This technical report uses the logical and physical architectures model for Enterprise Wide Systems with the CRWMS and all of its ancillary systems considered to be the overall Enterprise. Figure 7-1 depicts the CRWMS summary level logical systems architecture. Figure 7-2 is provided as an example of the architecture of the CRWMS summary level physical systems, and may not represent the actual architecture employed in the Enterprise Solution.

CIVILIAN RADIOACTIVE WASTE MANAGMENT SYSTEM
SUMMARY LEVEL LOGICAL SYSTEMS ARCHITECTURE

LEVEL 6 & 7
Time Interval 6&7

ENTERPRISE WIDE SYSTEMS

• 7.1.4 Waste Acceptance & Transportation Sys.
7.1.4.1 Production Transportation Analysis
7.1.4.2 Production Transportation Optimization

•MGDS
7.1.5.1 Production Data Historian
7.1.5.2 Production Scheduling
7.1.5.3 Production Analysis & Optimization
7.1.5.4 Nuclear Material Accountability

• 7.1.3 Overall Administration Sys.
(Enterprise Solution)
7.1.3.1 Finance / Accounting / Payroll
7.1.3.2 Human Resources Mgt. Systems
7.1.3.3 Personnel Training
7.1.3.4 Procurement
7.1.3.5 Materials Management
7.1.3.6 Maintenance Management
7.1.3.7 Offsite Disaster Recovery Sys

• 7.1.8 Quality Assurance Sys.

• 7.1.2 Overall Enterprise Document Management Systems
7.1.2.1 Master Record & Document Vault

• 7.1.6 Wide Area Network (Logical Traffic Functions)
7.1.6.1 PSTN Carrier Services
7.1.6.2 Microwave System
7.1.6.3 Commercial Satellite
7.1.6.4 Local Earth Station System
7.1.6.5 Global Pos. & Track.System

• 7.1.7 External Hot Lines (Logical Traffic Function)
7.1.7.1 National & Regional Organizations
7.1.7.2 Emergency Reaction Organizations
7.1.7.3 Civil Defense Organizations
7.1.7.4 PSTN Subscriber Services
7.1.7.5 Two Way Radio Offsite

LEVEL 5
Time Interval 5

SITEWIDE ADMIN. & AUXILIARY. SYS.

• 7.2.2 Communication Systems
7.2.2.1 Site Radio Sys., 7.2.2.1.1 Personal Paging Sys.
7.2.2.2 Data LANS. 7.2.2.3 Site Wide Telephone Sys
7.2.2.3.1 Hot Lines Telephone Systems.
7.2.2.4 Site Emerg.Radio, 7.2.2.5 SiteEmerg. Phone
Systems, 7.2.2.6 Offsite Emergency Comm.,
7.2.2.7 Site WideEmerg. Notification (PA/Sirens)

•Transportation Sys.
Rail & Safety Systems
Road & Safety Systems
Site Transportation, Motor Pool.
Service Station

• 7.2.1 Management & Administrative Systems
7.2.1.1 Central Warehouse Mgt. 7.2.1.2 Central Shop Mgt.,
7.2.1.4 Material Control, 7.2.1.4 MaintenanceSched.,
7.2.1.5 Weekly/Daily ProductionSched., 7.2.1.6 Product'n Sim. Sys.
7.2.1.7 Engineering Systems, 7.2.1.7.1 R&D Support Sys.,
7.2.1.7.2 Performance Confir. Sys., 7.2.1.7.3 UtilitiesMgt. Sys.
7.2.1.8 Cable Management System, 7.2.1.9 Security Administration,
7.2.1.10 Food Services, 7.2.1.11Proj. Mgt. Sys.,
7.2.1.12 Health, SafetyMgt. and Admin.

7.2.3 Desktop, PDS & CAD

Production to Enterprise Interf.

Primary Emerg. Response Ctr.
Emerg. Detection & Resp. Sys.

Secondary Emerg. Response Ctr.
Emerg. Det. & Resp. Sys

•Safety & Security Systems
Emergency Detection & Response System,
Health Safety Systems, Safeguards and Security Sys.,
Environmental Monitoring Systems,

LEVEL 4
Time Interval 4

SITEWIDE APPLICATIONS & DATA

•Lab Information Mgt. Sys.

• 7.3.1 Central Command & Control
7.3.1.1 Surf. Fac. Control Stations
7.3.1.2 Subsurf. Fac. Control Functions
7.3.1.3 Utility Sys.Mon. & Control Func.
7.3.1.4 Emerg. Detct & Resp. Interface
7.3.1.5 Health Safety Interface
7.3.1.6 Safeguards & Security Interface
7.3.1.7 Env. Monit. Interface

LEVEL 2 & 3
Time Interval 2/3

CONTROL & OPERATIONS

•Waste Handling System
Human Machine Interfaces
Carrier Cask Shipping & Receiving Sys.
Waste Preparation System
Waste Treatment System
Waste Emplacement & Retrieval System

•Operational Support System
Human Machine Interf.   NonRad. Waste Sys.
Utility Systems   Commun. Sys. (Oper)

•Waste Isolation System.
Human Machine Interfaces
Performance Confirmation Sys.

LEVEL 0 & 1
Continuous

CONTROL SYSTEMS & CONTROLLERS

•Waste Treatment System (Waste Trtmt Bldg.)
HVAC   Compressed Air
Electrical   Breathing Air
Fire Protection   Instrument Air
Security   Communications
Rad. Monitoring   Secondary Waste Handling Sys.

•Waste Emplacement Sys. (Subsurface Facil.)
HVAC   Electrical
Fire Protection   ISecurity
Communications   Rad. Monitoring

PLC's, Controllers Control LANs
Data Multiplexers Eqpt Monitors

•Production Analyzer Sys. Data
•Instrumentation Data

•Waste Preparation System (Waste Handling Bldg)
HVAC   Breathing air   Electrical
Fire Protection   Instrument Air   Security
Communications   Rad Monitoring   Carrier Prep. System
Carrier Cask Handling Sys.   Assembly Xfer Sys.
Canister Xfer. Sys. Disposal Container Handling Sys.
Waste Package Remediation Sys.

•Carrier Cask Shipping & Receiving (Carrier Prep.Bldg.)
HVAC   Electrical   Fire Protection
Security   Communications   Rad. Monitoring
Material Handling   Carrier Recycle Wash

•Underground Development Sys.
Subsurface Excavation Sys. Muck Handling Sys.

•Non Rad. Waste Systems
Hazardous Waste Collection Sanitary Waste Collect
SS Waste Water Collection System

•Utility Systems
Water   Electric Power   Gas

•Performance Confirmation Sys.
In Situ Monitoring
Emplacement Drift Inspection
Support System

•Operational Communications System
Radio Base Stations Portable Radios   Portable Pagers
Normal Telephones Telephone Hot Lines Security Lines

LEVEL 0
Continuous

INSTRUMENTS. & DATA ACQUISITION

•Flow, Pressure, Temp., etc.
•Data Acquisition Devices, etc.

•Supervisory Control & Data Acq. Sys.
•Analyzers

•HVAC Monitoring & Mgt.   Gas Detection & Alarm Sys.
•Contin. Emissions Mon. Sys.   Local AreaRad.Monitoring
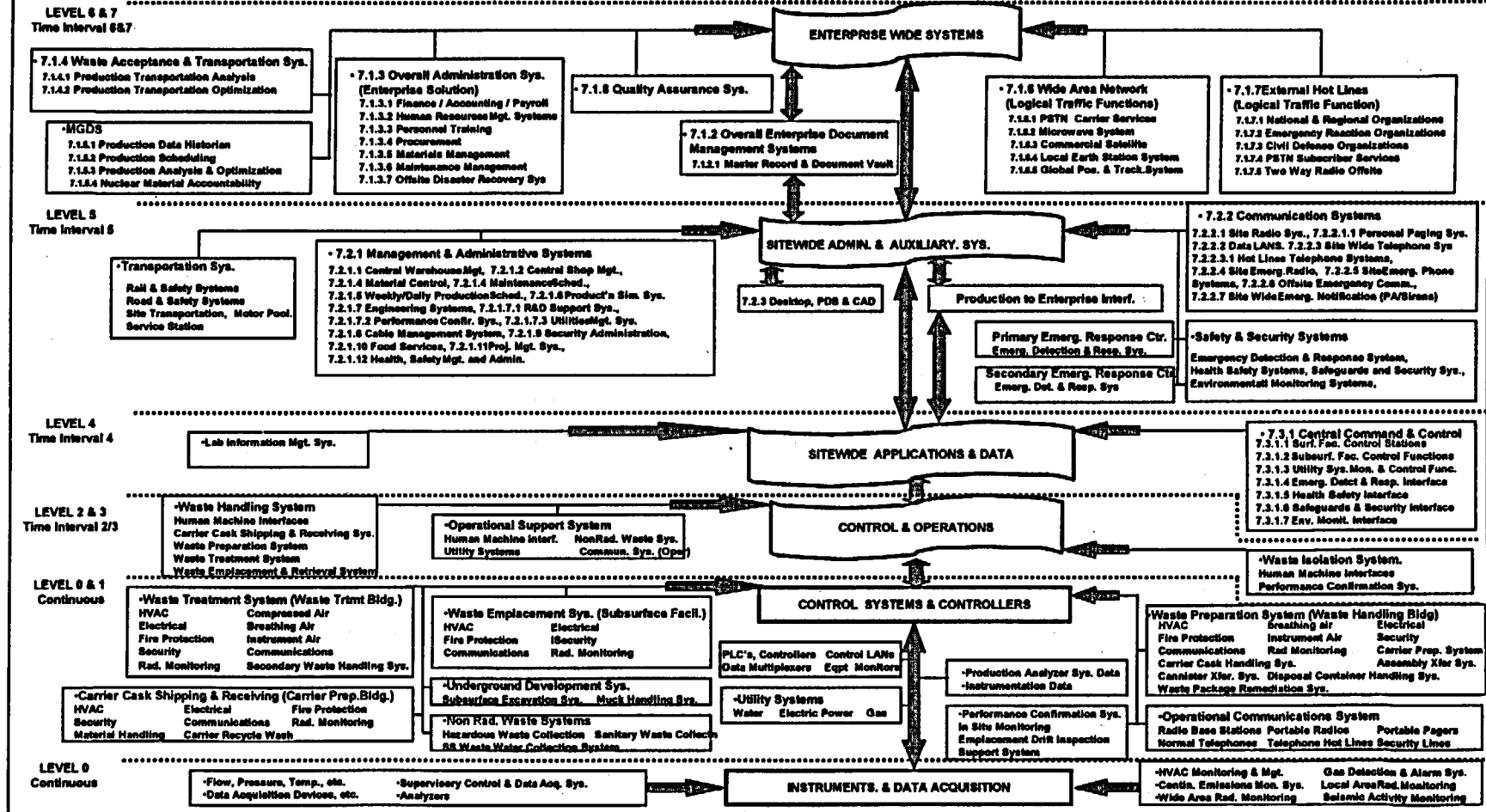**•Wide Area Rad. Monitoring   Seismic Activity Monitoring**

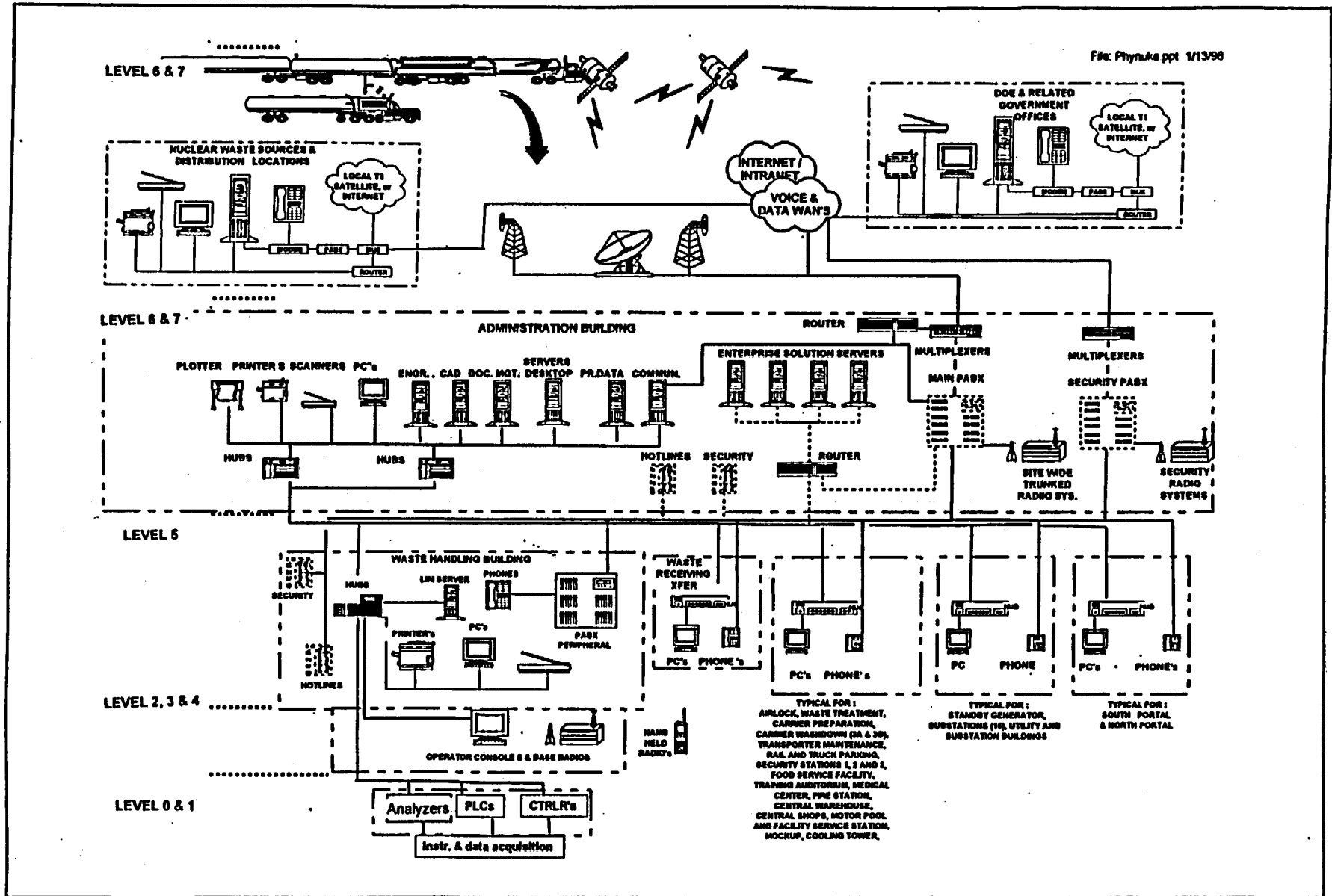Figure 7-1. CRWMS Summary Level Logical Systems Architecture

Figure 7-2. CRWMS Physical Systems Architecture

Electronic information and data can be moved quickly and reliably from the control systems level to the sitewide and office-wide levels of a manufacturing Enterprise. This makes possibly the implementation of an effective CIM systems that provide for the integration of information and control across the Enterprise.

To achieve the goals of CIM, a sitewide network architecture is helpful. The architecture can be separated into levels that are distinguished by the following principal criteria:

- Response time
- Resolution
- Reliability
- Repair time

This provides a mechanism of four "Rs" for separating systems and placing them at the correct level in the information architecture:

Response Time. In the information architecture, the time interval that can be tolerated increases as one moves higher in the information architecture. As an example, at the control loop level, data become unusable quickly. In a matter of milliseconds, or at most seconds, real-time measurements become too old to be useful for regulatory control or interlocking functions.

Resolution. It is necessary to consider the resolution for data that are stored and manipulated at each architecture level. It is not productive to move masses of control data with a resolution of milliseconds to seconds into production planning or accounting applications. Such an approach would generate excessive traffic and storage. Also, the very volume of the data would make extraction of useful information difficult and expensive.

Reliability. The level of reliability increases as one descends through the level of communications architecture. The consequences of failure in the local control network (LCN) connecting controllers to a distributed control system (DCS) and operator displays are obviously serious. By contrast, computer systems at Level 5 can be shut down for minutes to hours without disrupting Enterprise production.

Repair time. The ease of which devices can be repaired and maintained is another key consideration in developing networks. As an example, continuous processes cannot be easily shut down to repair controllers. These devices must be maintained "hot" to avoid shutting down Enterprise production. Again, by contrast, computer systems at Level 5 can be shut down for minutes to hours without disrupting Enterprise production.

The initial design of the communication systems reflects proven technology in common use today for each type of system discussed. Reliability and availability requirements flow directly from classifications listed for these systems in Table 2-1.

The initial design of the site control system is based on a distributed control network of controllers and HMIs. The control system design will utilize proven best-fit technologies for process control and monitoring of the facilities' operations. High integrity systems featuring self-diagnostic capabilities and high reliability will be employed.

7.1   LEVEL 6 AND 7 ENTERPRISE WIDE SYSTEMS

The general concept of an Enterprise Wide System is the integration of electronic data management and communications technologies into operation of the plant facilities. These include linkages of logical, physical, and people systems planning, development, and implementation for making the Enterprise and its business mission realizable.

Enterprise Wide Systems integrate the systems involved with operating the manufacturing processes (process control systems) with the systems involved in operation of the business as a whole (control systems for all management functions, planning, scheduling, financial, etc.). To accomplish these tasks, modular software by People Soft was proposed. The modules proposed are Supply Chain Optimize, Financial, Materials Management, Distribution, Manufacturing, and HRMS. These modules are fully compatible and integrated into relational, object-oriented data bases.

The Enterprise Solution integrates the above software modules and task submodules into a common data base under a single information exchange protocol. This integration is seamlessly accomplished due to the fact that the software provides a single operating environment and a single data repository for the users.

7.1.1   Enterprise Integration and Communication Systems

The Enterprise integration and communication systems will be installed to create a viable and efficient operating environment for the MGDS site and related entities. Digital electronic voice and data systems will be utilized throughout the MGDS and be the basic communication method for on-site and off-site interfaces. The modules and components of the Enterprise integration and communication systems are described. Both logical and physical elements are addressed. The personnel part of the Enterprise will be addressed when the site operation procedures and respective criteria are implemented.

For planning systems and their overall integration into manufacturing complexes, Purdue University has developed a Master Planning architecture containing a complete set of concepts for the total Master Planning life cycle of manufacturing Enterprises. This planning architecture covers projects from their inception, into the EPC cycle, through the permanent facilities life cycle. This Master Planning approach is called the *Purdue Enterprise Reference Architecture* (PERA) (Reference 5.5).

Master Planning accomplishes the following objectives:

•   A total life cycle approach that can be used for EPC as well as the permanent systems when

the manufacturing Enterprise goes into operation is provided. This approach also includes the plant's management and operational logical and physical system solutions including the CIM and personnel function development objectives for sitewide information and integration.

- The personnel function is developed as an integral part of logical and physical system planning.

- Using a total life cycle approach (PERA, etc.), an effective methodology for EPC systems to migrate to the permanent systems required for the Enterprise is provided.

- A direct linkage of logical systems (work processes and functions of the Enterprise) with the physical and people systems needed to make them operable is provided. The most cost effective Enterprise opportunities are identified early in the project using this approach.

This approach is proposed to be used for the CRWMS Master Planning activities.

Software tools for management and Enterprise Wide Systems administration will be provided. The tools will allow network management personnel to control, administer, and maintain various aspects of the user access, network configuration, and systems security.

7.1.2 Document Management Systems

An document management system will be installed and maintained for organizing and storing documents such as site drawings, specifications, operating procedures, personnel records, and operating documents. The system will allow appropriate development, routing, approval, change control, and storage of letters, memorandums, forms, certificates, permits, contracts, services agreements, procurement documents, and other such documents necessary to operate the site, maintain legal compliance, and have an auditable and traceable path of such operations and procedures.

Documents will be retrievable through the data network with search engines within the document management system.

7.1.2.1 Master Record and Document Vault

A master record and document vault will be installed and maintained for recording, storing, and archiving data for material received, repackaged, placed in disposal locations, retrieved, rehandled, and relocated in disposal locations, along with records of any other disposition of nuclear waste material. The master record and document vault initially will be located on the site and will be separate from the disaster recovery records located off-site. The master record and document vault will eventually be moved to a safe off-site location and necessary records will be duplicated and

distributed to other organizations and local governments and authorities for coordination in maintaining the integrity of the disposal site for the intended life of storage.

7.1.3   Overall Administration Systems (Enterprise Solution)

An Enterprise Solution will be used to seamlessly integrate a significant number of the overall systems required to administer and operate surface facilities. Enterprise Solution systems offer a single operating environment and a single data repository for consistency, accuracy, and reduced maintenance. These systems also provide for greatly improved user productivity by efficiently integrating desktop systems, such as electronic mail, Microsoft Windows™, electronic document management, electronic forms, and Internet/intranet technologies into Enterprise Solution operations. A much lower life cycle cost may be realized since the systems can be readily upgraded and migrated to new operating platforms.

The Enterprise Solution will contain the central administrative systems for site operations described in Sections 7.1.1 through 7.1.8. The systems will also contain the systems that optimize the supply chain of casks shipments from their various sources to the site across multiple transportation alternatives and contractor carrier services. The outside supply chain management will send to, and receive information from, the overall waste tracking systems, production transportation analysis systems, and production transportation optimization system and other sitewide administrative systems contained in the Enterprise Solution integrated data base where the work processes require such information exchanges to occur.

Based on specific work categories and work functions identified as necessary for operation of the facility, a specific Enterprise Solution will be configured to maximize operational efficiency.

The Enterprise Solution system will operate on three tier transaction processes where the application logic runs on application servers instead of the clients servers. This will relieve the client servers from processing intense data base transactions and greatly improve the performance of the system across the wide area networks (WANs) and site local area networks (LANs). The three tier architecture will allow the architecture to be scaled and accommodate a large number of concurrent users while maintaining a consistent and reliable performance level. Mirrored computer servers using redundant arrays of independent drives (RAID) will provide for storage of information. A long-term compact disc-read only memory (CD-ROM) disk farm will be provided to store and access permanent records. In addition, a fireproof vault containing a CD-ROM copy will be provided that contains a duplicate of the systems and information contained in the Enterprise Solution and the CD-ROM permanent records farm. These systems are described in Sections 7.2.3 and 7.2.4.

The overall Enterprise Solution will also provide for integrated operation of the systems described in the following Sections 7.1.3.1 through 7.1.4.2 and will send to, and receive information from, Section 7.1.2 and the sitewide administrative systems contained in the Enterprise Solution integrated data base where the work processes require such information exchanges to occur.

7.1.3.1 Finance/Accounting/Payroll

Finance/accounting will provide the overall administrative functions of general ledger, payables, receivables, projects, asset management, budgets, expenses, and treasury. These core applications allow rapid configuration and provide tools for implementation and customization of the functions for specific needs of the facility. Graphical representation of the financial data can be developed quickly for transformation of numbers into valuable graphical information. Integration with Microsoft Excel™ spreadsheets is seamless and allows users to analyze, process, and manage information without extensive additional training. Workflow capabilities include ticklers for overdue accounts, approval of vouchers, budgets, and projects to track.

General ledger functions have additional capabilities over the standard functions for analyzing and viewing financial information. Budgets, statistical information, or forecasts can be viewed alongside to provide valuable information.

The payables' application manages cash and related payables' transactions. Methods and timing of transactions can be customized to optimize cash flow for the facility. Accuracy and productivity of the payables department is maximized since the system is streamlined and automated from capturing of invoices to payment processes.

The receivables function is a complete system for management of the invoices, payments, and credit.

The project financial management function is a key for control and management of the financial implications of the multiple projects in the facility. Flexible project costing and budgeting tools minimize data entry and streamline the addition and maintenance of new and existing projects. Continuously updated financial status of all or each individual project is available to project management personnel.

The asset management function allows for complete financial asset accounting. Assets can be tracked, transferred, shared, and depreciated in various ways for compliance with various insurance, licensing, and tax regulations.

The budgets function supplements the Enterprise Solution by providing flexible and readily adaptable tools for generating various financial budgeting and forecasting information needs.

The expense function provides for control and reimbursement of expenses. Management of expenses reduces indirect costs, data entry, approval processing, and paper audit trail maintenance. Analysis tools for expense information of the facility will be provided.

The treasury function provides for complete control of corporate treasury functions and allows assessment of financial risks. Flexible cash management and in-house bank administration functions are provided.

The finance/accounting solutions will provide for an aggressive reduction in paperwork, cut red tape, raise productivity, and increase efficiency. The systems will help reduce waste, eliminate absolute functions, and enable the management of the facility to create smaller, but far more productive, workforces.

The finance/accounting/payroll module will have the capability to be configured for data access and/or electronic time keeping for employees, for payroll requirements and benefits administration modules.
These systems will send to, and receive information from, the sitewide administrative systems contained in the Enterprise Solution integrated data base, where the work processes require such information exchanges to occur.

7.1.3.2 Human Resource Management System

The human resource management system (HRMS) will provide the overall functions of personnel administration specifically tailored to the requirements of Federal Government employees. These functions will include:

- Classification and salary administration
- Payroll
- Personnel actions tracking
- Position management
- Staffing and recruiting
- Career and succession planning
- Labor and employee relations
- Government compliance
- Health and safety
- Employee performance management
- Awards
- Training administration
- Personnel benefits administration
- Time and labor collection
- Tool reporting.

Historical accounts for all personnel actions are stored in human resource data bases providing an excellent tool for retrieval of information when necessary as well as planning for future personnel needs of the facility.

The benefits administration function features personnel benefits, the Thrift Savings Plan, retirement, leave tracking, group life insurance, and health benefits program management, and administration.

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The payroll functions allow for time reporting, payroll preparation and calculation, tax computation, check preparation, along with all necessary payroll, tax, and audit reporting. Direct deposits, saving bonds, and other deductions are supported.

The HRMS applications will provide powerful graphical tools for reporting information customized to specific requirements. The customization and development tools are provided for maximum flexibility of tailoring the systems for the specific needs of the CRWMS facility. Greater information access by use of on-line analytical tools and client/server technologies adopted for the Enterprise Solution will allow for more effective decision making by the facility management.

The HRMS solutions will provide for an aggressive reduction in paperwork, cut red tape, raise productivity, and increase efficiency. The systems will help reduce waste, eliminate absolute functions, and enable the management of the facility to create smaller, but far more productive, workforces.

These systems will send to, and receive information from, the sitewide administrative systems contained in the Enterprise Solution integrated data base where the work processes require such information exchanges to occur.

In addition, sitewide information from the health and safety monitoring systems will send to, and receive information from, this data base where the work processes require these exchanges.

7.1.3.3 Personnel Training

The master modules in the Enterprise Solution software will contain integral training material and instructions for use. Personnel authorized to use the software will also have access to the training material. The system will maintain a record of the training material completed by each individual in the training system. An individual will be able to suspend a training exercise at any point and return to the exercise later without losing continuity in the training program. Other individuals may be assigned rights to training material and exercises by an authorized person.

7.1.3.4 Procurement

The procurement function will provide for the overall administrative functions of qualifying suppliers and contractors, processing material requisitions and scope of service requirements, inquiring and selecting suppliers and contractors, negotiating and generating purchase orders and service contracts, returning unsuitable or surplus materials to suppliers, and negotiating change orders to services contracts.

The system will have an added advantage to provide automated sourcing from requisitions to purchase orders, with the capability to select prioritized or General Services Agency (GSA)-approved vendors.

The requisitions will be generated automatically from inputs of plant wide systems including project management and materials management systems. Requisitions will be processed and approved on line with the goal of a paperless requisition system.

These systems will send to, and receive information from, the sitewide administrative systems contained in the Enterprise Solution integrated data base where the work processes require such information exchanges to occur.

In addition, sitewide information from the material management and health and project management systems will send to, and receive information form, this data base where the work processes require these exchanges.

7.1.3.5 Material Management

The material management system will be implemented to assist the management and operating personnel of the MGDS facility with the efficient and cost-effective management of all production related consumables, spare parts, equipment, supplies, etc.

The system is intended to increase efficiency in material management activities by integrating closely with the procurement system, the warehouse management system, and other interdependent Enterprise Solution systems. This integration will ensure that the necessary supplies, consumables, and capital assets are available for the optimal administration, operation, and maintenance of the facility, and their costs of purchasing are minimized. The system will track material usage and will identify and alert the management personnel of any deviations from the planned quantities.

The system will automatically generate requisitions for the assets as determined by the minimum level on hand required, identify discrepancies between the reported usage and on hand inventories, provide detailed cost accounting to responsible activities, generate multiple levels of reports that can be used for financial, tax, and lease asset accounting, and provide data for capital budgeting and other analysis and requirements.

The overall sitewide aspects of the material management system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas such as bar coding, and discrete input/output (I/O) will be interfaced to the Enterprise Solution through the application interface layer.

7.1.3.6 Maintenance Management

The maintenance management system will assist the management, operations, and maintenance personnel of the facility with planning, optimization, and performance of maintenance tasks in the facility. The system will utilize predictive and preventive maintenance methods and techniques to plan and schedule equipment maintenance and systems turnarounds via work order system as described in the maintenance scheduling system.

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Trending and analysis of critical equipment operating data will be available via maintenance management system. The interfaces between the control systems for the production systems/equipment and the maintenance management systems for data collection will be defined at a later date.

The system will track systems and individual equipment performance, maintain equipment records, maintain work order costing information, track maintenance and repair activities, manage and schedule personnel resources, provide input to the materials management system for optimization of materials, spare parts, and consumables inventory. Reports will be available for optimization of systems and equipment availability, optimization of the interval between scheduled maintenance activities, cost accounting for various maintenance tasks, etc.

The system will interface with the document management system for access and generation of system and equipment specific maintenance procedures, equipment drawings, manufacturers' recommendations, and other necessary data. The generation of these documents will be on an as-needed basis, or on demand via the maintenance scheduling system.

The system will benefit the Enterprise operations by reduction of maintenance cost, optimization of maintenance tasks, optimization of maintenance personnel utilization, optimization of maintenance spare parts and consumables inventories, and reduction of capital equipment costs required in the on-site warehouse.

The overall sitewide aspects of the maintenance management system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas such as work order system, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.1.3.7 Off-site Disaster Recovery System Interface

An off-site disaster recovery facility, maintained on a regular schedule, will be located far enough from the site to isolate it from disaster in the local vicinity. An interface to the disaster recovery facility will be provided. The facility will consist of a secure and fireproof vault that contains a duplicate of the systems and information contained in the Enterprise Solution and the CD-ROM permanent records farm.

7.1.4   Waste Acceptance and Transportation System Interface

An interface to the overall waste tracking system will be provided. The system will provide the structures and embedded subsystems that support the en route tracking of nuclear waste transportation carriers. The system will provide MGDS facility management and operational personnel with the current, real time data on all incoming nuclear waste shipments and their location en route. The system can track both the railway and over-the-road shipments, using a satellite communication and tracking system.

The data gathered by the system will be utilized for the production transportation analysis and the production transportation optimization subsystems.

The overall sitewide aspects of the overall waste tracking system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas such as GPS and GIS interfaces, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.1.4.1 Production Transportation Analysis Interface

An interface to the production transportation analysis system will be provided. This subsystem will utilize data from the overall waste tracking system to perform analysis of shipments and their routings and to predict their arrival on the site for processing.

Upon receipt of notification of shipment schedules from the overall waste tracking system, the production transportation analysis system will analyze and verify the shipment schedule.

The system will be able to alert MGDS facility management and operation personnel of possible shipment arrival schedule discrepancies. The shipment transport personnel may also be alerted to the hazardous conditions existing on the routing schedule for their appropriate action. Additionally, this system can detect unauthorized scheduled route deviations of shipments and alert the management and operations personnel of such deviations.

Reports can be generated that provide scheduled shipments arrival times, type and quantities of materials contained in each shipment, and predicted shipment schedule deviations.

The data from the system will be integrated into the production scheduling and the production analysis and optimization systems for optimization of upstream operations of the MGDS.

The production analysis system will provide inputs into the production management module of the Enterprise Solution through interfaces at the application interface layer.

7.1.4.2 Production Transportation Optimization Interface

An interface to the production transportation optimization system will be provided.

This subsystem will use data from the overall waste tracking system and from the production analysis subsystem.

The optimization will be concentrated on the production processing capacity to provide a uniform flow of waste materials to the facility and reduce site storage of the casks/containers. The transportation requests received from all of the purchasers will be analyzed to maximize facility production scheduling.

The production transportation optimization system will provide input to the production management module of the Enterprise Solution through interfaces at the application interface layer.

7.1.5 Production Management System

The production management system will include a data historian file server, a scheduling system, analysis and optimization tools, and a nuclear material accountability system. The system will interface with the site production systems to ensure proper processing of nuclear materials, low-level nuclear contaminated processing materials, and appropriate resources for the production process.

The production management system will receive or utilize data from other resources, such as the material control, production transportation, global positioning and tracking, personnel, and maintenance management systems to develop analysis and scheduling data for processing radioactive receivables, related consumables, and processing plans.

The production management system will provide data and information for use in other systems, such as security systems, weekly/daily production scheduling, material control, sitewide transportation system, and report information for Enterprise management.

A production model of the surface facilities and subsurface facilities will be developed and maintained in the production management system. The base model will be maintained in real time, and may be utilized for production analysis and optimization scenarios.

7.1.5.1 Production Data Historian System

The production data historians' system will maintain records of all production processes, production attributes of received and repackaged materials, attributes of all repackaging equipment and materials, personnel attributes required to process the various categories of radioactive materials and processing equipment.

The production data historians' system will maintain time/date stamps of production processes and events received from the production areas, such as global positioning and tracking system, sitewide transportation system, waste receiving and preparation, waste handling repackaging, disposal container (DC) preparation, as well as DC transportation, placement, and drift location mapping.

The production data historians' system will include data base operating and analysis tools for developing data trends on any recorded selection of records and fields, such as production equipment, repackaged materials, production processes, motion times, etc.

7.1.5.2 Production Scheduling

The production scheduling system will gather data from various other systems and develop coordinated schedules for material, supplies, machinery, equipment, transportation, and personnel.

The production scheduling system will develop contingency schedules for critical processes and higher risk processes. The production scheduling system will interact in real time with the production processes and will record and display the process events as they occur in the production schedule.

The production scheduling system will provide a material schedule and material requisition request to the material control system and receive verification from the Material Control System that the requested materials are committed to the respective production cycle and will be available at the necessary location at the required time. The production scheduling system will show this verification on the material schedule.

The production scheduling system will provide an equipment and machinery schedule for each piece of equipment and machinery necessary for the respective production cycle. The production scheduling system will compare equipment and machinery production times with the maintenance scheduling and will note maintenance schedule times or conflicts in the production schedule. For critical maintenance events, the production scheduling system will verify that the maintenance event is green and will accommodate the maintenance event in the production schedule. If the maintenance event is not green (material or personnel are not available to perform the maintenance event), the production scheduling system will provide a schedule flag to the production personnel and provide a contingency production plan for evaluation.

The production scheduling system will receive information from the global positioning and tracking system and forecast a "beginning of production schedule" in accordance with the estimated time of delivery of the respective radioactive waste.

The production scheduling system will provide a transportation schedule and requisition to the sitewide transportation system. This schedule configuration can be changed to include requests for inspection vehicles, radioactive instrumentation vehicles, preparation vehicles, transfer crane vehicles, waste recovery vessels, and waste handling trolleys or rail cars, among other scheduled items, personnel, and equipment. The production scheduling system will provide a separate transportation schedule and requisition for disposal cask transportation into the drifts.

The production scheduling system will provide a personnel schedule and will request clearance of personnel from the security, personnel, and health and safety systems. Security violations may exclude personnel from work locations. Personnel qualifications must be verified for each work area and work description. Health and safety qualifications must be verified for certain work areas and time limitations in some areas. The production scheduling system will provide a report forecasting scheduling concerns if a personnel match is not found for the production cycle. This report will be provided to the HRMS and to the production management system.

The production scheduling system will provide a schedule for nuclear material accountability verification, measurement, and HOLD/STOP points. This schedule will be published to the security system, the health and safety system, and to the relevant personnel for quality assurance and control.

7.1.5.3 Production Analysis and Optimization

The production analysis and optimization program will include routines for modeling the production processes and performing mathematical analyses of events and processes. Such analyses may include, but will not be limited to, modeling of production related transportation equipment and systems, modeling of waste handling facilities and supporting auxiliary systems (water systems, heating, ventilating, and air conditioning (HVAC), breathing systems, personnel movement, etc.), time-motion analyses of equipment and materials, "what if" scenarios, production historical trending and forecasting, and other production analysis tools.

Routines will be included for developing Gantt charts, PERT charts, heuristic models, constraint models and matrices, and performing optimization scenarios on each. Routings will be capable of utilizing real parameters from other data bases and systems, such as the transportation system, material control system, maintenance management system.

7.1.5.4 Nuclear Material Accountability

The production management system will include routines for nuclear material verification and accountability. The system will include measurement and audit records from the source of nuclear material supply, through transportation and tracking, through production, and through placement into the drifts.

HOLD/STOP points, measurement points, and verification points will be identified in the production schedule and located in the production models. Verifications and related data will be maintained in the production data historians' system along with references to measurements in the laboratory information management system. Summary data will become a part of the production cycle report for the nuclear material handled.

7.1.6 Wide Area Network (Logical Traffic Functions)

An interface to the overall OCRWM WAN will be installed and implemented for the MGDS to be in constant voice and data communication with the various nuclear waste source/distributors and the transport system linking them. The initial connection will be through the sitewide fiber optic backbone. This backbone or portions of the backbone will be changeable to other media in the future, including but not limited to satellite, microwave or other types of fiber optic transmission. This system will be installed at the MGDS, and will be dedicated and under total control of the MGDS operatives.

Any number of buildings can have voice and data connectivity to this system through a backbone network of a ring or star configuration.

Alternatively, the system will be reconfigurable in the future to utilize access to the public switched telephone network (PSTN).

The WAN will support any combination of voice, compressed graphics, data and fax communications, among all entities.

The system may consist of:

- Fiber optic cable
- Satellite earth stations
- Microwave radio terminals
- Multiplex equipment
- Network interface modules
- Uninterruptible power supply (UPS) systems
- Bridges, hubs, routers.

7.1.6.1 Public Switched Telephone Network Carrier Service Interface

The MGDS facility will have installed an interface access to the local PSTN. From there, any location within the contiguous United States will be available through the PSTN. Several methods are available to this end, so long as there is connectivity between the MGDS private automatic branch exchange (PABX) and the nearest central office. The methods of connections and media are transparent to the users at MGDS.

Depending on distance and topology, the interface transmission medium may be either copper or fiber cable, or microwave radio, each combination transparent to the users.

7.1.6.2 Microwave System

A microwave radio system will be installed to support backup communications between the MGDS site and the telephone company central office. The system will be capable of voice, data, and video data communications.

This microwave system will contain, as a minimum:

- Transceivers
- Multiplex/demultiplexers
- Up/down converters
- Baseband conditioning equipment
- Drop and insert (D&I) equipment
- Repeater equipment
- Towers
- High-gain directional antennas

- Direct current rectifier/chargers.

7.1.6.3 Commercial Satellite Interface

An interface to a commercial communication satellite system will be provided.

Communications support may be supplied by a service provider through a dedicated space link. The gateway earth station would be located on the service providers premises. Remote terminals will be located at designated areas at the MGDS facility. Waste providers will provide their remote terminals at their locations. This system will provide continuous seamless communications.

A tail circuit to Las Vegas will also be provided to the Las Vegas area, to provide connectivity to the PSTN.

Remote earth stations and UPS systems will be provided and installed at the MGDS facility for this configuration.

7.1.6.4 Local Earth Station System Interface

An interface to the local earth station will be installed to provide for a dedicated service in a point-to-multipoint configuration.

The system will be a very small aperture telemetry (VSAT) satellite type system with the Hub station located at the MGDS North Portal. This configuration will allow for dedicated voice and data links to/from all waste providers and the MGDS facility.

This system will contain the following equipment:

- HUB station with multiple up/down link equipment
- Network monitor and control system
- Remote terminal units
- UPS.

7.1.6.5 Satellite Communication and Tracking System

The Regional Servicing Contractor (RSC) will establish a real-time shipment tracking system. The RSC will provide all hardware, software, personnel, facilities, and purchase services necessary to establish and maintain a real-time tracking capability for all of the RSC's shipments from origin to the MGDS facility. The RSC will be responsible for tracking the shipments from originating purchasers' sites to the MGDS facility. The RSC will provide access to the tracking system only to those organizational entities designated by DOE (Draft DOE RFP, Reference 5.9).

The system shall contain at least the following information for each shipment:

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- Bill of lading
- Origin and departure date
- Cask designation(s) including number of casks if more than one cask on a train
- Type and quantity of material being shipped
- Planned route
- Emergency response contacts
- Contact names and telephone numbers
- Expected arrival date

7.1.7 External Hot Lines (Logical Traffic Function) Interfaces

A series of interfaces to the external hot telephone connections will perform connections and operations. External outgoing hot lines will be configured as telephone connections in the site PABX. The PABX will be capable of configuring a hot line for an automatic dial and automatic answer. Certain hot lines will be physically configured for fail-to-cut-through direct copper connection to the first available primary circuit entering the site, in case of site power failure. The outgoing hot line system will have keypad selection and control capability for selecting hot line connections, initiating hot line connections, terminating hot line connections, and re-selection and re-initiation of hot line connections. The outgoing hot line system will have operator console selection and control capability with the same functions as the keypad selection and control.

7.1.7.1 National and Regional Organizations Interfaces

An interface to certain national and regional organizations will be designed into the external hot line system. An automatic dial hot line connection will be installed to the National and Regional Organizations. Such organizations might be the DOE, the Nuclear Regulatory Commission (NRC), or any other organization. Organizations can be added, changed, or deleted in the hot line configuration by authorized personnel with an appropriate password. An operator will be capable of initiating a single automatic dial connection from a desktop console or an individual hot line phone. A hot line telephone conference can be initiated from a hot line phone with a hot line selection keypad. The hot line keypad will allow a preselection of the organization to connect. The keypad will have several selections and the system will allow several simultaneous selections for hot line connection. The keypad will indicate the selections made, the selections ringing, the selections connected, and the selections disconnected. A ringing selection may be disconnected by pressing the respective selection key on the keypad. The operator will have the capability to disable an unanswered dial.

7.1.7.2 Emergency Reaction Organizations Interfaces

Interfaces for hot line connections will be configured for certain emergency reaction organizations such as fire brigade support organizations, security assistance, spill containment and radioactive

release recovery organizations, local law enforcement, traffic control organizations, and mining disaster assistance organization.

Emergency reaction hot lines will be configured for an automatic dial or automatic ring. The receiving ends of automatic dial hot line circuits will be selectable for manual answer or automatic. Local emergency reaction hot lines will be connected to dedicated circuits for automatic ring connection at the receiving end. Emergency reactions hot line circuits will be configured for one-to-one connection.

7.1.7.3 Civil Defense Organizations Interfaces

An interface to the hot line circuit will be maintained with the local civil defense organization. The outgoing hot line circuit will be configured for an automatic dial, and the incoming hot line circuit will be configured for an automatic answer to a speaker-phone or speaker system, with an option of handset pickup.

7.1.7.4 PSTN Subscriber Services

The PSTN subscriber services will be initiated and maintained for priority dial and dedicated external hot line connections. Dedicated circuit telephone channels will be maintained for emergency reaction organization connections and for a civil defense organization connection. Priority dial subscriber connections will be initiated and maintained for external hot line connections to national and regional organizations.

7.1.7.5 Two-Way Radio - Off-site

Very-high-frequency (VHF) two-way radio equipment and connections will be installed and maintained for direct communications to local authorities, emergency reaction organizations, civil defense organization, and nearby site personnel temporarily off-site.

The PABX will connect to the radio equipment and be configured to switch to radio communications if the auto dial telephone circuit does not connect within a preconfigured time period. The radio connection will be maintained throughout an emergency situation.

7.1.8 Quality Assurance Systems

The QA system will be installed and will integrate all of the QA data from other subsystems to provide a comprehensive data base of information documenting production practices, archived production data, deviations between the production practices and production data logs, and storage materials and equipment inspection reports.

All casks, production materials, waste preparation, processing, and emplacement will have a predefined inspection and record keeping criteria. These data will be compiled and analyzed by the

QA system for process improvement and process quality monitoring functions.

The main interfaces for data gathering will be with the performance confirmation system and the waste handling system and its subsystems.

The overall sitewide aspects of the QA system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2   LEVEL 5 - SITEWIDE ADMINISTRATION AND AUXILIARY SYSTEMS

7.2.1   Management and Administration Systems

The management and administration systems will be installed and will be designed to provide data management and administration services required for management, planning, and coordinating MGDS day-to-day operations. The system will interconnect and integrate the following subsystems for coordinated data access and sharing:

- Central Warehouse management
- Central Shop management
- Material control (availability & distribution)
- Maintenance scheduling
- Weekly/daily production scheduling
- Production simulation system
- Engineering systems
- Cable management system
- Security administration
- Food services
- Project management system
- Safety management and administration system.

The management and administration systems will be interconnected within Enterprise Solution to share and exchange data for production, maintenance, and administration optimization.

The overall sitewide aspects of the management and administration systems will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas such as bar coding, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.1 Central Warehouse Management System

The central warehouse management subsystem will be used to optimize the operation of the Central Warehouse. All materials, equipment, tools, supplies, etc. stored in the warehouse will be tracked

by the system and current locations and quantity data will be available to the management and operations personnel, as well as to other systems such as material management, maintenance management, central shop management, procurement, etc. for optimization of inventory levels in the central warehouse management.

All items in the Central Warehouse will use a bar coding subsystem for inventory tracking.

The central warehouse management system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.2 Central Shop Management System

The central shop management system will coordinate the needs and activities of the Central Shops. A work order type system will be used to handle the repair, maintenance, and calibration activities. The work order system will verify availability of personnel, machines, materials, and supplies as well as the overall schedule for production, when issuing a work order for an activity in the Central Shops.

The system will gather information from the purchasing system to predict and allocate manpower and warehouse space for receiving and storing incoming materials, equipment, and supplies. The system will receive data from the material management and maintenance management systems for scheduling instrument testing and calibrations, repair, and maintenance of other equipment and devices.

Close integration of this system into the material control, central warehouse management, and other systems in the sitewide administration will be required and implemented.

7.2.1.3 Material Control System

The material control system (availability and distribution) will interface with the central warehouse management system, material management system, and purchasing systems to keep track of materials used for the operation and maintenance of the facility. This system will provide management, operational, and maintenance personnel with the current status of all materials, their distribution, disposition, and accountability.

The data obtained from the purchasing systems will be used to predict the stock availability for critical materials and parts used for production and maintenance activities, and feed the data into the production and maintenance scheduling systems.

The material control system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. Specific applications

for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.4 Maintenance Scheduling System

The maintenance scheduling system will assist plant management, operational and maintenance personnel with scheduling and performance of predictive, preventive, and breakdown maintenance of the facility.

The system will utilize a work order system to generate maintenance work schedules for all maintenance tasks.

The work order system will utilize data from other systems such as material control, central warehouse management, production scheduling, etc. to verify that materials, spare parts, tools, equipment, and any other necessary items are available for performance of the work order job, prior to issuance of the work order. Manpower availability, criticality of the work to be performed, system and/or equipment availability for outage, and other pertinent factors will be taken into account when issuing and scheduling of work orders.

As a part of work order issuance, materials, spare parts, and all necessary consumables will be requisitioned from the Central Warehouse and pulled into a designated area. These parts will be marked with the work order number and held for the pick up by authorized personnel. All necessary maintenance procedures and pertinent documents will be gathered and issued as a package along with the work order documentation. Maintenance and supporting manpower will be scheduled and allocated to the work order task.

Upon completion of the work order, a data sheet describing the work completion, materials and equipment used, manpower spent, etc. will be fed into the system to maintain system/equipment maintenance costing, system/equipment maintenance history, QA records, etc.

The maintenance scheduling system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.5 Weekly/Daily Production Scheduling System

The weekly/daily production scheduling system will generate schedules and work priorities for handling nuclear waste products in the facility. The system will evaluate the materials ready for repackaging, canister material requirements, manpower and production systems availability, and other pertinent data affecting production processes, and will optimize the production schedule.

The schedules can be generated on a weekly and daily basis with the ability to adopt to changing supply and plant material balance conditions. Schedules will be selectable by production shift, equipment use, production process, or by any other variable maintained in the system. The beginning time of the schedule will be selectable by a system operator or scheduler. The weekly/daily production scheduling system will be capable of delivering an electronic schedule to PC and HMI stations at any data node in the system.

The weekly/daily production scheduling system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.6 Production Simulation System

The production simulation system will have dual functions. The system will be used to simulate and optimize the most efficient methods for containing the materials, location and placement of casks, and other production tasks.

The other function for the system is for operator training. The system will be able to simulate the day-to-day operating conditions of the plant and provide operating personnel with a training tool.

The system will provide for visualization of the production operation with realistic simulation of production sequences. The system will be capable of modeling equipment failures, process and/or utility system upsets, and other emergency conditions so the operating personnel may be trained and can practice handling operational contingencies.

The production simulation system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.7 Engineering Systems

Engineering systems will be provided for plant engineering/scientific personnel. These systems will assist plant engineering/scientific personnel by providing engineering/scientific tools and expert systems for plant engineering support, production engineering support, definition and performance of engineering/scientific methodologies, development and maintenance of engineering standards, provide engineering/scientific calculation tools, and relevant data bases.

Programs for optimization of plant utility and support systems will be provided for plant engineering personnel.

Design programs will be provided in the engineering systems for creation and/or maintenance of facilities drawings and specifications. These programs will be the same or equivalent to the programs that were used to generate the original documentation for maximum compatibility and integration.

These systems will interface with the document management system module of the Enterprise Solution as well as other modules where relevant information exchanges are required.

7.2.1.7.1   Research and Development Support Systems

As a special subsystem of the engineering systems, a research and development support system will be provided. This system will consist of specialized scientific software to support scientific and research activities and functions at the MGDS facility. These activities may center around development and/or design improvement of waste handling systems, waste isolation systems, and operational support systems. Supporting software will be provided for data analysis of long-term waste storage effects on the underground and above round environmental effects.

This system will interface with the document management system module of the Enterprise Solution as well as other modules where relevant information exchanges are required. The models developed on the research and development support system will be capable of importing real-time data from other data bases for use in the models.

7.2.1.7.2   Performance Confirmation System Interface

An interface for performance confirmation system will allow for collection, storage, archiving, and analysis of data gathered by the performance confirmation system regarding environmental conditions of the waste emplacement operations. The analysis tools will provide indications and evaluations as to the performance of the Repository systems and whether or not they comply with design and performance criteria. In situ monitoring, laboratory and field test data will be collected, analyzed, and evaluated by this system.

7.2.1.7.3   Utilities Management System

Part of the engineering systems provided will be the utility management system. The system will collect, store, and analyze data regarding the usage of electrical power, potable water, chill water, hot water, fuel, etc. Analytical tools for analysis of that data will be provided to plant operations and engineering personnel to be able to optimize the electrical power, water, and other utilities' usage via employment of this system.

The utility management system will provide inputs into the management and administration systems modules as part of the overall Enterprise Solution described in Section 7.1.3. for verification of utilities billing and input into accounts payable subsystems.

7.2.1.8 Cable Management System

The cable management system will provide the ability for information systems, communications, plant engineering, and maintenance personnel to quickly access the communications cable distribution and termination information. With that information, new and change requirements to the voice and data communication services can be assessed, designed, and implemented quickly and efficiently.

The system will keep track the current status of all telecommunications and data transmission systems interconnections, with service indications of the equipment and cabling (primary/backup/spare service).

The maintenance of the system data base will be via PC input on connectivity changes. The system will generate reports to assist interconnection changes, termination requirements for information systems and telecommunication maintenance and installation personnel.

The system will interface with the document management system module of the Enterprise Solution as well as other modules where relevant information exchanges are required.

7.2.1.9 Security Administration System

The security administration system will include administration of security personnel, administration of non-security personnel in secured areas, administration of security vehicles, administration of security buildings and equipment, administration of security procedures, and administration of security for site personnel and visitors.

The security administration system will maintain security personnel records in a password-protected data base. The security administration data base will maintain security personnel qualifications for work duties, firearm qualifications, security clearances, training records, vehicle qualifications, and other records necessary to maintain a qualified security personnel data base. The security administration system will gather information from other data bases and provide security personnel profiles as needed by security management and other government authorities.

The security administration system will maintain a data base of qualified non-security personnel for general access control to the sites and access control to restricted areas. The system will be accessible by the security access control system.

A data base of security equipment and usage will be maintained by the security administration system. Such equipment will include vehicles, firearms, uniforms and uniform accessories, intrusion detection and intrusion assessment equipment, search equipment, site temporary badges and passes, recording devices and recording media, and general security supplies.

A personnel badging system will be installed and implemented. The badging system will maintain a record of badge number, employee or contractor personnel name, the names of organization, numeric code, digitized personnel photo, security level, issuing officer, date issued, date lost, date

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reissued, and new badge number. Other information may be added to the badging system as needed. Badging information and reports will be accessible by any variable recorded in the badging system.

The badging system will be a PC base with a connected digital camera for badging photos. The badging system will be capable of developing permanent plastic badges encoded with individual access privileges information for site personnel and contractors and temporary paper badges for site visitors or service personnel. The badging system will report badging information to the security system for use in personnel and visitor screening and access control.

7.2.1.10   Food Service System

A food service system will be included for the cafeteria and food service area. The system will be capable of maintaining a data base of food service suppliers and supply chains, and developing menus for personnel in several work shifts. The system will be capable of food service accounting, food service personnel and preparation scheduling, maintaining a food service equipment data base and service requirements, and other data requirement for the food service entity. The food service system will be capable of accepting credit for site personnel by use of the personnel badge and charging the meal service to the site accounting system for individual payroll deduction.

7.2.1.11   Management System

The project management system will allow the responsible facility personnel to track and monitor multiple projects being executed at the MGDS facility. Analytical and executive tools will be provided to facilitate management of multiple project development, analysis and tracking of projects with regards to project budget, cost, and schedule.

A historical project data base will be established to capture and archive engineering, design, and construction manpower, materials, capital equipment, and design costs for comparison of the ongoing project trends, and for preparation of costing information for new or planned projects in the facility.

The system will be capable of report generation illustrating all of the aspects of current and planned projects in the facility, such as schedule, cost, forecasts, related trends, and areas of concern.

The overall sitewide aspects of the project management system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas such as scheduling, and estimating, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.1.12   Health and Safety Management and Administration System

The health and safety management and administration system will be a repository of data and software functionality for tracking and managing all personnel-related safety data. These data may

include exposure level analysis, occupational accident data, material safety data sheet (MSDS) data and exposure characteristics, and any other safety related data. Statistical analysis tools will be provided for report generation illustrating safety compliance and safety performance of the facility operations.

The overall sitewide aspects of the health and safety management and administration system will be included in the modules of the Enterprise Solution described in Section 7.1.3. Specific applications for specialized areas, and discrete I/O will be interfaced to the Enterprise Solution through the application interface layer.

7.2.2 Communication Systems (Logical Functions)

7.2.2.1 Site Radio System

A modern, current technology, trunked radio system will be provided capable of supporting the needs of the MGDS and the site contractors during construction and operation of the facility. The trunked system will allow rapid access to radio channels and accommodate the expected loading of the system.

The system will serve the communication needs of the MGDS for a minimum of 15 years, and it will have the flexibility of adapting to changing system requirements without replacing major equipment elements. As an example, the backbone system will be fully equipped to support the transmission of data including encrypted voice and remote data transmissions on all trunked radio channels. The system will also have the capability of adding additional repeater and satellite receiver sites to increase coverage should the need arise. The system will be used for normal operations and off-normal and emergency response situations. The design will be such that no single point failure (by accident, malfunction, or sabotage) would diminish capabilities or communications.

The backbone system will consist of one repeater site located at the North Portal, capable of multiple satellite receiver sites and multiple control stations to provide reliable communications between fixed site, mobile and portable units throughout the desired area of coverage. Multiple channels of digital access, trunked repeater sites will be installed to cover the MGDS area. The radio system will support all site radios, talk groups, trunk groups, emergency radio communications, logical separation of site entities, and multiple scheduling of each radio and entity. One control station will be included on-site for configuration and traffic monitoring and analysis. The satellite receivers will be located as necessary to cover the necessary area.

Additional trunking repeaters and satellite receiver sites can be added at any time and the system can be linked to other systems in the future. The basic operational mode will be trunked with field units monitoring a common data channel and a central site controller making channel assignments over the data channel. Most of the communications will use this mode with communications taking place over the main repeater site. The mobile and portable radios are also capable of direct or non-trunked operation.

The system will support unit and group addressing. There will be a minimum of discrete unit identifications based on the analysis of system requirements. Group addresses will have the capability of being partitioned into several layers of subgroups. Supervisors will be capable of calling other radios or dispatchers in an individual call mode that will not be overheard by other mobile or portable units.

The trunked system will include a site controller and system management computer. This will allow additional features and system enhancements such as a telephone system interconnect, increased levels of priority, and data base management.

The backbone system (stations, voters, console and site controller) will include support of unit-to-unit fully digitized voice on all trunking channels without additional system equipment. Additionally, the system will support digital voice with or without encryption. Finally, the system will include support for both analog and digital radios allowing intercommunication between the units on all trunking channels.

The system will have the capability of assigning any of the trunked repeater stations to perform as the control channel. When a new control channel is assigned, field radio units will automatically acquire the control channel.

If the control channel fails, the failure will be detected and one of the remaining stations will be automatically assigned as the control channel.

The main antenna system will consist of two gain antennas, a transmitter combiner and a receiver multi-coupler. The transmitter combiner and receiver multi-coupler will be the expandable type.

The control stations will be desktop units. The control stations will support remote control units (RCUs) and will be equipped with local controls to initiate group and individual calls. The RCU will be a full-function accessory used for operating the control station over telephone lines or a microwave link.

The radios are to be fully synthesized and supplied with a visual alphanumeric display and all necessary mounting hardware for a complete installation. All radio controls and inter-cabling will be supplied, including antennas. The radios will have the following features:

- Trunked/conventional operation
- Repeater talk-round
- Operator emergency
- Individual call
- Voice encryption capable (encryption optional)
- External relay
- Telephone interconnect (dual tone multi-frequency (DTMF)) (option)

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- Unit ID display
- Conventional frequency operation
- Conventional frequency scan with priority (option)
- DATA ready
- PC programmable.

Portable hand held radios will be provided with a visual alphanumeric display on the front of the radio showing the current operating mode, and an indication of low battery voltage will be supplied with the radio. The radios will have similar features as outlined above.

A paging system that uses a transmitter of the same manufacturer as the trunked repeaters is proposed. A paging terminal will be supplied and connected to the telephone switch allowing internal and external access to the paging system. The paging transmitter will use the trunked antenna system through the transmitter combiner.

The site controller and system manager provides hardware and software that take the system from a basic trunked system to a featured trunked system with increased levels of priority and talk group configurations. This also allows the interface of other functions below.

The system management computer will allow data management information entry and retrieval from the system. Data retrieval will include receiving alarm messages from the site controller. Data entry will include altering system parameters, removing channels from operation, regrouping radio units, disabling radios, etc. A data base management package will be provided with the computer that will permit sorting calls by units, subgroups, time of day, duration of call, channel, site, and priority.

Hardware will be provided that will monitor system and equipment parameters at the trunked repeater site. Parameters to be monitored will include forward power into the antenna and RF power of all repeater stations including the control channel. The control channel will be monitored to ensure data integrity. Alarm inputs will be provided to monitor and sense other site activities such as door alarms, tower lights, etc. System monitoring is incorporated with the site controller and system manager.

The telephone interconnect function will allow any properly equipped and authorized radio units to make and receive telephone calls without assistance. Hardware will be provided to interface to a trunked repeater and to telephone lines that will allow the telephone interconnection. This function will be transparent to the telephone system except for the connection of the telephone circuits.

7.2.2.1.1 Pager System

A personal pager system will be installed and will use a transmitter of the same manufacturer as the trunked repeaters. The personal pager system will be used for normal operations, and for off-normal and emergency response situations. A personal pager terminal will be supplied and connected to the telephone switch allowing internal and external access to the paging system. The personal pager

transmitter will use the trunked antenna system through transmitter combiners. Personal pager signals will be receivable at each personal pager at a distance defined by a radius of a no less than 10 miles from the perimeter of the MGDS facility. The personal pager system will be designed such that no single point failure (by accident, malfunction or sabotage) will diminish capabilities or communications.

The personal pager system will address audio beeper pagers, alphanumeric message pagers, and voice message pagers. All pagers will be addressable from the telephone system and from the personal pager operating system on the data network. The personal pager system configuration can be changed to allow single pager addressing or pager addressing in blocks for multiple simultaneous paging from an operator console. The alphanumeric pager system will be capable of transmitting preconfigured messages in response to an input from a code entered from a telephone or selection of a message in a menu in the personal pager operating system. The personal pager system will be interactive with the site data network to allow alarm signals to automatically generate personal pager signals in response to emergency notification system alarms.

Beeper pagers shall have a minimum of pager addresses separate from other types of pager addresses with the minimum based on the analysis of system requirements. Alphanumeric pagers shall have a minimum of alphanumeric pager addresses separate from other types of pager addresses and shall have a minimum number of characters for their alphanumeric displays with the minimums based on the analysis of system requirements. Voice pagers will have a minimum of voice pager addresses and will be capable of a minimum length of a voice message for each transmission with the minimums based on the analysis of system requirements.

7.2.2.2 Data Local Area Networks

An LAN will be installed and will connect all users of the PCS and workstations to shared resources. The LAN will provide a common connection.

An overall network management software module will allow the system administrator to effectively manage the LAN and its configuration.

The LAN will support Ethernet transport control protocol/Internet protocol (TCP/IP) and will provide the following common functionality for all users:

- Electronic mail (E-mail) system
- Common file storage areas for shared file access
- Secure file storage areas for selected groups of users or departments
- Administrative, financial, engineering/scientific software application access for selected users
- Intranet access for selected users.

The proposed network operating system will be the newest technology operating system.

Assume the desktop computing platforms and workstations will be Intel™-based machines running Microsoft Windows™ or Microsoft Windows NT™ operating system, or equivalent. Several user versions are envisioned:

- Normal office environment
- Portable office environment
- Environmentally hardened environment
- Portable environmentally hardened environment
- Computer-aided design/computer-aided engineering (CAD/CAE) environment.

7.2.2.3 Sitewide Telephone System

A telephone system consisting of an electronic private automatic branch exchange (EPABX), switching equipment, telephone sets, telephone cabling, and connectivity to the central office will be installed to furnish complete internal and external telephone communications, including facsimiles. This system will be modular in nature allowing for expansion as site requirements change over time.

Depending on distances between buildings, peripheral modules may be installed and interconnected to the main EPABX by fiber optic cable. Satellite buildings within the vicinity of the peripheral units will have voice service extended to them via home run copper cable. This approach will ensure voice capability to any and all structures requiring this service.

7.2.2.3.1 Hot Lines Telephone System

A hot line telephone system will be implemented in designated areas of the facility. These dedicated hot lines will provide for direct access communications between radiologically controlled areas/buildings and the designated central monitoring and control and the emergency/fire and medical units. It is intended for these hot lines to be directly connected from point-to-point, bypassing the EPABX telephone system and powered by external ringdown circuits.

7.2.2.4 Site Emergency Radio System

The site emergency radio system will be included in two parts. The first part is a configuration of the site trunked radio system that can be implemented from certain radios with an emergency call button, certain radio users with a call code, or a switch at the radio operator console. The emergency radio mode of the trunked radio system configuration can be changed for an emergency broadcast to all radios, an emergency broadcast to groups of radios, or a priority channel interrupt to specific receivers.

The second part of emergency radio communications will be a group of radios that can be switched to simplex mode so that each receiver can receive transmissions from each transmitter in the group. The radios can be switched by the emergency signal from an authorized user or from the radio

configuration console by an authorized operator. Radios can be returned to normal mode of operation by an authorized operator upon clearing the emergency.

7.2.2.5 Site Emergency Telephone System

A site emergency telephone system will be installed. Selected telephones on this system will have the capability to be directly copper-connected to the site private automatic branch exchange (PABX) upon loss of power at a distribution point or drop/insert point. Each of these fail-to-cut-through telephones will have direct dial out capability with the copper connection. Other selected telephones on the site will have emergency priority dialing capability with the use of a predialed code at the handset. These telephones will override calls in progress and directly connect to a dialed extension in the telephone system if the dialed extension is busy. Selected telephones in some areas may have autodialing capability upon activation by an alarm event.

The PABX will have the capability to automatically dial each extension in the site telephone system and send a prerecorded message in reaction to an emergency. The priority list of extensions and their configuration can be changed by an operator. Telephone extensions that are not configured will be automatically configured by the system to dial in sequence after the configured telephone extensions have been dialed.

7.2.2.6 Off-site Emergency Communications Interfaces

Interfaces to several types of off-site emergency communications will be installed and implemented. The radio system is discussed some in Section 7.2.2.4. The hot lines telephone system is discussed some in Section 7.2.2.3.1. The radio system is supplemented by an emergency mode configured into the trunked radio system. The trunked radio system allows communications to radios both on-site and off-site up to the cutoff radius from the nearest antenna to the radio. The radio system is supplemented by a personal pager system. Personal pagers, in addition to being used for normal operations, will be used for emergency communications to personnel and contractors off-site or in transit between site locations.

Hot line telephones allow automatic dial or automatic ringdown to off-site telephones at predetermined locations for emergency communications. Switches on the site will switch the emergency telephone to a backup microwave system or to a satellite if the dialing circuit does not connect after a predetermined time. The microwave system and satellite system can also be used directly by dialing a prefix to the number being called.

7.2.2.7 Sitewide Emergency Notification System (PA, Sirens, Paging)

A sitewide emergency notification system will be installed and will consist of several levels of notification for the facility personnel.

A standard hard wire system will be installed as a first level basis. The system will consist of interconnected emergency manual actuation push-button stations, call boxes, and paging system with audible alarms and light beacons. The audible alarms will have distinctive tones for each major category of emergency conditions, as well as an audible voice message describing each emergency condition.

The system will be interfaced with control and detection systems that will activate the system alarms. A site emergency telephone interface will be provided to the system for access to paging functions of the system. Normal desktop or call box station can also be used for system emergency announcements overriding the preprogrammed emergency condition signaling.

The system will be designed such that designated individual areas of the facility (zones), as well as plant wide emergency conditions, can be alarmed.

In non emergency conditions, the system can be used as a standard paging system.

For an increased level of protection, all personnel will be equipped with emergency alphanumerical pagers. These pagers will be activated upon an emergency condition and display the type of the emergency on the pager display.

Hot lines will be provided, and will interconnect the necessary operating and security areas. The hot line operation will allow the operating / security personnel to reach any designated area equipped with hot line terminals by picking up the terminal handset and pushing the desired location button. The other location phone will ring and await pickup by the designated personnel. Multiple locations can be selected for simultaneous multi-party communications.

7.2.3   Desktop Systems, Plant Design System, and Computer-Aided Drafting System

The desktop system, CAD system, and plant design system central processing unit (CPU)/random access memory (RAM) specifications will be based upon the best current technology available at the time of procurement.   Minimum CPU clock speeds, hard disk sizes, RAM sizes, number of peripherals (e.g., CD ROMs and CD-Rs, etc.) will also be based on the analysis of system requirements.

7.2.4   Physical Systems

7.2.4.1 Building Inside Cabling, Station Termination Outlet, Main Distribution Frame/ Intermediate Distribution Frame, Network Equipment, and Servers

This section describes the connection equipment required for data and phone service with its associated building inside cabling (BIC). The BIC is the inside building's portion of the LAN comprising main distribution frames (MDFs) and intermediate distribution frames (IDFs).