U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

DOE/RW-0573, Rev. 0

June 2008

Yucca Mountain Repository License Application

SAFETY ANALYSIS REPORT

Chapter 5: Management Systems

This publication was produced by the U.S. Department of Energy
Office of Civilian Radioactive Waste Management.

For further information contact:
U.S. Department of Energy
Office of Civilian Radioactive Waste Management
1551 Hillshire Drive
Las Vegas, Nevada 89134

or call:
Yucca Mountain Information Center
1-800-225-6972

or visit:
Office of Civilian Radioactive Waste Management website
http://www.ocrwm.doe.gov

Section 508 Accessibility Elements Included in this Document

The PDF version of this report includes features that address applicable accessibility standards in the 1998 amendment to Section 508 of the Rehabilitation Act. These features include tagged text, which is available to assistive technologies such as screen readers; alternative text (alt text), which complements graphic materials; and bookmarks and hyperlinks, which allow efficient navigation of the report.

If you require an alternative format of this report, or interpretive services, please contact our toll-free information line, at 1-800-225-6972.

CONTENTS

Page

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

Page

CONTENTS (Continued)

CONTENTS (Continued)

CHAPTER 5 ACRONYMS

ALARA	as low as is reasonably achievable
DOE	U.S. Department of Energy
GROA	geologic repository operations area
HLW	high-level radioactive waste
ITS	important to safety
ITWI	important to waste isolation
NRC	U.S. Nuclear Regulatory Commission
OCRWM	Office of Civilian Radioactive Waste Management
PCSA	preclosure safety analysis
PSHA	probabilistic seismic hazard analysis
PVHA	probabilistic volcanic hazard analysis
QA	quality assurance
QARD	*Quality Assurance Requirements and Description*
SNF	spent nuclear fuel
SSC	structure, system, or component
TAD	transportation, aging, and disposal
TSPA	total system performance assessment

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5. MANAGEMENT SYSTEMS

Overview—Management systems are utilized to control activities to ensure that the repository is designed, constructed, operated, and closed so that high-level radioactive waste (HLW) or spent nuclear fuel (SNF) are handled and emplaced while protecting the health and safety of workers and the public, and protecting the environment. The preclosure safety analysis (PCSA) determines which structures, systems, and components (SSCs) are important to safety (ITS). Management systems are used throughout the life of the repository to control activities and integrate programs to provide assurance that the repository will be constructed and operated within analyzed conditions and that the validity of the design and analytical bases is maintained as modifications occur.

The total system performance assessment (TSPA) provides an analytical basis for evaluating repository performance following closure. An analysis of the repository's natural and engineered barriers provides information on barrier features that are important to waste isolation (ITWI). Management systems will ensure that sufficient data exist to confirm TSPA bases are satisfied and that the Performance Confirmation Program provides appropriate confirmatory bases as part of making the determination to permanently close the repository. Procedural and administrative safety controls are provided for ITS and ITWI SSCs to ensure they are maintained and operated within analyzed conditions, and are capable of performing their intended functions. Management systems implement these administrative and procedural safety controls. Specifically, management systems provide additional requirements for activities affecting ITS and ITWI SSCs by providing the administrative and programmatic framework for:

- Quality assurance (QA)
- Records, reports, tests, and inspection
- Training and certification of personnel
- Startup activities and testing
- Conduct of normal activities, including maintenance, surveillance, and periodic testing
- Emergency planning
- License specifications
- Operational radiation protection
- Configuration management system.

The management systems in each of these programs are implemented through procedures governing work processes in accordance with the Quality Assurance Program and are summarized below.

Quality Assurance—The Quality Assurance Program provides the QA requirements for the design and construction of the repository (Section 5.1). The requirements of the Quality Assurance Program are applied to the U.S. Department of Energy and its contractors for the design and construction activities that affect ITS and ITWI SSCs. These SSCs and associated activities are determined to be necessary to protect the public, the workers, and the environment against the radiological consequences of event sequences. Additional QA requirements, as needed for operational activities, will be developed and implemented prior to operations.

The Quality Assurance Program and applicable implementing procedures are reviewed and revised, as necessary, to reflect needed changes that occur over the life of the repository. QA controls are established and personnel are trained prior to performing quality-affecting activities. Quality shall be achieved and maintained by those who have been assigned responsibility for performing work. QA oversight verifies the achievement of QA requirements through audits, surveillances, assessments, and quality reviews. The QA organization reports to the Director of the Office of Civilian Radioactive Waste Management and is independent of the line organization.

Records, Reports, Tests, and Inspections—Records will be created and maintained to describe the construction and the resulting as-built configuration of the repository surface and subsurface facilities (Section 5.2). Specifications and as-built drawings will be modified to reflect plant modifications so that the specifications and drawings at the time of closure will reflect actual plant configuration. Repository records will be maintained to document the receipt, handling, and disposition of HLW and SNF at the repository to provide a complete history of HLW or SNF from shipper through repository closure.

Records are filed, indexed, and stored to allow retrieval throughout their life cycle, in accordance with the Quality Assurance Program.

Onsite events will be evaluated, and reports will be issued to the U.S. Nuclear Regulatory Commission as required by regulation or the license. To comply with 10 CFR Part 21, deficiencies will be identified, evaluated and reported in accordance with approved repository procedures.

The testing and monitoring programs will be developed to ensure that ITS and ITWI SSCs are able to meet their intended design function. Compliance with the license specifications, which include surveillance testing, will demonstrate operability of SSCs.

Training and Certification of Personnel—The organizational structure, identification of key positions, and minimum qualifications of personnel that implement the management systems are described in Section 5.3. The training program, through the use of a systematic approach to training, will identify tasks and personnel classifications that require training, before personnel can operate, maintain, engineer, manage, or perform quality-affecting activities. The Quality Assurance Program identifies training and qualification requirements for QA personnel performing quality-affecting activities for nondestructive examination, inspection, tests, and audits.

The Training Program is a dynamic program that will change to reflect changes in repository design or operation. The program will accommodate the various stages of repository development and operation. The Training Program will be updated to reflect changes in the repository design and operations to ensure that employees are properly trained. Line managers will be responsible for ensuring that personnel are properly trained and capable of performing assigned tasks in a quality manner. Line managers will have direct input into the conduct and material used in training of their personnel.

Startup Activities and Testing—The Startup and Testing Program (Section 5.5) will be applied to SSCs and operational processes. The startup testing of ITS and ITWI SSCs and operational processes for initial operating capability will be performed prior to receipt of HLW or SNF. The

testing program includes testing necessary to demonstrate that the SSCs are capable of performing their intended functions as designed under operational conditions and that measured parameters are bounded by the design analysis. Trained and qualified personnel will perform the testing program according to approved procedures. The Startup Manager will report to the Operations Manager. Startup testing will be performed utilizing procedures and will be completed before SSCs within a construction phase are turned over to the operating organization. Results of startup testing will be reviewed by the Waste Handling Manager to ensure that SSCs perform their intended safety functions within acceptable analyzed parameters, measured parameters, or both.

Conduct of Normal Activities, Including Operations, Maintenance, Surveillance, and Periodic Testing—Prior to receipt of HLW or SNF, the repository will develop and implement plans and procedures for the conduct of normal activities, including operations, maintenance, surveillance, and periodic testing of SSCs and related processes (Section 5.6). Procedures will be developed, organized, and implemented to ensure that controlled methods govern the conduct of normal activities, including administrative procedures that will control changes to procedures. Since construction will continue after operations have begun, the integrity of the physical barriers, the operational control of activities that may impact either construction or operations, and control of security boundaries that separate the two ongoing activities will be administered by procedural controls. Conduct of operations and conduct of maintenance plans patterned after nuclear industry guidelines will be developed in advance of HLW or SNF receipt. These plans will result in an integrated set of procedures that will define the interfaces and roles, responsibilities, accountabilities, and authority of the two organizations (Construction and Operations) for operations, maintenance, surveillance, and periodic testing.

Qualified repository personnel will receive specific procedures to ensure waste forms are handled and the repository is operated so that the probability of initiating an event sequence does not exceed that assumed in the safety analysis. License requirements, through the application of surveillances, limiting conditions of operation, and adherence to action statements, coupled with the use of nuclear industry conduct of maintenance standards, will ensure the availability and capability of the SSCs credited in the PCSA to meet design bases.

Emergency Planning—The Emergency Plan will establish the basis for written procedures and practices for control of emergency events that may occur at the repository (Section 5.7). The plan will define the responsibilities for maintaining and updating the Emergency Plan to ensure it reflects the current repository design and organization. Emergency response personnel for normal and off-normal working hours will be trained and qualified before being assigned emergency response roles. Minimum staffing levels will be identified so that responders are available to properly respond to emergency events.

Drills will be conducted to evaluate the effectiveness of the Emergency Plan and maintain key response skills necessary for Emergency Plan implementation. Deficiencies identified by the drills will be documented and corrective actions taken to resolve the deficiencies. The drills and their results will be documented and maintained.

License Specifications—The license to receive and possess SNF and HLW will include license specifications, which will be derived from the PCSA and the TSPA (Section 5.10). The PCSA establishes and analyzes activities and ITS SSCs that are relied upon to prevent or mitigate

potential event sequences during preclosure operation. Management systems ensure that activities are performed within analyzed conditions and that ITS SSCs maintain their ability to perform their intended safety functions when required throughout the licensed period.

The TSPA provides the analytical basis for demonstrating the protection of the public. An analysis of barriers consistent with the TSPA analysis establishes activities and ITWI SSCs. License specification and management systems ensure that activities are performed in accordance with the analytical bases that support the TSPA and that ITWI SSCs maintain their ability to function as defined in their design bases. Potential subjects of License Specifications derived from these analyses are discussed in Section 5.10.

Operational Radiation Protection Program—The Operational Radiation Protection Program will be implemented through procedures and work controls that ensure radiation protection measures are employed for the protection of workers, the public, and the environment commensurate with the scope and extent of licensed activities (Section 5.11). Sources of radiation and radioactive material identified and addressed in the program include SNF and HLW waste forms, as well as sealed sources of radioactive material and site-generated low-level radioactive waste. The program will address radiation risk posed by testing and startup activities, transportation cask receipt and return operations, movement of HLW or SNF from transportation casks to the waste packages, or staging of HLW or SNF for aging, movement and emplacement of waste packages into underground facilities, waste package remediation, and other support operations necessary for safe handling of radioactive material at the repository.

The components of the program, its policy, supporting programs, and implementing procedures ensure that radiation doses to workers and the public will not exceed regulatory limits and will be as low as is reasonably achievable.

The radiation protection organization will be staffed with qualified radiation safety professionals responsible for ensuring that the program is developed and implemented effectively. Qualification of radiation protection technicians will incorporate certification training and examination, on-the-job training, and evaluation. The Radiation Protection Manager will have direct access to the Site Operations Manager and other repository management to address issues related to radiation protection. The Radiation Protection Manager or designee will review procedures and processes and revisions thereto to ensure the Radiation Protection Program is appropriately addressed.

Restricted areas where HLW or SNF handling is performed inside the geologic repository operations area will be incorporated into the repository layout to assist in minimizing exposure of personnel. The Radiation Protection Program will describe the radiological access control system to verify that the radiological entry requirements for personnel have been met prior to allowing access. The access control features of high and very high radiation areas will meet the criteria of 10 CFR Part 20.

The Radiation Protection Program will also provide radiological access control, low-level radioactive waste management, external and internal control and dose monitoring, air sampling and analysis, respiratory protection, and radioactive material training. The program will ensure that proper notices to workers are provided and that radiation-protection-related reports and records are properly maintained.

The Radiation Protection Program will develop and implement an Environmental Radiological Monitoring Program to ensure that radiation doses to members of the public in the general environment are below the applicable preclosure limits and are as low as is reasonably achievable.

Configuration Management System—Configuration management is central to the management systems in maintaining design bases and will be integrated with repository procedures. The objectives of configuration management are to provide a disciplined approach to ensure design and operation within the design bases of SSCs by identifying and controlling preparation and review of documentation associated with SSCs, by controlling changes to SSCs, and by maintaining the physical configuration of the repository consistent with the approved design.

The configuration management system is implemented through procedures. Configuration management is provided throughout the design, construction, testing, operation, and closure stages of the repository. Configuration management establishes and maintains the technical baseline for the repository based on clearly defined requirements. During the design and construction of the repository, the Engineering and Construction Manager has responsibility for configuration management through the design control process (Section 5.3.1.2.4). Selected documentation is controlled under the configuration management system in accordance with appropriate procedures associated with design control, document control, and records management. Design changes to SSCs undergo formal review, including interdisciplinary reviews, as appropriate, in accordance with approved procedures.

After the U.S. Nuclear Regulatory Commission authorizes construction of the repository, changes to the repository design or procedures as described in SAR will be subject to the requirements of 10 CFR 63.44, as well as any specific license conditions imposed in accordance with 10 CFR 63.32. In accordance with 10 CFR 63.42, the Nuclear Regulatory Commission may impose additional license conditions as part of the license to receive and possess waste.

Proposed changes to engineering, science and programmatic documents that form the basis of the SAR and supporting documents that could impact the design, analysis, or operation of the repository will be screened as part of the process of review for changes in accordance with 10 CFR 63.44. The purpose of this initial screening is to determine if the proposed change could impact the SAR and therefore require additional evaluation and documentation subject to the criteria of 10 CFR 63.44. This screening process is subject to the QA program required by 10 CFR 63.141 through 143. Therefore, these screenings are performed by personnel who are properly trained and familiar with the subject matter and the content of the SAR. These screenings are integrated into the controlling procedures for any engineering, science, or operations product (which would include the configuration management processes applied at the repository) that could potentially impact the information contained in the SAR. These procedures include the approval of new or revised drawings, calculations, specifications, science products, operation/maintenance procedures, construction procedures and programmatic plans.

For proposed changes that are determined to require a full evaluation, the proposed change is evaluated to determine if it impacts a license condition or specification and evaluated against the seven criteria specified in 10 CFR 63.44(b). Consistent with the application of the QA process to this activity, this stage of the review is conducted in accordance with written procedures governing the performance of the evaluations, review and approval of the evaluations, and related record

keeping. Required documentation of these reviews includes a written basis for the decision reached on each of these criteria. Evaluations are conducted by trained staff familiar with both the subject matter and the overall content of the SAR and supporting documents.

Construction procedures require that the SSCs be constructed in accordance with the design requirements reflected in design drawings and standards. During construction, changes to drawings and specifications issued for construction, procurement, or fabrication will be systematically reviewed and verified, evaluated for impact on existing design, and approved by engineering prior to implementation. Proper implementation is verified by inspection activities and reflected in the design basis documentation.

During operations of the repository, configuration control is ensured by the Onsite Safety Committee reviews (Section 5.3.1.5). The operating organization, through the broad expertise of the Onsite Safety Committee, will ensure that operating documents are revised as necessary to reflect repository modifications. The training organization will review repository modifications to ensure that if the training program is affected, appropriate actions are taken to maintain the training program current with repository design and operation.

The scope of SSCs under configuration management includes SSCs that are being designed to be constructed and operated at the repository. Configuration controls will be developed and implemented, which will specify and control data in support of the design basis, design criteria, operational configuration for ITWI SSCs, and reliability requirements associated with SSCs considered in the PCSA. Design documents, postclosure analyses, and supporting documents subject to configuration management include calculations, safety analyses, design criteria, engineering drawings, system descriptions, technical documents, and specifications that establish design requirements for SSCs. The scope of documents included in the configuration management system will expand throughout the design process. As drawings and specifications related to SSCs will be prepared and approved for procurement, fabrication, or construction, these documents are included in the configuration management system. Changes to the analyzed design will be evaluated in accordance with applicable regulations, and changes to the license application will be made as necessary.

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5.1 QUALITY ASSURANCE

[NUREG-1804, Section 2.5.1.3]

The Office of Civilian Radioactive Waste Management (OCRWM) *Quality Assurance Requirements and Description* (QARD) describes the requirements of the Quality Assurance Program that apply to quality-related activities at the Yucca Mountain repository. The QARD is prepared in accordance with the requirements of 10 CFR 63.21(c)(20) and 10 CFR 63, Subpart G, addresses the acceptance criteria contained in Section 2.5.1.3 of NUREG-1804, and is incorporated into the license application by reference.

5.1.1 Organization

As described in the QARD, the Director of OCRWM is responsible for the execution of policies, plans, and procedures governing acceptable performance of repository activities in accordance with the Quality Assurance Program.

The Director of the Office of Quality Assurance has the primary responsibility for ensuring the overall implementation, adequacy, and effectiveness of the repository Quality Assurance Program.

All personnel conducting work within the scope of the OCRWM Quality Assurance Program are responsible for implementing the requirements of the program within their scope of responsibility.

OCRWM personnel, contractors, vendors, and other federal agencies have responsibility and authority to execute quality-affecting activities in accordance with the requirements of the QARD. The quality assurance functions for each of the current principal contractors are identified in the QARD. OCRWM provides oversight through the U.S. Department of Energy procurement contract management processes, quality assurance audits and surveillances, management controls, and review of activities by the project and field organizations.

During the design and construction phase of the project, OCRWM may elect to assign contractors for design, construction, and other activities. These contractors are responsible for developing and implementing quality assurance programs that are consistent with the applicable requirements of the QARD or for working directly under the QARD.

5.1.2 Quality Assurance Program

As described in the QARD, the overall Quality Assurance Program consists of the QARD policies, implementing procedures, work practices, and management systems utilized at the Yucca Mountain repository. For the design, analysis, fabrication, construction, and testing of the repository, the present revision of the QARD describes the quality assurance requirements and strategies that OCRWM is required to implement.

The QARD is formatted to be consistent with the 18 sections of 10 CFR 63.142. The QARD also includes additional supplements and appendices that address other activities at the Yucca Mountain repository.

The QARD will be revised at appropriate times to address future activities related to facility operations, permanent closure of the repository, and decommissioning and dismantlement of the surface facilities. These future revisions to the QARD will be submitted to the U.S. Nuclear Regulatory Commission consistent with the requirements of 10 CFR 63.144.

CONTENTS

Page

INTENTIONALLY LEFT BLANK

TABLES

Page

INTENTIONALLY LEFT BLANK

5.2 RECORDS, REPORTS, TESTS, AND INSPECTIONS

Section 5.2 provides information that addresses specific regulatory acceptance criteria in Section 2.5.2.3 of NUREG-1804. The following table lists the information provided in this section, the corresponding regulatory requirements, and applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.2.1	Records	63.21(c)(23) 63.51(a)(3) 63.71 63.72	Section 2.5.2.3: Acceptance Criterion 1
5.2.2	Reports	63.21(c)(23) 63.71 63.73	Section 2.5.2.3: Acceptance Criterion 1
5.2.3	Tests	63.74	Not applicable
5.2.4	U.S. Nuclear Regulatory Commission Inspections	63.75	Not applicable

Section 5.2.1 describes the records management processes for creating and maintaining records required by conditions of the license or rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC), including records of construction of the geologic repository operations area (GROA) and records of the receipt, handling, and disposition of radioactive waste. Section 5.2.2 describes the processes for evaluating deviations and failures to comply with requirements and reporting deficiencies that could adversely affect safety, represent a significant deviation from design criteria and design bases, or represent a deviation from the conditions stated in the terms of the construction authorization or license. Section 5.2.3 describes the process for performing tests the NRC considers appropriate or necessary for the administration of the regulations. Section 5.2.4 describes how the U.S. Department of Energy (DOE) will comply with NRC requirements for inspecting the premises of the GROA and adjacent areas.

5.2.1 Records

[NUREG-1804, Section 2.5.2.3: AC 1]

The *Quality Assurance Requirements and Description* (QARD) DOE/RW-0333P establishes the requirements for the Quality Assurance Program that meets the requirements of 10 CFR 63.142. (Section 5.1). Records meeting the QARD definition of a quality assurance (QA) record are managed in accordance with the Quality Assurance Program and procedures that implement applicable regulatory requirements. The records life cycle consists of three basic stages: creation, active maintenance and use, and storage and disposition. Records management standards have been established for the accurate and complete documentation of the policies and transactions of the repository and to control the quantity and quality of records produced. Under the records management procedures, required records are retained and preserved regardless of media, based on approved disposition schedules of the National Archives and Records Administration and NRC requirements. Access controls are provided for sensitive information, such as information related to

privacy, safeguards, and homeland security, to restrict access and disclosure to authorized persons. As described in the QARD, the current program applies to activities up to the time of receipt of high-level radioactive waste and spent nuclear fuel. The QARD will be revised as necessary at the appropriate time to include facility operation, permanent closure, and decontamination and dismantling of surface facilities.

Records management procedures integrate NRC requirements into the overall management process. Procedures are in place and others will be developed, at the appropriate time, to include production and retention of records related to NRC regulations identified in Table 5.2-1.

5.2.1.1 Program Objectives

The primary objectives of records management are to:

- Retain the records of receipt, handling, and disposition of radioactive waste in a manner that ensures their use by future generations (10 CFR 63.71(b))
- Furnish objective evidence documenting the quality of structures, systems, and components and related activities that are important to safety or important to waste isolation
- Provide an NRC-compliant program for the management of records.

5.2.1.2 Record Creation

Plans and procedures are in place to support current activities and will be in place as needed in the future to identify those records that are to be generated as part of the design, construction, operations, and decommissioning process.

Records containing adequate and proper documentation of design, scientific analysis, and safety analysis are being created and preserved. Records that document the actions required by procedures are also being created. Records management procedures identify the approval and authentication process for records, as well as corrections and changes thereto. Records will be created and maintained to document procurement activities.

Once permitted by a construction authorization, records will be created and maintained to describe the construction and resulting as-built configuration of the surface and subsurface structures, systems, and components. To meet the requirements of 10 CFR 63.72, construction records will include the following, at a minimum:

- Surveys of the underground facility excavations, shafts, ramps, and boreholes that are referenced to readily identifiable surface features or monuments
- A description of the geologic materials and structures encountered
- Geologic maps and geologic cross sections

- Locations and amounts of seepage
- Details of equipment, methods, progress, and sequence of work
- Descriptions of construction problems
- A description of anomalous conditions encountered
- Instrument locations, readings, and analyses
- Locations and descriptions of structural support systems
- Locations and descriptions of dewatering systems, if used
- Details, methods of emplacement, and locations of monuments used to identify the GROA and site after permanent closure
- Details, methods of emplacement, and locations of seals used
- Facility design records, including specifications and as-built drawings.

Once authorized by license, records will be created and maintained to document the receipt, handling, and disposition of radioactive waste to provide a complete history of the movement of the waste from receipt through disposal. Shipper records obtained at the time of waste receipt will also be maintained.

Finally, records management procedures will be used to create, preserve, and maintain facility operating records associated with permanent closure and decommissioning.

Specifications and as-built drawings will be updated and maintained with each specification and facility modification so that the specifications and drawings at the time of closure reflect actual design and operations at the time of application to amend the license for permanent closure.

5.2.1.3 Record Maintenance and Use

Records are filed, indexed, and stored to allow retrieval as necessary to provide information on the applicable item or activity. Approved records retention times will be established. Procedural controls have been established for record types requiring special handling, such as safeguards and homeland security provisions, privacy, QA, permanent, and licensing-related records.

Selected records are and will be maintained on electronic media and can be retrieved throughout the length of their required retention period. The guidance in *NRC Regulatory Issue Summary 2000-18 Guidance on Managing Quality Assurance Records in Electronic Media* (NRC 2000) will be incorporated into the development of procedures governing the management of electronic media records. Records management procedures describe the migration strategy and plan for electronic records whose retention periods are longer than the life expectancy of the media upon which the information is stored.

Selected record types, such as QA records, are maintained as digital images in order to allow for timely retrieval.

5.2.1.4 Records Storage

Quality records are stored in locations that meet the requirements of ANSI/ASME NQA-1-1983, *Quality Assurance Program Requirements for Nuclear Facilities*, Supplement 17S-1, and described in the QARD. Storage requirements, including temporary storage requirements, will be incorporated into procedures and define the appropriate protection and access. The Federal Records Center and offsite commercial storage facilities will be used as necessary.

To comply with 10 CFR 63.71(b), dual storage of records of receipt, handling, and disposition of spent nuclear fuel and high-level radioactive waste, including those associated with permanent closure and decommissioning, will be created and maintained. These records will contain enough information to provide a complete history of the movement of radioactive waste from the point of receipt at the GROA through disposal. Shipper records will also be maintained. In accordance with 10 CFR 63.51(a)(3), the records will be maintained in a manner that ensures their usability for future generations. The retention periods for records are delineated in the records retention schedule and meet or exceed the retention requirements in ANSI/ASME NQA-1-1983 and Regulatory Guide 1.28. QA records will be maintained until the end of the operating period.

5.2.1.5 Disposition of Records

Records are identified and retained in accordance with the archival requirements of 10 CFR 63.51(a)(3)(ii) and records disposition schedules.

As required by 10 CFR 63.51(a)(3)(ii), records will be placed in the archives and land record systems of local, state, and federal government agencies and in archives elsewhere in the world that would likely be consulted by potential human intruders. Such records will identify: the location of the GROA, including the underground facility, boreholes, shafts, and ramps; the boundaries of the site; and the nature and hazard of the waste.

Prior to permanent closure of the repository, the DOE will develop and maintain a list of specific locations where such records will be located and maintained.

5.2.2 Reports

[NUREG-1804, Section 2.5.2.3: AC 1]

As required by 10 CFR 63.73, methods will be in place prior to the issuance of the construction authorization to identify, evaluate, and report deficiencies. Deficiencies to be reported are those

found in the characteristics of the Yucca Mountain site and in the design and construction of the GROA that, if left uncorrected, could result in one or more of the following:

- An adverse effect on safety at any future time
- A significant deviation from the design criteria and design basis stated in the license application
- A deviation from the conditions stated in the terms of the construction authorization or the license.

Onsite repository events will be evaluated and reports will be issued to the NRC whenever required by regulatory requirements or conditions of the license. Table 5.2-2 lists current NRC regulations applicable to reports. Reports required by conditions of the license or rules, regulations, and orders of the NRC will be prepared and maintained.

As required by 10 CFR 63.73(b), methods will be in place to evaluate and report deviations and failures to comply, as well as to identify defects and failures to comply, that are associated with substantial safety hazards at the GROA. These methods will be based on the applicable requirements of 10 CFR 50.55(e), as it applies to the design and the construction authorization of the GROA. In accordance with the requirements of 10 CFR 72.75, prior to obtaining a license to receive and possess spent nuclear fuel and high-level radioactive waste, methods will be in place to address reporting specific events and conditions described in Section 5.7. The notification of these events and conditions will occur in accordance with applicable regulations. As specified in 10 CFR 63.73(d), written reports will be submitted to the NRC addressed: ATTN: Document Control Desk; Director, Office of Nuclear Material Safety and Safeguards; U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and to the NRC onsite representative. Reports will also be furnished to the appropriate NRC Regional Office.

5.2.3 Tests

Repository testing will be designed to comply with the requirements of 10 CFR 63.74, including implementing the Performance Confirmation Program in accordance with 10 CFR 63, Subpart F. Table 5.2-3 summarizes the applicable NRC regulations related to tests.

Repository tests will be performed throughout construction and operation. Table 5.2-4 identifies various test categories, test objectives, and testing requirements that will be considered in addressing the regulatory requirements.

The NRC may wish to conduct tests or to have the repository personnel conduct tests associated with the administration of the NRC responsibilities under 10 CFR 63.74(a). In the case of NRC testing, the NRC test plans will be evaluated to ensure compatibility with ongoing tests. Personnel who perform tests at the repository will be qualified and trained for particular tasks. To ensure that the tests are performed in accordance with applicable procedures and requirements, personnel will conduct tests or assist NRC personnel, as appropriate, in conducting tests required by the NRC. Tests required by the NRC will be conducted in accordance with approved plans and procedures. NRC personnel will be able to define the test requirements, review the test procedures, and observe

and monitor the tests. Any test requested by the NRC should be identified in sufficient time for the test to be planned, prepared, and conducted.

5.2.4 U.S. Nuclear Regulatory Commission Inspections

The DOE will comply with NRC requests for inspections. Table 5.2-5 summarizes applicable NRC regulations related to inspections.

Personnel will engage in complete, open, and accurate communications with NRC inspectors. NRC personnel will have access to records and reports, and to office space and equipment to support their inspections of GROA activities.

As required by 10 CFR 63.75(a), the DOE will allow the NRC to inspect the premises of the GROA and adjacent areas to which DOE has rights of access.

Upon reasonable notice, pursuant to 10 CFR 63.75(b), the DOE will make records kept by DOE pertaining to activities under 10 CFR Part 63 available to the NRC for inspection.

The DOE will provide office space in accordance with 10 CFR 63.75(c)(1) for the exclusive use of NRC inspection personnel. Office space will include visual and acoustic privacy. As required by 10 CFR 63.75(c)(2), the office space provided will accommodate two full-time NRC inspectors and other transient NRC personnel and be commensurate with office space provided for DOE personnel. The combined space provided for NRC inspection and transient personnel will be no less than 250 ft^2. Once proper identification and compliance with applicable access control measures have been met for security, radiation protection, and personal safety, as required by 10 CFR 63.75(c)(3), NRC personnel will have immediate and unfettered access to the GROA and adjacent areas to which DOE has rights of access.

5.2.5 General References

ANSI/ASME NQA-1-1983. *Quality Assurance Program Requirements for Nuclear Facilities.* New York, New York: American Society of Mechanical Engineers. TIC: 216628.

NRC (U.S. Nuclear Regulatory Commission) 2000. *NRC Regulatory Issue Summary 2000-18 Guidance on Managing Quality Assurance Records in Electronic Media*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20041019.0235.

Regulatory Guide 1.28, Rev. 3. 1985. *Quality Assurance Program Requirements (Design and Construction)*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238519.

Table 5.2-1. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Records

Regulation	10 CFR Section	Records Requirement
10 CFR Part 20, Standards for Protection Against Radiation	10 CFR 20.2101	General provisions for radiation records
	10 CFR 20.2102	Records of the Occupational Radiation Protection Programs
	10 CFR 20.2103	Records of radiation surveys
	10 CFR 20.2104	Determination of prior employee occupational dose
	10 CFR 20.2105	Records of planned special exposure to radiation worker(s)
	10 CFR 20.2106	Records of individual special radiation monitoring results
	10 CFR 20.2107	Records of dose to individual members of the public
	10 CFR 20.2108	Records of waste disposal
	10 CFR 20.2110	Form of radiation records (e.g., electronic, hard copy)
10 CFR Part 21, Reporting of Defects and Noncompliance	10 CFR 21.51	Maintenance and inspection of records involving evaluations of basic component deviations and failures
10 CFR Part 63, Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada	10 CFR 63.4	Communication and records for 10 CFR Part 63 regulations
	10 CFR 63.44	Changes, tests, and experiments
	10 CFR 63.46	Particular activities requiring license amendment
	10 CFR 63.51	License amendment for permanent closure
	10 CFR 63.71	Records and reports in connection with licensed activities
	10 CFR 63.72	Construction records
	10 CFR 63.73	Reports of deficiencies found in the characteristics of the Yucca Mountain site, in the design, and in the construction of the GROA
	10 CFR 63.78	Material control and accounting records and reports for special nuclear material
	10 CFR 63.142	QA records
	10 CFR 63.144(b)(3)	Quality Assurance Program change reporting requirements

Table 5.2-1. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Records (Continued)

Regulation	10 CFR Section	Records Requirement
10 CFR Part 73, Physical Protection of Plants and Materials	10 CFR 73.46	Fixed site physical protection systems, subsystems, components, procedures
	10 CFR 73.51	Requirements for the physical protection of stored nuclear fuel and high-level radioactive waste
	10 CFR 73.56	Personnel access authorization requirements for nuclear power plants
	10 CFR 73.70	Records involving physical protection of plants and material
10 CFR Part 95, Facility Security Clearance and Safeguarding of National Security Information and Restricted Data	10 CFR 95.13	Maintenance of records involving national security information and restricted data
	10 CFR 95.25	Protection of national security information and restricted data in storage
	10 CFR 95.33	Security education for personnel safeguarding national security information and restricted data
	10 CFR 95.34	Control of visitors at the Yucca Mountain repository
	10 CFR 95.36	Site access by representatives of the International Atomic Energy Agency or by participants in other international agreements
	10 CFR 95.41	External receipt and dispatch records involving classified information
	10 CFR 95.57	Reports required involving safeguarding of national security information and restricted data

Table 5.2-2. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Reports

Regulation	10 CFR Section	Reports and Notifications
10 CFR Part 19, Notices, Instructions and Reports to Workers: Inspection and Investigations	10 CFR 19.13	Notifications and reports to individuals of radiation exposure data
10 CFR Part 20, Standards for Protection Against Radiation	10 CFR 20.2201	Reports of theft or loss of licensed radioactive material
	10 CFR 20.2202	Notification of incidents involving radioactive material
	10 CFR 20.2203	Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits
	10 CFR 20.2204	Required reports of planned special radiation exposures
	10 CFR 20.2205	Required reports to individuals of exceeding radiation dose limits
	10 CFR 20.2206	Required reports of individual monitoring performed annually by licensee
10 CFR Part 21, Reporting of Defects and Noncompliance	10 CFR 21.21	Notification of failure to comply or existence of a defect and its evaluation
10 CFR Part 63, Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada	10 CFR 63.32	Conditions of the construction authorization to furnish periodic or special reports
	10 CFR 63.43(b)(6)	Reports necessary to ensure facility is conducted in a safe manner and in conformance with license specifications
	10 CFR 63.44	Changes, tests, and experiments
	10 CFR 63.45	Amendment of operating license process
	10 CFR 63.73	Reports of deficiencies found in the characteristics of the Yucca Mountain site, the design, and the construction of the GROA
	10 CFR 63.132	Surveillance activities in the Performance Confirmation Program for confirmation of geotechnical and design parameters during construction and operation
10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste	10 CFR 72.74	Required reports of accidental criticality or loss of special nuclear material
	10 CFR 72.75	Reporting requirements for specific emergency events and conditions
	10 CFR 72.76	Required material status reports for NRC use
	10 CFR 72.78	Required nuclear material transfer reports

Table 5.2-2. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Reports (Continued)

Regulation	10 CFR Section	Reports and Notifications
10 CFR Part 73, Physical Protection of Plants and Materials	10 CFR 73.71	Required reporting of safeguards events
10 CFR Part 95, Facility Security Clearance and Safeguarding of National Security Information and Restricted Data	10 CFR 95.19	Changes to security practices and procedures
	10 CFR 95.21	Withdrawals of requests for facility security clearance
	10 CFR 95.53	Termination of security facility clearance
	10 CFR 95.57	Reports required involving safeguarding of national security information and restricted data

Table 5.2-3. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Tests

Regulation	10 CFR Section	Criteria Description
10 CFR Part 63, Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada	10 CFR 63.44	Changes, tests, and experiments
	10 CFR 63.74	Tests required by the NRC for 10 CFR Part 63 regulations
	10 CFR 63.112	Requirements for preclosure safety analysis of the geological repository operations area
	10 CFR 63.133	Design testing requirements during the early construction stage
	10 CFR 63.134	Performance Confirmation Program requirements for monitoring and testing waste packages
	10 CFR 63.142	Required QA criteria
	10 CFR 63.152	Training and certification program requirements for operating and supervising personnel
10 CFR Part 73, Physical Protection of Plants and Materials	10 CFR 73.20	General performance objective and requirements for a physical protection system
	10 CFR 73.26	Requirements for transportation physical protection systems, subsystems, components, and procedures
	10 CFR 73.46	Requirements for fixed site physical protection systems, subsystems, components, and procedures
	10 CFR 73.50	Requirements for physical protection of licensed activities
	10 CFR 73.55	Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage
	10 CFR 73.60	Additional requirements for physical protection at nonpower reactors

Table 5.2-4. Test Categories Indicating Regulatory Requirements

Test Category	Test	Objective
Design, Construction, and Operations	Prototype Evaluations	Confirm fabrication methods, welding techniques, and effectiveness of nondestructive examination methods. Data to be used to confirm or modify equipment design, fabrication, and inspection. See Section 1.5.2.
	Design, Construction, and Start-Up Tests	Confirm data used for preclosure design and construction materials (e.g., concrete). Confirm functional and operational performance. Data to be used to confirm design analytical bases and operational readiness. See Sections 5.5 and 5.6.
	Operations and Maintenance Tests	Confirm maintenance requirements, operating performance, and safety systems availability. Data to be used to confirm operating and maintenance procedures. See Section 5.6.
Performance Confirmation	Performance Confirmation	Testing and monitoring necessary to comply with 10 CFR Part 63. Data to be evaluated and reported to the NRC to satisfy 10 CFR Part 63. See Chapter 4.
Regulatory Directed Research and Development	NRC Requested Research and Development Safety Tests	Resolve safety issues identified by the NRC. Data to be used for reporting resolution of conditions of license. See Section 5.2.
	NRC 10 CFR 63.74(a) Tests	Perform tests specified by the NRC under 10 CFR 63.74(a). Data to be used to respond to NRC-specified tests. See Section 5.2.
Licensing Specifications	Licensing Specifications Tests	Comply with NRC licensing specifications issued as a part of the license to ensure operations are performed within analyzed safety bases. Data to be used to allow for operations within the confines of the conditions of the license and for evaluation and compliance reporting to the NRC for the preclosure period. See Section 5.10.
Security and Emergency	Security, Safeguards, and Emergency Tests	Confirm functional performance of the systems. Data to be used to document the adequacy of the systems and required NRC regulatory reporting for the preclosure period.
Equipment Qualification Program	Harsh Environment, Seismic, and Startup	Ensure structures, systems, and components important to safety have the ability to perform their intended safety functions as required by 10 CFR 63.112(e). See Section 1.13.

Table 5.2-5. Applicable U.S. Nuclear Regulatory Commission Regulations Addressing Repository Inspections

Regulation	10 CFR Section	Inspection Description
10 CFR Part 19, Notices, Instructions and Reports to Workers: Inspection and Investigations	10 CFR 19.16	Requests by workers for inspections of licensed activities
10 CFR Part 21, Reporting of Defects and Noncompliance	10 CFR 21.41	Inspections allowed to the NRC involving records, premises, activities, and basic components
	10 CFR 21.51	Maintenance and inspection of records involving evaluations of basic component deviations and failures
10 CFR Part 63, Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada	10 CFR 63.43	License specification requirements at the repository
	10 CFR 63.75	Inspections allowed to the NRC
	10 CFR 63.142	QA records
10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste	10 CFR 72.44	License condition requirements for independent spent fuel storage installation facilities
	10 CFR 72.82	Inspections and tests required by the NRC for independent spent fuel storage installation facilities material control and accounting
	10 CFR 72.154	Requirements for control of purchased material, equipment, and services at independent spent fuel storage installation facilities
	10 CFR 72.160	Requirements for licensee inspection of the repository during construction
	10 CFR 72.168	Inspection, test, and operating status requirements for the repository licensee
	10 CFR 72.232	Inspection and tests allowed to the NRC at independent spent fuel storage installation facilities
10 CFR Part 73, Physical Protection of Plants and Materials	10 CFR 73.46	Requirements for fixed site physical protection systems, subsystems, components, and procedures
10 CFR Part 95, Facility Security Clearance and Safeguarding of National Security Information and Restricted Data	10 CFR 95.59	Inspections performed by the NRC of security facilities

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

FIGURES

Page

INTENTIONALLY LEFT BLANK

5.3 TRAINING AND CERTIFICATION OF PERSONNEL

This section provides information that addresses specific regulatory acceptance criteria in Section 2.5.3 of NUREG-1804. The information presented in this section also addresses the requirements contained in 10 CFR 63.21(c)(22), 10 CFR 63.151, 10 CFR 63.152, and 10 CFR 63.153 by providing a general description of the U.S. Department of Energy (DOE) organizational structure, as it is anticipated to exist at the time of repository construction and operations; the key positions assigned responsibility for safety and operations; and the personnel qualification and training requirements. The following table lists the information provided in Section 5.3, the corresponding regulatory requirements, and the applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.3.1	Organizational Structure of the Office of Civilian Radioactive Waste Management within the DOE	63.21(c)(22)(i)	Section 2.5.3.1.3: Acceptance Criterion 1 Acceptance Criterion 2(1)
5.3.2	Key Positions Assigned Responsibility for Safety and Operations at the Site	63.21(c)(22)(ii)	Section 2.5.3.2.3: Acceptance Criterion 1 Section 2.5.3.3.3: Acceptance Criterion 9
5.3.3	Personnel Qualification and Training Requirements	63.21(c)(22)(iii) 63.151 63.152	Section 2.1.1.2.3: Acceptance Criterion 1(4) Section 2.5.3.3.3: Acceptance Criterion 1 Acceptance Criterion 2 Acceptance Criterion 3(1) Acceptance Criterion 3(2) Acceptance Criterion 3(3) Acceptance Criterion 3(5) Acceptance Criterion 3(6) Acceptance Criterion 4(1) Acceptance Criterion 4(3) Acceptance Criterion 5(2)
5.3.4	Basis and Objectives for Training	63.21(c)(22)(iii) 63.151 63.152	Not applicable
5.3.5	Organization of Instruction Using Lesson Plans and Other Training Guides	63.21(c)(22)(iii) 63.151 63.152	Not applicable
5.3.6	Evaluation of Trainee Learning	63.21(c)(22)(iii) 63.151 63.152	Not applicable
5.3.7	Conduct of On-the-Job Training	63.21(c)(22)(iii) 63.151 63.152	Not applicable

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.3.8	Evaluation of Training Effectiveness	63.21(c)(22)(iii) 63.151 63.152	Section 2.5.3.3.3: Acceptance Criterion 8
5.3.9	Personnel Qualification and Certification	63.21(c)(22)(iii) 63.151 63.152	Section 2.1.1.2.3: Acceptance Criterion 1(4) Section 2.5.3.3.3: Acceptance Criterion 4(2) Acceptance Criterion 5
5.3.10	Periodic Work Performance Evaluations	63.21(c)(22)(iii) 63.151 63.152	Section 2.5.3.3.3: Acceptance Criterion 5
5.3.11	Physical Condition and General Health of Operations Personnel	63.21(c)(22)(iii) 63.153	Section 2.5.3.3.3: Acceptance Criterion 6
5.3.12	Methods for Selecting, Training, and Qualifying Security Guards	63.21(c)(22)(iii)	Section 2.5.3.3.3: Acceptance Criterion 7

5.3.1 Organizational Structure of the Office of Civilian Radioactive Waste Management within the DOE

[NUREG-1804, Section 2.5.3.1.3: AC 1(1), AC 2(1)]

The DOE Office of Civilian Radioactive Waste Management (OCRWM) was established in 1983 pursuant to the Nuclear Waste Policy Act of 1982, as amended (42 U.S.C. 10101 et seq.), to develop and manage a federal system for the disposal of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) in a geologic repository. As the applicant and license holder, the DOE has the responsibility for the construction and safe operation of the repository.

The Director of OCRWM is the authorized DOE representative with the authority and responsibility for compliance with the construction authorization and the license to receive and possess SNF and HLW. The Director of OCRWM carries out his responsibilities through an experienced and qualified management team and provides clear roles, responsibilities, accountabilities, and authorities to that team. The management team ensures effective implementation of management systems that comply with quality assurance (QA) and other applicable regulatory requirements.

The Director of OCRWM will create and maintain an organization with management positions staffed by competent, experienced, and qualified individuals to fulfill the delineated responsibilities. Section 5.3.1.2 provides a functional description of the management organization and specific responsibilities of personnel who will be in place at a time appropriate to support repository construction and subsequent operations.

The Director of OCRWM is responsible for the execution of policies, plans, and procedures that ensure acceptable performance of repository activities in accordance with the Quality Assurance Program (Section 5.1). In addition, the Director of OCRWM has management responsibilities and approval authority to define program requirements and performance objectives for the activities under management control.

DOE personnel, contractors, vendors, and other federal agencies (e.g., the U.S. Geological Survey) will be assigned responsibility and authority by OCRWM to carry out the licensee responsibilities. Authority for carrying out these responsibilities and implementing applicable licensee requirements by other than DOE personnel will be defined and controlled by OCRWM contracts or by formal agreement with other federal agencies. For example, scopes of work, such as the design, construction, and operation of the facilities, will be assigned to contractors and vendors that provide specific expertise and capabilities. Responsibility and authority for work executed by contractors, vendors, and other federal employees affecting activities important to safety (ITS) or important to waste isolation (ITWI) will be performed under the terms of the license and consistent with the Quality Assurance Program. The DOE provides oversight of contracts and work activities associated with the contracts through DOE contract management processes, QA audits, programmatic controls, and the day-to-day review of field activities by the facility or project organization.

The OCRWM functional organizational structure anticipated at the time of repository construction and operations is shown in Figure 5.3-1. This figure illustrates the functional responsibilities of OCRWM and the reporting relationships within OCRWM. The organizational structure indicates the principal lines of communication and control of activities associated with the design, construction, and operation of the repository. In carrying out its license responsibilities, OCRWM will maintain technical capabilities through a combination of DOE employees and contractors.

To ensure appropriate, qualified staff members are available for key positions at all times, a procedure for delegating authority in routine and emergency situations will be developed as discussed in Section 5.3.1.4.

Personnel, including those identified as holding key positions, may be located either on site or off site. In this section, personnel located at the repository are referred to as being located "on site." Personnel located away from the repository (e.g., in Las Vegas; Washington, D.C.; or elsewhere) are referred to as being located "off site."

In future revisions to the license application, prior to receipt of a construction authorization and again prior to receipt of a license to receive and possess SNF and HLW, the DOE will indicate which key positions will be filled by DOE personnel and which positions will be filled by contractor personnel. Those revisions will also provide the address of the office of record for each entity in the organization that provides a key onsite or offsite position, a point of contact, and a telephone number, fax number, and e-mail address. The DOE will address changes to the above information, including changes to the organizational structure and managerial functions shown in Figure 5.3-1, through the license application revision process to keep the U.S. Nuclear Regulatory Commission (NRC) apprised of changes to the organization throughout construction and operation of the repository.

5.3.1.1 Organizational Structure of the Office of Civilian Radioactive Waste Management within the DOE during Construction and Operations

[NUREG-1804, Section 2.5.3.1.3: AC 1(1)]

This section describes the organizational structure as it is anticipated to exist at the time of repository construction and operation. As the repository nears startup testing and eventual licensed

operation, the focus of the organization will expand from construction to construction and operations. When construction is completed on repository systems, the systems will undergo testing, as required by procedure, as part of the transition to operations. When construction testing is complete on a particular system, control will be turned over to the Startup organization to conduct startup testing. After turnover of portions of the facility from the Startup organization to the Operations organization, construction activities conducted in preclosure-controlled areas or on systems turned over to the Operations organization will require prior approval by the Operations organization before the activities can start and the staffing levels and responsibilities will change accordingly.

The organization described in this section will transition into place over time in order to manage activities as repository construction and operation progress. For example, the engineering and licensing positions will be in place to manage necessary activities early in the project. Personnel responsible for the operational aspects, such as site protection, startup, and operations, will perform preparatory actions during the construction phase in order to carry out those responsibilities at the appropriate time. However, the Site Operations Manager, who will be in charge of both construction and operations, will be on site prior to receipt of a construction authorization. Likewise, the Engineering and Construction Manager and staff will be on site prior to receipt of a construction authorization. The Quality Assurance Program will be updated to reflect evolving QA requirements as these transitions in the repository phases occur, including any required changes in organizational responsibility as indicated in NUREG-1804, Section 2.5.3.1.3, Acceptance Criteria 1 and 2.

5.3.1.2 Management Functions and Responsibilities of the Office of Civilian Radioactive Waste Management within the DOE during Construction and Operations

[NUREG-1804, Section 2.5.3.1.3: AC 1(1)]

This section describes the positions responsible for the design, construction, and operation of the repository. The repository will be staffed at sufficient levels prior to operations to allow for the training of personnel, procedure development, and other preoperational activities. The responsibilities, authorities, and lines of communications for each key position are provided in this section. Responsible managers have the authority to assign tasks to other individuals reporting to them, but these managers retain the accountability for assigned tasks.

Key positions may be held by either DOE employees or contract employees to ensure that employees occupying these positions have acceptable experience and qualifications. Contractor personnel filling positions will have assigned roles, responsibility, authorities, and accountabilities clearly stated in contracts written in compliance with QA requirements and procedures. Personnel in these positions will have at least the minimum levels of education and experience described in Section 5.3.2.

5.3.1.2.1 Director of the Office of Civilian Radioactive Waste Management

The Director of OCRWM will be located off site. The Director is responsible for budget preparation and defense in order to ensure that adequate funds are available to construct and operate the repository in a manner consistent with applicable regulations and license conditions. The Director carries out his technical responsibilities through an experienced and qualified management team

(Figure 5.3-1). The Director delineates clear roles, responsibilities, accountabilities, and authorities for that team, which will ensure implementation of management systems through procedures that comply with the Quality Assurance Program and applicable regulatory requirements. These management controls will be implemented by experienced and qualified key managers. Safety decisions will be made on the authority granted in the responsibilities and accountabilities of the organization in accordance with procedures implemented by experienced and qualified personnel. The Director has three direct reports: the Quality Assurance Manager, the Site Operations Manager, and the Executive Advisory Board.

Executive Advisory Board—The Executive Advisory Board will be a senior, executive-level committee that will provide the Director with advice on matters related to policy, site operations, and personnel management. Members will have nuclear facility management experience or other relevant experience. Members will be appointed by the Director.

Key Staff—The organization discussed below describes the key staff supporting design, construction, and operations:

- Site Operations Manager
- Quality Assurance Manager
- Engineering and Construction Manager
- Licensing Manager
- Postclosure Performance and Confirmation Manager
- Site Protection Manager
- Radiation Protection Manager
- Operations Manager.

In the absence of the Director, the Deputy Director will fulfill the responsibilities of the Director.

5.3.1.2.2 Site Operations Manager

The Site Operations Manager is a key manager who will be located on site and will report to the Director of OCRWM and will be responsible for the management of repository construction and operations. The Site Operations Manager will be supported by the Onsite Safety Committee (Section 5.3.1.5). As the Chief Nuclear Officer, the Site Operations Manager ensures that the geologic repository operations area (GROA) will be constructed and operated in such a manner that the health and safety of workers and the public will be protected. The Site Operations Manager ensures that nuclear operations and maintenance, and repository facilities will be operated in accordance with the license. The Site Operations Manager ensures that the operations and maintenance resources will be appropriately prioritized and allocated. After receipt of the license to receive and possess SNF and HLW, the Site Operations Manager will be the senior manager in charge of onsite licensed operations and activities and lines of communications and safety decisions regarding operations. The Site Operations Manager will specifically address management of the interface between receipt, processing, and storage of SNF and HLW and continuing site construction activities. The Site Operations Manager also will be responsible for

various feedback programs, such as corrective actions, self-assessments, benchmarking, and human performance. The Site Operations Manager will have the following direct reports:

- Engineering and Construction Manager
- Licensing Manager
- Postclosure Performance and Confirmation Manager
- Site Protection Manager
- Radiation Protection Manager
- Operations Manager.

5.3.1.2.3 Quality Assurance Manager

The Quality Assurance Manager will be located on site and is a key manager who will report to the Director. The Quality Assurance Manager fulfills the QA role, independent of other key managers, including those responsible for design, construction, and operations activities. The Quality Assurance Manager is responsible for the development and maintenance of the Quality Assurance Program and the QA oversight of activities related to structures, systems, and components (SSCs) ITS or ITWI. The line managers and their staffs who will be responsible for performing quality-affecting work will be responsible for implementation of and compliance with the requirements of the Quality Assurance Program.

Site Quality Manager—The Site Quality Manager will be located on site and is a key manager who will report to the Quality Assurance Manager. The Site Quality Manager directs the onsite QA activities, independent of other key managers, including those responsible for design, construction, and operations activities. The Site Quality Manager provides inspection services to the Project Construction Manager during construction and to the Waste Handling Manager during operations.

5.3.1.2.4 Engineering and Construction Manager

The Engineering and Construction Manager will be located on site and is a key manager who will report to the Site Operations Manager. The Engineering and Construction Manager will be responsible for ensuring that overall project-level management and integration for engineering and construction are performed safely and in compliance with the construction authorization and, subsequently, the license to receive and possess SNF and HLW. A Project Engineering Manager and a Project Construction Manager will report to the Engineering and Construction Manager. These managers will ensure that regulatory compliance is achieved during design and construction. The Engineering and Construction Manager will ensure that the engineering and construction resources and priorities will be appropriately allocated to meet budget and schedule guidelines. The Engineering and Construction Manager will be responsible for configuration management on the design and construction side of the repository and for ensuring that the design basis of the repository will be satisfied. After receipt of the license, the Engineering and Construction Manager will continue to exercise the above responsibilities for ongoing construction.

Project Engineering Manager—The Project Engineering Manager is a key manager who will be located on site and will report to the Engineering and Construction Manager. The Project Engineering Manager will direct design and engineering management activities to ensure these

activities meet applicable regulations. This manager will be responsible for managing the engineering and design interface with construction for the surface and subsurface activities ITS or ITWI. These activities include construction and installation of mechanical, electrical, structural, and instrumentation components and the control of SSCs to ensure that the design bases will be maintained. This manager will have the day-to-day responsibility to manage, develop, and implement processes and programs, including the issuance of procedures, that ensure the repository, and any modifications thereto, will be designed safely and in accordance with the Quality Assurance Program and applicable NRC regulations.

Facility Project Manager—The Facility Project Manager reports to the Project Engineering Manager and will be located on site. The Facility Project Manager will be responsible for ensuring that the surface handling facilities and the underground facility are designed in accordance with design and regulatory requirements. Facility project engineers assist the Facility Project Manager to ensure activities are conducted in accordance with design and regulatory requirements and that the design bases are maintained.

Project Construction Manager—The Project Construction Manager is a key manager who will be located on site and will report to the Engineering and Construction Manager. The Project Construction Manager will provide direction to construction management to ensure construction activities meet applicable regulations. This manager will have the day-to-day responsibility to manage, develop, and implement processes and programs, including the issuance of procedures, to ensure that the repository will be constructed safely and in accordance with the Quality Assurance Program and applicable NRC regulations.

5.3.1.2.5 Licensing Manager

The Licensing Manager is a key manager who will report to the Site Operations Manager and will be located off site. This individual will interface with the NRC and other regulatory agencies, as necessary. The Licensing Manager will be responsible for the integration of regulatory activities and requirements within OCRWM to confirm compliance with NRC requirements. In addition, the Licensing Manager is responsible for preparing submittals to the NRC, including routine reporting to the NRC and updates to the license application. This manager will be responsible for maintaining environmental permits. The Licensing Manager will also be responsible for reporting events to the NRC in accordance with NRC regulations. Key aspects of this manager's responsibilities will include regulatory interactions, support of NRC inspections, and the development, maintenance, and implementation of the Commitment Management Program and the Regulatory Reporting Program.

The Licensing Manager will be responsible for maintaining and updating the Safety Analysis Report with approved repository changes and updates resulting from the data gathered and evaluated from the ongoing natural and engineered testing programs during construction and the Performance Confirmation Program.

5.3.1.2.6 Postclosure Performance and Confirmation Manager

The Postclosure Performance and Confirmation Manager is a key manager who will be located off site, who will report to the Site Operations Manager, and who will be responsible for management

of the total system performance assessment and for implementing and evaluating the results from the Performance Confirmation Program. The Postclosure Performance and Confirmation Manager will be responsible for ensuring that natural and engineered system testing in support of the design and postclosure safety analyses is conducted appropriately and will review the results of such testing (Section 4). The Postclosure Performance and Confirmation Manager will also advise the Site Operations Manager on matters related to science and science–engineering interfaces.

5.3.1.2.7 Site Protection Manager

The Site Protection Manager is a key manager who will be located on site, will report to the Site Operations Manager, and will be responsible for developing and maintaining the physical security of the site, the Waste Material Control Program, and the emergency preparedness program in accordance with the license. The Site Protection Manager will ensure the appropriate prioritization and integration of activities among physical protection, material control and accounting, and emergency preparedness and their implementation on a sitewide basis.

The Site Protection Manager will have the following direct reports:

- Physical Protection Manager
- Waste Material Control Manager
- Emergency Preparedness Manager.

Physical Protection Manager—The Physical Protection Manager is a key manager who will be located on site, will report to the Site Protection Manager, and will be responsible for implementing the physical security of the repository during operations. The Physical Protection Manager will ensure that the physical protection activities are carried out in accordance with the license.

Waste Material Control Manager—The Waste Material Control Manager is a key manager who will be located on site, will report to the Site Protection Manager, and will be responsible for implementing the Material Control and Accounting Program once waste is accepted for handling at the repository. The Waste Material Control Manager will ensure that material accounting activities are carried out in accordance with the license.

Emergency Preparedness Manager—The Emergency Preparedness Manager is a key manager who will be located on site, will report to the Site Protection Manager, and will be responsible for implementing the Emergency Plan to ensure emergency preparedness at the repository and surrounding area during operations. This manager will also be responsible for interactions with local and state authorities, as well as federal agencies, in accordance with the Emergency Plan. The Emergency Preparedness Manager will ensure that emergency activities, including drills, are carried out in accordance with the license.

5.3.1.2.8 Radiation Protection Manager

The Radiation Protection Manager is a key manager who will be located on site and will report to the Site Operations Manager. This manager will be responsible for the conduct of day-to-day development, management, and implementation of processes and programs, including the issuance

of procedures, associated with the Radiation Protection Program. The Radiation Protection Manager will ensure that sufficient personnel will be available to implement the Radiation Protection Program in compliance with applicable procedures, the Quality Assurance Program, and NRC regulatory requirements. This manager's duties will include development of radiation protection training based on a systematic approach to the training process, training personnel in the use of radiation control equipment, controlling radiation exposure of personnel, and conducting the Radiological Environmental Monitoring Program.

This manager will be independent of the Operations Manager to ensure objective radiation protection surveillance, review, and control activities. During emergency conditions, the Radiation Protection Manager's duties will also include:

- Providing emergency center personnel information and recommendations concerning radiation levels at the repository
- Gathering and compiling onsite and offsite radiological monitoring data
- Making recommendations concerning onsite and offsite protective actions deemed necessary for limiting radiological exposures to repository personnel and members of the general public
- Coordinating decontamination activities.

5.3.1.2.9 Operations Manager

The Operations Manager is a key manager who will be located on site and will report to the Site Operations Manager. The Operations Manager will have direct responsibility for work control, criticality safety, startup activities, training, maintenance, and the conduct of operations for GROA nuclear and balance of plant facilities, including fire protection and review and approval of maintenance procedures. The Operations Manager will also be responsible for activities supporting the waste acceptance function.

Work Control Manager—The Work Control Manager is a key manager who will be located on site and will report to the Operations Manager. The Work Control Manager will be responsible for coordinating, prioritizing, and scheduling all work activities during both operations and outages.

Criticality Safety Manager—The Criticality Safety Manager is a key manager who will be located on site and will report to the Operations Manager. The Criticality Safety Manager will be responsible for developing and overseeing the adequacy of the implementation of the nuclear criticality safety programs. To ensure objective criticality audit, review, and control activities, the Criticality Safety Manager is independent of the Waste Handling Manager.

Startup Manager—The Startup Manager is a key manager who will be located on site and will report to the Operations Manager. The Startup Manager will be responsible for planning, directing, scheduling, and conducting startup testing activities. The Startup Manager will coordinate with the Waste Handling Manager and the Test Review Board to ensure that comprehensive test plans are developed and that testing results are satisfactory (Section 5.5)

Waste Handling Manager—The Waste Handling Manager is a key manager who will be located on site and will report to the Operations Manager. After receipt of the license to receive and possess SNF and HLW, the Waste Handling Manager will be responsible for the day-to-day handling and disposal of waste and for monitoring of nuclear operations in accordance with the terms of the license, regulatory requirements, and the Quality Assurance Program.

A Waste Handling Manager will be assigned to each rotating shift when waste handling activities are planned or conditions exist that would require such a presence.

The Waste Handling Manager will also be responsible for ensuring that SSCs ITS or ITWI will be operated safely. The Waste Handling Manager will be responsible for developing and implementing lockout and tag-out procedures and for approving waste handling procedures (Section 5.6). The Waste Handling Manager will ensure that the design basis will be maintained for the repository. The Waste Handling Manager will have the following functional responsibilities:

- Hot testing as a component of initial startup operations
- Waste handling operations
- Implementation of criticality safety measures.

Shift Manager—The Shift Manager is a key manager who will be located on site and will report to the Waste Handling Manager. The Shift Manager will have direct responsibility for the conduct of operations, including preparation and implementation of waste handling procedures. The Shift Manager will be responsible for ensuring safe operations, maintaining procedures, and keeping operator certifications and qualifications current. The Shift Manager will be responsible for the conditions of SSCs ITS or ITWI, as well as achieving the standard for conduct of operations. The Shift Manager will have overall operations responsibility when the Operations Manager and the Waste Handling Manager are not on site.

Training Manager—The Training Manager will be located on site and will report to the Operations Manager. The Training Manager will interface with the Engineering and Construction Manager, the Licensing Manager, the Postclosure Performance and Confirmation Manager, the Site Protection Manager, the Radiation Protection Manager, and the Operations Manager, and their personnel. The Training Manager will be responsible for developing and maintaining training programs for all aspects of repository construction and operations, including general employee training. The Training Manager will also be responsible for maintaining training records in accordance with the records management system.

Maintenance Manager—The Maintenance Manager will be located on site and will report to the Operations Manager. The Maintenance Manager will have responsibility for planning, directing, and scheduling maintenance activities within the assigned facility to ensure proper operation of the facility, including preparation and implementation of maintenance procedures. This responsibility includes activities to repair, perform equipment preventive maintenance on, implement reliability-centered maintenance processes for, and test the systems and components to ensure that they are functioning as specified in design documents.

5.3.1.3 DOE Points of Contact

[NUREG-1804, Section 2.5.3.1.3: AC 1(2)]

Director of the Office of Civilian Radioactive Waste Management—U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, D.C. 20585. Telephone: (202) 586-6842. Fax: (202) 586-6638. Additional points of contact will be provided later.

5.3.1.4 Procedure for Delegation of Authority

[NUREG-1804, Section 2.5.3.1.3: AC 2(1)]

The Site Operations Manager will develop a procedure for delegating authority for positions that have the responsibility to act in routine and emergency situations. The procedure will be developed prior to waste receipt and will address the minimum staffing requirements for each shift. The procedure will make clear that there is always a qualified individual on site with the responsibility and authority to make decisions in safety-related matters, even during periods of suspended operations. The procedure will also address the following considerations:

- Authority to issue "stop work" directives and declare a site emergency condition
- Essential services (to be defined in the procedure) for repository operations, operations support, and security functions for shift crews
- Minimum staffing requirements for normal operations and for off-normal and emergency situations
- The processes for ensuring that minimum staffing requirements are met
- Minimum experience and skills necessary for key positions when delegating.

The procedure will be revised, as necessary, to reflect changes in organizational structure and project phases.

5.3.1.5 Responsibilities of the Onsite Safety Committee

[NUREG-1804, Section 2.5.3.1.3: AC 1(1)]

The Onsite Safety Committee is a multidiscipline team comprised of repository managers who are responsible for advising the Site Operations Manager regarding activities ITS or ITWI that could impact workers, public safety, and the environment. These responsibilities include but are not limited to:

- Evaluating performance indicators relating to safety and operations
- Evaluating procedures and proposed changes to safety procedures related to 10 CFR 63.44, as deemed appropriate by the Site Operations Manager (Section 5.6.1)
- Evaluating significant conditions adverse to quality and selected root cause evaluations

- Evaluating human performance statistics and indicators
- Evaluating reportable events.

The scope of activities of the Onsite Safety Committee includes but is not limited to:

- Radiation protection, including the policy on keeping doses as low as is reasonably achievable (ALARA)
- Nuclear and criticality safety
- Industrial safety
- Administrative procedures
- Fire protection
- Environmental protection
- Proposed changes to repository design or operations.

The combined experience and knowledge the Onsite Safety Committee will include expertise in the following areas:

- Operations
- Engineering
- Chemistry and radiochemistry
- Licensing
- Maintenance
- Radiological protection
- Environmental protection
- Administrative controls
- Training
- QA.

The Onsite Safety Committee shall be composed of at least five members, including a chairman. The chairman, members, and alternate members of the Onsite Safety Committee shall be appointed by the Site Operations Manager. They shall have accredited degrees in engineering or physical science fields and a minimum of 5 years of technical experience.

The Onsite Safety Committee shall meet as needed and at least once per calendar quarter. The committee will meet at least once prior to waste receipt.

5.3.2 Key Positions Assigned Responsibility for Safety and Operations at the Site
[NUREG-1804, Section 2.5.3.2.3: AC 1; Section 2.5.3.3.3: AC 9]

This section identifies key positions responsible for safety and operations, including construction activities that take place during the operational phase. The DOE will place only experienced and qualified personnel in key management positions throughout the operating life of the facility.

Using general functional titles, key management positions are identified in this section, along with the minimum education requirements and experience levels required for personnel filling these positions. On a case-by-case basis, additional relevant experience may be substituted for educational requirements. Such substitution will be approved by the line manager and documented in personnel files, as appropriate. The names of specific individuals who meet these requirements are not included in this initial submittal; however, as positions are filled, the NRC may review the qualifications of assigned managers against the minimum requirements stated in this section. Alternates, qualified to act in the absence of individuals assigned to the key management positions, also will meet or exceed the minimum education and experience requirements.

5.3.2.1 General Functional Titles and Required Qualifications for Key Positions
[NUREG-1804, Section 2.5.3.2.3: AC 1(1)]

Although workers will have responsibilities for the safe operation of the facilities, the following sections provide the minimum qualifications for the key personnel who will have management responsibility for the safe operation of the repository. The organizational structure is discussed in Section 5.3.1. Some of these position titles are used during both the construction phase and the operational phase concurrent with ongoing construction.

5.3.2.1.1 Site Operations Manager

The minimum qualifications for this position are a bachelor's degree in engineering, a combined 8 years of experience in nuclear engineering or operations, and 4 years of supervisory or management experience. The Site Operations Manager must have nuclear facility knowledge consistent with the requirements of a nuclear facility manager, or must have been certified in nuclear facility operations.

5.3.2.1.2 Quality Assurance Manager

The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline; 6 years of QA-related experience, which includes 4 years of nuclear experience; 2 years of supervisory or management experience; and 1 year of experience performing quality verification activities.

Site Quality Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related science, 4 years of nuclear experience related to QA, and 1 year of supervisory or management experience.

5.3.2.1.3 Engineering and Construction Manager

The minimum qualifications for this position are a bachelor's degree in engineering, a combined 8 years of experience in nuclear design and operations, 3 years of construction management experience, and 2 years of supervisory or management experience.

Project Engineering Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 6 years of experience in technical and design activities for nuclear facilities, and 3 years of supervisory or management experience.

Facility Project Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 5 years of experience in technical and design activities for nuclear facilities, and 2 years of supervisory or management experience.

Project Construction Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, 8 years of experience in nuclear design and operations, and 3 years of construction management experience.

5.3.2.1.4 Licensing Manager

The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, 8 years of experience in nuclear facility licensing and regulatory compliance, and 3 years of supervisory or management experience.

5.3.2.1.5 Postclosure Performance and Confirmation Manager

The minimum qualifications for this position are a bachelor's degree in science or engineering science, a combined 4 years of technical and Yucca Mountain programmatic experience, and 1 year of supervisory or management experience.

5.3.2.1.6 Site Protection Manager

The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combination of 5 years of experience in nuclear facility physical protection or material accounting and emergency preparedness, and 3 years of management experience.

Physical Protection Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline and 5 years of experience in managing nuclear facility physical protection programs.

Waste Material Control Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline and 5 years of experience in managing nuclear material accounting programs.

Emergency Preparedness Manager—The minimum qualifications for this position are 5 years of experience in the implementation of emergency plans and procedures at a nuclear facility.

5.3.2.1.7 Radiation Protection Manager

The minimum qualifications for this position are a bachelor's degree in science, health physics, or engineering; a combined 6 years of experience in the radiological protection aspects of nuclear facility design and operations; and 3 years of supervisory or management experience.

5.3.2.1.8 Operations Manager

The minimum qualifications for this position are a bachelor's degree in engineering, 8 years of experience in nuclear engineering or operations, and 4 years of supervisory or management experience. The Operations Manager must have nuclear facility knowledge consistent with the requirements of a nuclear facility manager, or must have been certified in nuclear facility operations.

Work Control Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 6 years of experience in work control and nuclear operations, and 3 years of supervisory or management experience.

Criticality Safety Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 6 years of experience in the criticality safety aspects of nuclear facility design and operations, and 3 years of supervisory or management experience.

Startup Manager—The minimum qualifications for this position are 6 years of experience in nuclear facility design or startup and operations and 3 years of supervisory or management experience.

Waste Handling Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 6 years of experience in nuclear facility design and operations, and 3 years of supervisory or management experience. In addition, the Waste Handling Manager must have been certified as a waste handler supervisor or have waste handling knowledge consistent with the requirements of the repository Operations Manager.

Shift Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 4 years of experience in nuclear facility design and operations, and 3 years of supervisory or management experience. In addition, the Shift Manager must have been certified as waste handler supervisor or have waste handling knowledge consistent with the requirements of a Waste Handling Manager.

Training Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, 6 years of experience in nuclear facility training, and 3 years of supervisory or management experience.

Maintenance Manager—The minimum qualifications for this position are a bachelor's degree in engineering or a related discipline, a combined 6 years of experience in nuclear facility design and operations, and 3 years of supervisory or management experience.

5.3.3 Personnel Qualification and Training Requirements

[NUREG-1804, Section 2.1.1.2.3: AC 1(4); Section 2.5.3.3.3: AC 1, AC 2, AC 3(1), (2), (3), (5), (6), AC 4(1), (3), AC 5(2)]

In accordance with 10 CFR 63.21(c)(22)(iii), this section describes the Training Program for the operational phase of the repository, as well as preoperational, functional, and initial startup testing. Training requirements will apply to personnel engaged in operation, maintenance, testing, or other activities of the repository SSCs ITS or ITWI. General employee training will be given to those employees at the repository who are permitted inside the GROA without a full-time escort. As noted in Section 2.5.3.3 of NUREG-1804, an NRC-approved Personnel Qualification and Training Program for the repository is not required to be in place at the time of issuance of the construction authorization but will be in place to support receipt of waste.

The Quality Assurance Program provides training and qualification requirements during the design and construction phases for:

- QA training of personnel performing QA work activities relating to SSCs ITS or ITWI
- Nondestructive examination, inspection, and test personnel
- QA auditors.

Training for QA personnel performing operational activities will be described in an update to the Quality Assurance Program for the operations phase, which will be submitted in advance of receipt of waste.

The principal objective of the Qualification and Training Program is to ensure the job proficiency of repository personnel. The program is designed to support the phased startup of facilities and satisfy commitments with established regulations and standards.

Qualification and certification will be obtained by the successful completion of prescribed training and demonstration of the ability to satisfactorily perform assigned tasks for the worker classification being evaluated. Training is designed, developed, and implemented according to a systematic approach, as described in ANSI/ANS-3.1-1993, *American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants*, and will consider recent experience of the employee. Employees will be provided with formal training to establish the knowledge and skills (through on-the-job training and classroom instruction) necessary to fulfill their assigned tasks. Continuing training is provided, as required, to maintain proficiency in these knowledge and skill components and to update skills to match changes in procedures, job tasks, or the repository design.

Formal, documented training programs will be established for personnel assigned to the repository. The training programs shall include methods for verifying training effectiveness, such as written tests and actual demonstration of skills. Changes to training will be implemented if necessary because of incidents potentially compromising safety or if changes are made to facilities or processes.

Training programs will include general employee training, provided within 30 days of reporting to work, consisting of safety preparedness for all safety disciplines (criticality, radiological, chemical,

and industrial); training for practices in keeping doses ALARA; training on emergency procedures; and specific training on in-depth technical subjects, depending on job requirements, in the areas of radiological safety, criticality safety control, and repository operations and maintenance. Nuclear criticality safety training will be consistent with ANSI/ANS-8.20-1991, *American National Standard for Nuclear Criticality Safety Training*. Personnel will be retrained for radiological and criticality safety at least annually; training will include updates to reflect changes in programs or the repository and performance of required skills.

The training programs and maintenance of the training programs at the repository will be the responsibility of the Training Manager, who reports to the Operations Manager. Accurate training records are maintained on each employee's qualifications, certifications, experience, training, and retraining. Training records are retained in accordance with the records management system.

The line manager will be responsible for ensuring that before personnel perform activities or operate controls that are ITS or ITWI they are trained and certified or operate only under the direct visual supervision of an individual trained and certified in such operations. The line manager will review and approve the training program applicable to the manager's employees and ensure the training provides the skills and knowledge necessary for the employee to perform assigned activities in a quality manner.

The training and certification program will be implemented in time to provide the required training and certification of personnel before work activities that require training and certification are performed. This responsibility will require the training and certification program to be implemented in stages, with applicable portions of the program in place prior to receipt of SNF or HLW, so that trained and certified personnel can receive this material. The Repository Training and Certification Program Plan will be submitted to the NRC in a timely manner to facilitate NRC approval prior to receipt of SNF or HLW.

5.3.3.1 Organization and Management of the Training Function

Line managers will be responsible for the content and effective conduct of training for their personnel. Training responsibilities for line managers will be included in position descriptions, and line managers will be given the authority to implement training for their personnel. The training organization will provide support to line managers by ensuring that the planning, direction, analysis, development, conduct, evaluation, and control of training are performed in accordance with a systematic performance-based process. A systematic approach to training, similar to that discussed in ANSI/ANS-3.1-1993, will be used for analyzing, designing, developing, conducting, and evaluating training.

Repository administrative procedures will establish the requirements for indoctrination and training of personnel working on SSCs ITS or ITWI. Line managers will ensure that the training program is conducted in a reliable and consistent manner throughout the areas of training.

Lesson plans will be used for classroom and on-the-job training. When design changes or modifications to repository operations or facilities are implemented, updates to applicable training materials will be included in the change control process.

5.3.3.2 Analysis and Identification of Functional Areas Requiring Training

A needs and job analysis will be performed and tasks will be identified to ensure that appropriate training is developed and provided to personnel working on tasks ITS or ITWI.

The training organization will be capable of training initial and replacement personnel for safe, reliable, and efficient operation of the repository. Appropriate training for personnel of various abilities and experience backgrounds will be provided. The level at which an employee initially enters the training program will be determined by an evaluation of the employee's past experience, level of ability, and qualifications.

5.3.3.2.1 General Employee Training

General employee training encompasses QA, radiation protection, safety, emergency preparedness, and administrative procedures as established by repository management and applicable regulations. Continuing training will be conducted in these areas as necessary to maintain employee proficiency. Persons under the supervision of the repository management, including contractors, will participate in general employee training; however, certain repository support personnel, depending on their normal work assignment, might not participate in all topics of this training. Temporary personnel will receive general employee training to the extent necessary to ensure personal safety and safe performance of their duties. The program will be developed consistent with guidance in Regulatory Guide 1.8 and ANSI/ANS-3.1-1993.

Typical general employee training topics include:

- General administrative controls and procedure use
- QA policies and procedures
- General description of repository and equipment
- Radiation safety (e.g., use of dosimetry, protective clothing, and procedures)
- Industrial safety
- Emergency plan and procedures
- Repository security
- Fire protection
- Fitness for duty
- New employee orientation.

Personnel assigned to the repository who are not expected to receive occupational radiation doses will be trained in radiation protection and the safety considerations that preclude their entry into posted (restricted) areas.

5.3.3.2.2 Radiation and Criticality Training

Training programs will be established for job positions (such as operators, radiation protection technicians, and contractor personnel) commensurate with the criticality potential or radiation safety responsibilities associated with each position. Visitors to a restricted area will be trained in the formal training program or will be escorted by trained personnel while in the area. Procedures and policies will be used to ensure completion of formal training prior to granting unescorted access

to restricted areas. The radiation protection training will be consistent with recommendations in ASTM E 1168-95, *Standard Guide for Radiological Protection Training for Nuclear Facility Workers*, and applicable guidance in Regulatory Guides 8.8, 8.27, and 8.29. In accordance with 10 CFR 19.12, individuals who, in the course of their employment, are likely to receive yearly occupational doses in excess of 100 mrem will receive this training. Additional details on the radiation protection training programs are described in Section 5.11.3.7.

Typical topics to be covered in radiation and criticality training include:

- Practices of keeping doses ALARA
- Contamination control practices and limits
- Principles of criticality hazard control
- Use of personnel monitoring equipment
- Emergency procedures
- The nature and sources of radiation, including GROA-specific radiological hazards
- Biological effects of radiation
- Principles of nuclear criticality safety
- Risk to pregnant females
- Radiation protection practices
- Protective clothing
- Respiratory protection
- Repository access and visitor control.

The effectiveness of the training programs will also be evaluated by audits and by assessment personnel responsible for implementing the requirements related to the topics listed above.

5.3.3.2.3 Technical Training

Technical training will be designed, developed, and implemented to provide repository employees with an understanding of applicable installation, design, and operating fundamentals; procedures; emergency procedures; and job practices at the operating repository. Technical training will also be used to develop the skills necessary to perform assigned work in a competent manner and in compliance with approved methods and procedures.

Typical components of technical training will include:

- Fundamentals training
- Worker classification-specific training
- On-the-job training and qualifications
- Continuing training
- Special training.

Technical training will be developed to provide an understanding of basic scientific principles, systems, and procedures used in work activities. This training may consist of live lectures, taped or filmed lectures, self-guided study, demonstrations, and on-the-job training.

Technical training and qualification programs will be developed for certain facility classifications such as operations and maintenance, as well as others as required by the systematic approach to training process and repository procedures. Training for each classification will be divided into logical modules and presented in such a manner that specific behavioral and learning objectives will be accomplished. Each classification will have tailored training, as identified through the application of the systematic approach to training. Trainee understanding will be evaluated by written examinations, oral tests, or practical tests. Technical training will encompass training from a basic understanding of systems and related sciences to the qualification of personnel who will require specific knowledge and skills to understand the design basis and operation of both individual systems and the integration of multiple systems. The culmination of technical training will lead to qualification or certification of personnel to perform work activities ITS or ITWI.

5.3.3.2.3.1 Fundamentals Training

Fundamentals training will include basic concepts and fundamentals in physics, chemistry, heat transfer, radiation protection, criticality protection, design features, and other knowledge and skill sets identified by the training program. This training will provide a general overview of Yucca Mountain equipment and familiarize the trainees with the terminology, conduct of operations, and nomenclature of the repository. Training will include familiarization and orientation with repository layout, systems, and equipment.

5.3.3.2.3.2 Worker Classification-Specific Training

After basic knowledge skills are established, additional comprehensive training in specific areas, as identified by application of the systematic approach to training, will be conducted on an employee activity-classification basis. The purpose of the worker classification-specific training will be to tailor training modules to the specific task and skills of the different classifications of employee activities associated with the operation of SSCs ITS or ITWI. Typical classifications include but will not necessarily be limited to:

- Operators
- Maintenance technicians (electrical, mechanical, and instrumentation)
- Radiation protection technicians
- Chemistry technicians
- Engineers and professionals.

Further definition of these specific training programs will be developed by application of the systematic approach to training process.

5.3.3.2.3.3 On-the-Job Training and Qualifications

On-the-job training will be a systematic method of providing training or evaluation of the required job-related skills and knowledge for a position. Applicable tasks and related procedures comprise the on-the-job training and qualifications program for each technical area and will be designed to supplement and complement other formal training. The objective of the program will be to ensure the trainee's ability to perform job tasks as described in the task descriptions and in the applicable training and qualification guides.

5.3.3.2.3.4 Continuing Training

Continuing training will be any training not provided as initial qualification and basic training that maintains or improves job-related knowledge, skills, and proficiencies. Examples of some continuing training subjects include:

- Repository systems and component changes
- On-the-job training and qualifications program retraining
- Policy and procedure changes
- Operating experience feedback programs
- Training identified to resolve deficiencies or reinforce seldom-used knowledge skills
- Quality Assurance Program awareness.

Continuing training will consist of formal and informal components performed on a frequency needed to maintain proficient job performance as determined by line managers. The continuing training program will be developed from a systematic approach, using information from job performance, industry experience, and other appropriate feedback as a basis for determining the content of the continuing training. Once the objectives of continuing training have been determined, the methods for conducting training will be designed to provide clear evidence of objective accomplishments and ensure consistency in delivery.

5.3.3.2.3.5 Special Training

Special training involves those subjects of a unique nature required for a particular area of work. Special training will be given to selected personnel based on specific needs.

5.3.4 Basis and Objectives for Training

Learning objectives identify the training content, as established by needs and job analyses, as well as position-specific requirements. The task list from the needs and job analysis will be used to develop action statements that describe the desired post training performance. Objectives include the knowledge, skills, and abilities the trainee should demonstrate; the conditions under which the required actions will take place; and the standards of performance the trainee should achieve upon completion of the training activity.

5.3.5 Organization of Instruction Using Lesson Plans and Other Training Guides

Lesson plans will be developed from the learning objectives that will be based on job performance requirements. Lesson plans and other training guides will be developed under the guidance of the training function, will be reviewed by the training organization, and will be generally reviewed by the organization cognizant of the subject matter. Lesson plans will be approved prior to issue or use; will be used for classroom training and on-the-job training, as required; and will include standards for evaluating acceptable trainee performance.

5.3.6 Evaluation of Trainee Learning

Trainee understanding and command of learning objectives will be evaluated through observation and demonstration, oral tests, or written tests, as appropriate. Such evaluations measure the trainee's skills and knowledge of job performance requirements.

5.3.7 Conduct of On-the-Job Training

On-the-job training will be used in combination with classroom training for activities that are ITS or ITWI. Designated personnel who are competent in the program standards and methods of conducting the training will conduct on-the-job training using current performance-based training materials. Completion of on-the-job training is demonstrated by task performance or performance of a simulation of the task with the trainee explaining task actions using the conditions encountered during the performance of the task, including references, tools, and equipment reflecting the actual task, to the extent possible.

5.3.8 Evaluation of Training Effectiveness

[NUREG-1804, Section 2.5.3.3.3: AC 8]

Periodically, the training program will be systematically evaluated to measure its effectiveness in producing competent employees. Effectiveness will be determined by comparison of actual training performance to established objectives and criteria. The trainees provide feedback after completion of classroom training sessions to provide data for this evaluation for program improvements. These evaluations identify program strengths and weaknesses, determine whether the program content matches current job needs, and determine whether corrective actions will be needed to improve program effectiveness. The training function will be responsible for leading the training program evaluations and for implementing any corrective actions.

Evaluation of the training program may address the following areas:

- Management and administration of training and qualification programs
- Performance of the training staff
- Design and development of training programs
- Conduct of training
- Trainee examinations and evaluations
- Event analysis
- Supervisory or management observation data.

Evaluation results will be documented, with program strengths and weaknesses being highlighted. Identified weaknesses will be reviewed, improvements will be recommended, and changes will be made to procedures, practices, or training materials, as necessary.

Periodically, training and qualification activities will be monitored by designated repository or contracted training personnel. QA personnel will audit the repository training and qualification system. Training activities will be evaluated at a frequency sufficient to determine program effectiveness.

5.3.9 Personnel Qualification and Certification

[NUREG-1804, Section 2.1.1.2.3: AC 1(4); Section 2.5.3.3.3: AC 4(2), AC 5]

The qualifications of key management personnel are described in Section 5.3.2. In addition, qualification and training requirements for personnel will be established and implemented in procedures. It will be the responsibility of each manager to ensure that only trained and certified personnel perform work that affects safety or waste isolation. Operations personnel who operate equipment or controls that are ITS or ITWI will be trained and certified or under the direct visual supervision of an individual who is trained and certified in the operations. Supervisory personnel who personally direct the operation of equipment or controls that are ITS or ITWI will be trained and certified in such operations.

Operators, supervisors, and other operating repository staff will successfully complete applicable training requalification programs at least every 2 years.

5.3.10 Periodic Work Performance Evaluations

[NUREG-1804, Section 2.5.3.3.3: AC 5]

Personnel performing activities relied upon for safety or waste isolation will be evaluated every 2 years to determine whether they are capable of continuing these activities. The evaluation will be a written test, an oral test, or an on-the-job performance evaluation. The results of the evaluation will be documented. When the results of the evaluation dictate that retraining or other remedial action is necessary, it will be provided. Retraining may also be required because of repository modifications, procedure changes, and Quality Assurance Program changes that result in new or revised information.

5.3.11 Physical Condition and General Health of Operations Personnel

[NUREG-1804, Section 2.5.3.3.3: AC 6]

The repository will establish requirements for the physical condition and general health of personnel who operate equipment or controls that are ITS or ITWI in accordance with applicable sections of Regulatory Guide 1.134. Medical evaluations will be conducted on such individuals. NRC Form 396 will be used for the certification of the physical examination. Guidance contained in ANSI/ANS-3.4-1996, *American National Standard for Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants*, with exceptions provided in Regulatory Guide 1.134, will be followed to certify that the fitness, physical condition, and general health of the individual are acceptable.

Individuals designated as operators of equipment or controls that are ITS or ITWI will have a physical examination by a licensed physician every 2 years. Observation of continued fitness for duty will be controlled by procedures and training of personnel. These procedures and training will include the information necessary to ensure that personnel who operate equipment or controls that are ITS or ITWI are capable of performing such duties without impairment. The procedures and training will include the authority for any trained individual to deny the right of a person to operate equipment or controls that are ITS or ITWI, should that person fail to meet the standards of fitness for duty.

Permanent conditions of individuals that could cause impaired judgment or motor coordination will be considered for accommodation by the physician performing the physical examination. Temporary conditions causing impaired judgment or motor coordination will be considered in the procedures as a possible cause of restricted performance of these duties if, in the opinion of trained personnel, further evaluation by a physician is required.

The results of medical evaluations will be documented and made available to the NRC upon request.

5.3.12 Methods for Selecting, Training, and Qualifying Security Guards

[NUREG-1804, Section 2.5.3.3.3: AC 7]

The methods for selecting and qualifying security guards, watchmen, armed response personnel, and other members of the security organization will be described in the Physical Protection Plan.

5.3.13 General References

ANSI/ANS-3.1-1993. 1999. *American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants*. La Grange Park, Illinois: American Nuclear Society. TIC: 235767.

ANSI/ANS-3.4-1996. *American National Standard for Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants.* La Grange Park, Illinois: American Nuclear Society. TIC: 251478.

ANSI/ANS-8.20-1991. 2005. *American National Standard, Nuclear Criticality Safety Training*. La Grange Park, Illinois: American Nuclear Society. TIC: 258162.

ASTM E 1168-95. *Standard Guide for Radiological Protection Training for Nuclear Facility Workers*. West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 241268.

Nuclear Waste Policy Act of 1982. 42 U.S.C. 10101 et seq.

Regulatory Guide 1.8, Rev. 3. 2000. *Qualification and Training of Personnel for Nuclear Power Plants.* Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20060105.0200.

Regulatory Guide 1.134, Rev. 3. 1998. *Medical Evaluation of Licensed Personnel at Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20050516.0414.

Regulatory Guide 8.8, Rev. 3. 1978. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as is Reasonably Achievable*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238609.

Regulatory Guide 8.27. 1981. *Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238517.

Regulatory Guide 8.29, Rev. 1. 1996. *Instruction Concerning Risks from Occupational Radiation Exposure*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20010724.0313.

INTENTIONALLY LEFT BLANK

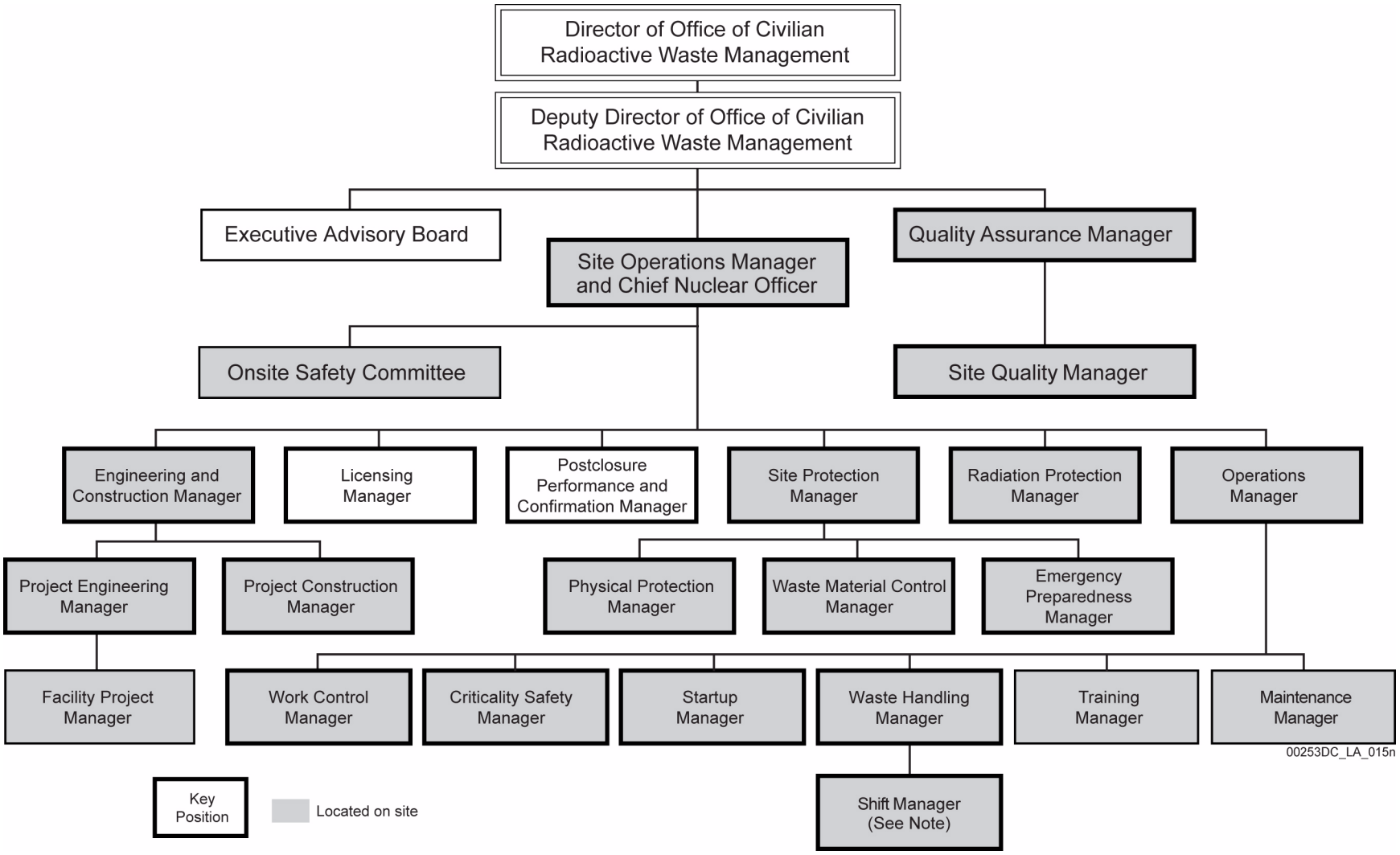

Figure 5.3-1. Functional Organizational Structure during Repository Construction and Operations

NOTE: The Shift Manager will have overall operations responsibility in the absence of the Operations Manager and the Waste Handling Manager.

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5.4 EXPERT ELICITATION

The information presented in this section addresses specific acceptance criteria in Sections 2.2.1.2.2.3, 2.2.1.3.2.3, 2.2.1.3.8.3, 2.2.1.3.10.3, 2.2.1.3.11.3, and 2.5.4.3 of NUREG-1804. It includes information concerning the techniques used to conduct expert elicitations, the use of guidance in NUREG-1563 (Kotra et al. 1996), and the rationale for any variance between the U.S. Nuclear Regulatory Commission (NRC) staff guidance in NUREG-1563 (Kotra et al. 1996) and the U.S. Department of Energy (DOE) conduct of expert elicitations.

The following table lists the information provided in this section, the corresponding regulatory requirements, and the acceptance criteria from NUREG-1804. Acceptance Criterion 2 of NUREG-1804, Section 2.5.4.3, is not applicable, and is, therefore, not addressed in this section since the DOE has not completed updates to the results of any expert elicitations and does not expect to rely upon any such updates to comply with 10 CFR Part 63. Insofar as the DOE completes any updates to the expert elicitations that are relied upon to comply with 10 CFR Part 63, the DOE will docket, as part of the license application, the results of the updates.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.4.1	Probabilistic Volcanic Hazard Analysis	63.21(c)(19)	Section 2.2.1.2.2.3: Acceptance Criterion 4(1)(c) Section 2.2.1.3.10.3: Acceptance Criterion 2(4) Acceptance Criterion 3(3) Section 2.2.1.3.11.3: Acceptance Criterion 3(3) Section 2.5.4.3: Acceptance Criterion 1(1) Acceptance Criterion 1(2)
5.4.2	Probabilistic Seismic Hazard Analysis	63.21(c)(19)	Section 2.2.1.3.2.3: Acceptance Criterion 3(4) Section 2.5.4.3: Acceptance Criterion 1(1) Acceptance Criterion 1(2)
5.4.3	Saturated Zone Flow and Transport	63.21(c)(19)	Section 2.2.1.3.8.3: Acceptance Criterion 3(4) Section 2.5.4.3: Acceptance Criterion 1(1) Acceptance Criterion 1(2)

Expert elicitation is a formal, structured, and documented process for obtaining the views of the informed scientific community. Expert judgment is used in any technical assessment, but it is often implicit and undocumented. Formal expert elicitation explicitly includes judgments of multiple experts representing the range of scientific views on a specific subject and documents the

basis for the judgments reached. Consistent with NUREG-1804, there are several conditions that indicate when expert elicitation may be needed, including the following:

- Difficulty or impracticality of obtaining sufficient data to resolve technical issues
- Presence of large uncertainties that could strongly affect analysis results
- Existence of more than one conceptual model that can explain empirical data
- Technical judgment required to assess whether bounding assumptions or calculations are appropriately conservative.

Expert elicitation provides a means for properly and fully incorporating the uncertainties represented by diverse technical interpretations and provides transparency through documentation of the process and results. In 1996, the NRC issued NUREG-1563 (Kotra et al. 1996), which gives NRC guidance on the use of expert elicitation in the high-level radioactive waste program.

The most recent advances in expert elicitation methodology arose in the context of developing probabilistic seismic hazard analyses (PSHA) to assess the likelihood of earthquakes of various sizes occurring in regions of low seismicity (e.g., the eastern United States). Based on differing results obtained in the late 1980s from two large PSHA projects conducted for the eastern United States using multiple experts (Budnitz et al. 1997, Section 1.3), it became clear that the process used to conduct an expert elicitation can have a significant effect on the results of the elicitation. Accordingly, a methodology for conducting a PSHA using expert elicitation was developed in a project jointly sponsored by the DOE, the NRC, and the Electric Power Research Institute. The project was known as the Senior Seismic Hazard Analysis Committee study. The final guidance resulting from the study was published in NUREG/CR-6372 (Budnitz et al. 1997).

Using NRC guidance in NUREG-1563 (Kotra et al. 1996) and that in NUREG/CR-6372 (Budnitz et al. 1997), the DOE developed requirements for expert elicitation, which first appeared in Revision 8 of *Quality Assurance Requirements and Description* (DOE 1998a) as accepted by the NRC (Bell 1998). The Quality Assurance Program identified in Section 5.1 describes the current DOE commitments to the requirements and recommendations of Section 3 of NUREG-1563 (Kotra et al. 1996).

The DOE relies on expert elicitations to directly support the license application in the areas of igneous activity, seismic hazard, and saturated zone flow and transport.

The degree to which each expert elicitation conforms to the provisions of NUREG-1563 (Kotra et al. 1996) and NUREG/CR-6372 (Budnitz et al. 1997) is summarized in this section. Variances from the guidance in NUREG-1563 (Kotra et al. 1996) are also identified and justified.

In addition to the three expert elicitations directly utilized to support the license application and described in this section, the DOE completed four other expert elicitations to support the total system performance assessment for the viability assessment (DOE 1998b) from 1996 to 1998. The purpose of these four expert elicitations was to quantify uncertainties associated with key models

and to provide a perspective on modeling and data collection activities that could help to characterize and reduce uncertainties. These elicitations focused on four models:

- Unsaturated zone flow
- Near-field environment and altered zone coupled effects
- Waste form degradation and radionuclide mobilization
- Waste package degradation.

The information developed to quantify uncertainties in these four elicitations is not directly utilized to support the license application because adequate and appropriate data and information were collected from other models and laboratory testing to support the required analyses. As such, these four elicitations are not addressed further in this section. The unsaturated zone flow expert elicitation (CRWMS M&O 1997), although not directly used to support the models or analyses of infiltration and unsaturated zone flow presented in Sections 2.3.1 and 2.3.2, was indirectly used to confirm the reasonableness of the unsaturated zone percolation flux distribution. In addition, recommendations provided by the elicited experts have been addressed. Additional information on the indirect use of the unsaturated zone flow expert elicitation within the context of infiltration and unsaturated zone flow are provided in Sections 2.3.1.3.3 and 2.3.2.4.1.2.4.5.7, respectively.

The principal steps followed in each of the elicitation projects included:

1. Definition of objectives
2. Selection of experts
3. Refinement of issues and problem definition
4. Assembly and dissemination of basis information
5. Pre-elicitation training
6. Elicitation of judgments
7. Post-elicitation feedback
8. Aggregation of judgments
9. Documentation.

The meetings of the expert panel were structured, facilitated interactions in workshops and, for some projects, field trips. An elicitation team of experts in the expert elicitation process facilitated the workshops. The workshops were designed to identify the significant issues, available data, alternative models, and uncertainties related to each process model. The expert panel members were given detailed summaries and presentations of available data and models and the status of various components of the modeling and testing program. Debate and technical challenge of alternative interpretations were encouraged to ensure that uncertainties were identified. At the workshops, researchers from a variety of organizations, including national laboratories, U.S. Geological Survey, universities, and private groups presented pertinent data sets and alternative models and methods.

5.4.1 Probabilistic Volcanic Hazard Analysis

[NUREG-1804, Section 2.2.1.2.2.3: AC 4(1)(c); Section 2.2.1.3.10.3: AC 2(4), AC 3(3); Section 2.2.1.3.11.3: AC 3(3); Section 2.5.4.3: AC 1]

In 1995, prior to NRC issuance of NUREG-1563 (Kotra et al. 1996), the DOE initiated the PVHA for the Yucca Mountain site (CRWMS M&O 1996). Experts with the needed expertise in volcanic studies in the southern Great Basin or similar extensional environments were assembled to evaluate volcanic hazard in the Yucca Mountain region. The probability of a future volcanic event disrupting the repository at Yucca Mountain was the focus of this study. The region surrounding Yucca Mountain is characterized by several small-volume volcanic centers that have erupted within the past 1 million years. Reconstructing accurate eruptive histories is difficult, and data may indicate multiple eruptions at a single center. The volcanic hazard was expressed as the probability of disruption either by magma that ascends directly through the repository or erupts or intrudes nearby. A 10-member expert panel evaluated the uncertainty in a range of possible approaches to modeling the hazard and the associated input parameters. The PVHA was conducted in a manner generally consistent with the nine-step procedure defined in NUREG-1563 (Kotra et al. 1996) and proceeded as follows.

Step 1—Definition of Objectives—The objective was to assess the probability of a volcanic event (intrusive and extrusive) disrupting a repository at Yucca Mountain. The basic elements to be assessed were the spatial distribution of future volcanic events in the Yucca Mountain region and the recurrence rates of future volcanic events. This included capturing the uncertainties involved in the assessment of volcanic hazard, including uncertainty in the models used to represent physical controls on volcanism and uncertainty in the parameter values used in the models.

Step 2—Selection of Experts—The selection criteria for the PVHA expert panel included possessing the right knowledge and expertise, availability and willingness to participate and to explain and defend their technical positions, as well as providing diverse opinions, areas of technical expertise, and institutional or organizational backgrounds. These criteria were intended to ensure a high-quality panel with significant stature and diversity. The objectives of the elicitation project and the selection criteria were provided to several volcanologists who were asked to provide nominations to the panel. From this list of nominations, experts with the needed range of expertise in physical volcanology, volcanic hazards, geophysics, and geochemistry were chosen to evaluate the volcanic hazard for the Yucca Mountain site.

The selection criteria did not include a criterion for willingness to publicly disclose potential conflicts of interest, as recommended in Step 2 of NUREG-1563 (Kotra et al. 1996). The purpose of this criterion is to ensure that the experts do not oppose revealing any potential real or perceived conflicts of interest. While the expert selection criteria did not specifically include this criterion, the experts themselves did not oppose this obligation. This is evidenced by the fact that the experts disclosed their experience and then-current affiliations during the elicitation, as well as in their biographies provided in the final report prepared for the PVHA.

Step 3—Refinement of Issues and Problem Definition—After panel selection, a series of structured, facilitated workshops was conducted, and the technical issues were refined. The experts analyzed the objectives to further specify more focused and simpler subissues. Some of

the major technical issues identified by the experts included the types and nature of eruptions, structural control of volcanism in the region of Yucca Mountain, reliability and uncertainty of age determinations, the orientation of feeder dikes, and appropriate analogue regions. A complete list of the technical issues identified by the expert panel is contained in the PVHA report.

Step 4—Assembly and Dissemination of Basis Information—Available information, including site-specific data and relevant information from analogue regions, was assembled and uniformly distributed to the experts. The PVHA report provides a list of documents distributed to the expert panel (CRWMS M&O 1996, Appendix B). In addition, recently gathered data from the Yucca Mountain region and from analogue areas were presented in workshops or made available in preliminary form to the experts for their review. Examples of these types of data included a seismic reflection line across Crater Flat and Yucca Mountain and a ground magnetic survey being developed by the Center for Nuclear Waste Regulatory Analyses.

Step 5—Pre-Elicitation Training—The experts completed pre-elicitation training as a group during the workshops. The pre-elicitation training included familiarizing the experts with the subject matter, which included discussion of available data and of alternative models pertinent to the Yucca Mountain site. During the pre-elicitation training, the experts received instruction regarding quantifying uncertainty for probability encoding, expressing alternative evaluations using subjective probability (weights), and understanding biases that might unduly influence expert evaluations. Also, the experts practiced articulating their judgments and the assumptions and rationales supporting their judgments.

Step 6—Elicitation of Judgments—Individual elicitation interviews were conducted by the elicitation team in an appropriate setting, conducive to uninterrupted discussion. The expert panel developed a distinct set of issues and definitions and assumptions related to those issues. Each expert was presented with a consistent set of questions to facilitate development of their evaluations prior to the interview to assist them in preparing for the elicitation interview. All data sets provided to the experts during the course of the PVHA were available during the elicitation interviews. The elicitation interview followed a logical sequence from general to more specific assessments, usually from spatial to temporal issues. Alternative models, approaches, and hypotheses were discussed, and relative weights were assigned to the alternatives to express uncertainties. Each expert developed a volcanic hazard model.

Step 7—Post-Elicitation Feedback—Experts were provided feedback throughout the elicitation process. The expert panel reviewed and then discussed the written elicitation summaries and the technical basis for these summaries in a workshop. In addition, experts were provided with information and sensitivity analyses to help them understand the implications of their assessments. The written elicitation summaries were also reviewed by the elicitation team for adequacy and completeness of the technical basis for the expert judgments.

The elicitation team did not require individual experts to document revisions to their initial assessments during the feedback process as recommended in NUREG-1563 (Kotra et al. 1996). The basic premise of an expert elicitation is that assessments prepared by experts should be reviewed, discussed, and challenged by other members of the expert panel prior to finalization of the assessments. Experts evaluated data or other information using their past experiences. Hypotheses were advanced that expressed models and conclusions consistent with the data and the experts'

experience. The hypotheses were presented and debated among peers who likely had different experience and who may have interpreted data differently. Based on feedback received from other panel members, the experts were allowed to modify or strengthen their original interpretations. Documenting revisions to expert evaluations can anchor the experts to their initial evaluations, making them reluctant to revise an evaluation after the feedback process. Thus, the DOE did not require documentation of the rationale for revisions to an expert's initial assessment, consistent with the guidance contained in NUREG/CR-6372 (Budnitz et al. 1997) and consistent with Revision 8 of *Quality Assurance Requirements and Description* (DOE 1998a).

Step 8—Aggregation of Judgments—The results of the PVHA models developed by each expert were combined to produce an aggregate expected annual frequency of intersection of the repository footprint by a volcanic event. The approach taken for aggregation of the expert assessments was equal weighting. This was done because most aspects of the PVHA were very specific to the expert's interpretation. To ensure that an equal weight scheme was defensible, the following steps were completed:

1. The experts were selected using a formal selection process.
2. All experts were provided with all applicable data bases.
3. Expert interaction was encouraged.
4. Alternative interpretations were presented and challenged.
5. Sufficient feedback was provided to allow each team member the opportunity to understand the implications of their evaluations relative to the hazard results.

The final report also documented each individual expert's assessment so that the impact of an individual's assessment on the overall results was clear.

Step 9—Documentation—The technical basis for the expert evaluations was thoroughly documented. The documentation includes the individuals involved in the elicitation project and their specific roles, the details of the process followed, and the results of the elicitation.

The expert elicitation associated with the PVHA is in the process of being updated in a manner that is consistent with NUREG-1563 (Kotra et al. 1996) and past practices. The update is not required to support the technical basis for compliance with 10 CFR Part 63.

Sections 2.2 and 2.3.11 provide more information regarding the process and results of the PVHA.

5.4.2 Probabilistic Seismic Hazard Analysis

[NUREG-1804, Section 2.5.4.3: AC 1; Section 2.2.1.3.2.3: AC 3(4)]

In 1995, prior to NRC issuance of NUREG-1563 (Kotra et al. 1996), the DOE initiated a PSHA for Yucca Mountain using an expert elicitation process. Experts with the needed range of expertise in regional and local earthquake and fault tectonics, earthquake physics, ground motion modeling, and seismic hazard analyses were assembled to evaluate seismic hazards in the Yucca Mountain

region. They characterized and assessed the uncertainty of seismic sources, earthquake recurrence, ground motion models, and fault displacement models for faulting conditions known to be present in the vicinity of the Yucca Mountain site. Six teams, with expertise in Basin and Range Province earthquake tectonics, earthquake seismology, and Quaternary fault displacement modeling, evaluated seismic source, fault displacement, and associated uncertainties using a structured elicitation process. A separate panel of seven ground motion experts was convened using a similarly structured elicitation process to evaluate ground motion attenuation and associated uncertainties. Using these inputs, the seismic hazard was calculated and expressed as a probability distribution on the annual frequency at which levels of ground motion or fault displacement will be exceeded. These results form part of the bases for developing preclosure seismic design inputs and provide information on the frequency of occurrence of potentially disruptive ground motions for assessment of long-term performance of the repository. The PSHA was conducted in a manner generally consistent with the nine-step procedure defined in NUREG-1563 (Kotra et al. 1996) and proceeded as follows:

Step 1—Definition of Objectives—The objective was to assess fault displacement and vibratory ground motion hazards for the underground and surface facilities. Specific topics included:

- Evaluation and characterization of relevant seismic sources, including the potential for fault displacement
- Evaluation and characterization of vibratory ground motion attenuation, including effects of earthquake source, wave propagation, and a rock site
- Probabilistic calculation of both fault displacement and vibratory ground motion hazards.

Step 2—Selection of Experts—The selection criteria for the PSHA experts included possession of relevant expertise; willingness to forsake the role of proponent of any model and to perform as an impartial expert; specific knowledge of the Yucca Mountain area, the Basin and Range Province, or ground motion characterization; and willingness to participate in open workshops, to diligently prepare the required evaluations, and openly explain and defend technical positions. Additional criteria included personal attributes that included strong communication skills, flexibility and impartiality, and the ability to simplify and explain the basis for interpretations and technical positions, as well as availability and willingness to commit the time required to complete the project.

The selection criteria did not include a criterion for willingness to publicly disclose potential conflicts of interest, as recommended in NUREG-1563 (Kotra et al. 1996). The purpose of this criterion is to ensure that the experts do not oppose revealing any potential real or perceived conflicts of interest. While the expert selection criteria did not specifically include this criterion, the experts themselves did not oppose this obligation. This is evidenced by the fact that the experts disclosed their experience and then-current affiliations during the elicitation, as well as in their biographies provided in the final report prepared for the PSHA (CRWMS M&O 1998a). Conflict of interest forms, modeled after the forms used by the National Academy of Science to document potential conflicts of interest, were completed for the PSHA expert panel (Murray 1999).

Step 3—Refinement of Issues and Problem Definition—After panel selection, a series of structured, facilitated workshops was conducted, and the technical issues were refined. The experts analyzed the objectives to further specify more focused and simpler subissues in the first workshop. For the seismic source and fault displacement panel, the basic approach was to: (1) identify technical issues of most significance to seismic hazards at Yucca Mountain, (2) link those issues with the data most relevant to addressing the issues, (3) specify the available relevant data for the Yucca Mountain region, and (4) identify the data required by the experts to characterize seismic sources.

Some of the major technical issues identified by the experts during the first workshop included choosing recurrence models and weights for fault sources, characterizing fault geometry and kinematics, and characterizing distributive faulting. A complete list of the technical issues is included in the first workshop summary in the PSHA report.

For the ground motion panel, six principal issues were identified:

1. The site response characteristics specific to Yucca Mountain

2. The model-dependent range of values of source parameters for earthquakes in this region of the Basis and Range Province

3. The explanation for the apparent aseismic slip in the uppermost few kilometers of crust for earthquakes with rupture that reaches the surface

4. The Yucca-Mountain–specific ground motion attenuation predicted by various numerical ground motion simulations

5. The basis for the apparent discrepancies in the literature regarding regional attenuation

6. The explanation for the reported large amplification of motions at Yucca Mountain compared to other Nevada Test Site sites.

Step 4—Assembly and Dissemination of Basis Information—The seismic source and fault displacement panel members were each provided with data and lists of relevant data sources before the first workshop. A complete list of this material is provided in the PSHA report. The ground motion panel identified data and analyses required to resolve their technical issues in the first workshop. The specific data needs related to site response, source parameters, aseismic shallow slip, numerical simulations, regional attenuation, and Yucca Mountain site amplification. These data needs are specified in detail in the PSHA report.

Step 5—Pre-Elicitation Training—As a group, the experts completed pre-elicitation training during workshops. The pre-elicitation training included steps to familiarize the experts with the subject matter, which included discussion of available data and of alternative models. The experts also received instruction regarding quantifying uncertainty for probability encoding, expressing alternative evaluations using subjective probability (weights), and understanding biases that might unduly influence expert evaluations. Also, the experts practiced articulating their judgments and the assumptions and rationales supporting their judgments.

Step 6—Elicitation of Judgments—The individual elicitation interviews were conducted by the facilitation teams in an appropriate setting, conducive to uninterrupted discussion. The facilitation team presented each expert with a defined and consistent set of questions and documentation to facilitate development of their evaluations. For the seismic source and fault displacement panel, alternative models, approaches, and hypotheses were discussed, and the logic structure for the assessments and associated probability distributions were developed. For the ground motion panel, each expert provided written documentation of the models deemed relevant to the PSHA and the means by which the expert formed point estimates from these models. Each expert was asked to explain the procedures adopted to obtain median estimates, aleatory uncertainties, and the epistemic uncertainties on both. Each expert defended the selection of relevant models and also explained the basis for rejecting other models.

Step 7—Post-Elicitation Feedback—Experts were provided feedback and revised their evaluations accordingly. Workshops were held to provide an opportunity for the expert teams to discuss the first round of their interpretations, to allow each team member to understand and to ask questions about the interpretations made by other experts, to provide information on the derivative products of the first round of assessments, and to provide sensitivity assessments of the initial expert assessments.

The elicitation team did not require individual experts to document revisions to their initial assessments during the feedback process as recommended in NUREG-1563 (Kotra et al. 1996). The basic premise of an expert elicitation is that assessments prepared by experts should be reviewed, discussed, and challenged by other members of the expert panel prior to finalization of the assessments. Experts evaluate data or other information using their past experience. Hypotheses are advanced that express models and conclusions that are consistent with the data and the experts' experience and are presented and debated among peers who likely have different experience bases and interpret data differently. Based on feedback received from other panel members, the experts may modify or strengthen their original interpretations. Documenting revisions to experts' evaluations has the potential to anchor the experts to their initial evaluations, making experts reluctant to revise an evaluation after the feedback process. Thus, the DOE did not require documentation of the rationale for revisions to an expert's initial assessment in the expert elicitation process, consistent with the guidance contained in NUREG/CR-6372 (Budnitz et al. 1997) and with Revision 8 of *Quality Assurance Requirements and Description* (DOE 1998a).

Step 8—Aggregation of Judgments—The aggregation of the experts' or expert teams' interpretation through the direct combination of their final probability distributions used equal weights. To ensure that an equal-weight scheme was defensible, the following steps were completed: the experts were selected using a formal selection process, all experts were provided with all applicable databases, expert interaction was encouraged, alternative interpretations were presented and challenged, and sufficient feedback was provided to allow each team member the opportunity to understand the implications of their evaluations relative to the hazard results.

Step 9—Documentation—The technical basis for the expert evaluations was thoroughly documented. The documentation includes the individuals involved in the elicitation process and their specific roles, the details of the process followed, and the results of the elicitation.

Sections 1.1.5.2, 1.2.2.3, 2.2, and 2.3.4 provide more information regarding the process or results of the PSHA.

5.4.3 Saturated Zone Flow and Transport

[NUREG-1804, Section 2.5.4.3: AC 1; Section 2.2.1.3.8.3: AC 3(4)]

In 1997, the DOE initiated an evaluation of saturated zone flow and transport using an expert elicitation (CRWMS M&O 1998b). Experts with the needed expertise in field and laboratory methods for characterizing and/or methods for analyzing and modeling groundwater flow and radionuclide transport in saturated fractured rock were assembled to evaluate saturated zone flow and transport at Yucca Mountain. The five-member expert panel convened for this project addressed a variety of technical issues related to the saturated zone beneath the repository and the downgradient flow system. Issues assessed included hydraulic conductivity of hydrogeologic units, flux at the water table beneath Yucca Mountain, dilution and dispersivity, and hydrochemical transport parameters of key radionuclides. The expert panel members also provided their perspectives on issues related to conceptual models and groundwater flow modeling. The saturated zone flow and transport expert elicitation was conducted in a manner generally consistent with the nine-step procedure defined in NUREG-1563 (Kotra et al. 1996).

Step 1—Definition of Objectives—The technical objective of the saturated zone flow and transport elicitation was to evaluate the uncertainties involved in assessing saturated flow processes, including uncertainty in both the models used to represent the physical processes controlling saturated zone flow and transport and the parameter values used in those models. The resulting assessments and probability distributions provide representation of the knowledge and uncertainties for processes in saturated zone flow and transport.

Step 2—Selection of Experts—These criteria included knowledge and expertise in saturated zone flow and transport, technical competence, availability, willingness to participate, and a willingness to explain and defend their technical positions. These criteria sought to provide diverse opinions, areas of technical expertise, and institutional and organizational backgrounds.

The selection criteria for the expert panel did not include a criterion for willingness to publicly disclose potential conflicts of interest, as recommended in NUREG-1563 (Kotra et al. 1996). The purpose of this criterion is to ensure that the experts do not oppose revealing any potential real or perceived conflicts of interest. While the expert selection criteria did not specifically include this criterion, the experts themselves did not oppose this obligation. This is evidenced by the fact that the experts disclosed their experience and then-current affiliations during the elicitation, as well as in their biographies provided in the final report.

Step 3—Refinement of Issues and Problem Definition—After panel selection, a series of structured, facilitated workshops was conducted, and the technical issues were refined. The experts analyzed the objectives to further specify more focused and simpler subissues. Some key issues included the conceptual model of groundwater flow beneath the repository, magnitude and direction of advective flow, and estimates of regional recharge and discharge. A complete list of these technical issues is contained in *Saturated Zone Flow and Transport Expert Elicitation Project*.

Step 4—Assembly and Dissemination of Basis Information—Available information, including literature and data sets pertinent to assessing saturated zone flow and transport, was assembled and uniformly distributed to the experts. *Saturated Zone Flow and Transport Expert Elicitation Project* provides a list of documents distributed to the expert panel. *Saturated Zone Flow and Transport Expert Elicitation Project* also provides summaries of the technical data and alternative models that were presented and discussed with the expert panel. Examples of the types of data presented include hydrochemistry, hydraulic data, and information on recharge and discharge.

Step 5—Pre-Elicitation Training—Experts completed pre-elicitation training as a group during the workshops. In the first workshop, the pre-elicitation training included steps to familiarize experts with the subject matter, which included discussion of available data and alternative models. During the second workshop, experts received instruction about quantifying uncertainty for probability encoding, expressing alternative evaluations using subjective probability (weights), and understanding biases that might unduly influence expert evaluations. Also, the experts practiced articulating their judgments and the assumptions and rationales supporting their judgments.

Step 6—Elicitation of Judgments—Individual elicitation interviews were conducted by the elicitation team in an appropriate setting, conducive to uninterrupted discussion. All data sets provided to the experts during the saturated zone flow and transport expert elicitation were available during the elicitation interview. Each expert was presented with a defined and consistent set of issues and documentation to facilitate development of their evaluations. The elicitation interview followed a logical sequence from general to more specific assessments and covered all of the issues. The issues included conceptualization of saturated zone groundwater flow, the large hydraulic gradient to the north of Yucca Mountain, flux beneath Yucca Mountain, hydraulic conductivity, specific discharge, influence of climate change, conceptual models of saturated zone transport, dilution factor or dispersivity, effective fracture density, hydrochemical transport parameters, thermohydrology, colloids, water table changes from disruptive events, and anisotropy. The experts also provided judgments on additional data collection activities, analyses, and modeling that could be conducted to reduce uncertainties in these key issues.

Step 7—Post-Elicitation Feedback—Experts were provided post-elicitation feedback throughout the elicitation process through interaction among the experts. For example, the individual experts were provided elicitation summaries from all members of the expert panel. This provided each expert with the broader perspective on the range of interpretations being developed. After reviewing the feedback package, the experts finalized their expert elicitation summaries.

The elicitation team did not require individual experts to document revisions to their initial assessments during the DOE feedback process. The basic premise of an expert elicitation is that assessments prepared by experts should be reviewed, discussed, and challenged by other members of the expert panel prior to finalization of the assessments. Experts evaluate data or other information using their past experiences. Hypotheses are advanced that express models and conclusions that are consistent with the data and expert experience. These hypotheses are presented and debated among peers who likely have different experience bases and are likely to interpret data differently. Based on feedback received from other panel members, experts may modify or strengthen their original interpretations. Documenting revisions to expert evaluations has the potential to anchor the experts to their initial evaluations, making experts reluctant to revise an

evaluation after the feedback process. Thus, the DOE did not require documentation of the rationale for revisions to an initial expert assessment in the expert elicitation process, consistent with the guidance contained in NUREG/CR-6372 (Budnitz et al. 1997) as well as in Revision 8 of *Quality Assurance Requirements and Description* (DOE 1998a).

Step 8—Aggregation of Judgments—The approach taken to aggregate the expert assessments was equal weighting. To ensure that an equal-weight approach was defensible, several steps were taken. The experts were selected using a formal selection process, and comprehensive data were disseminated to all the experts. The experts were also trained in elicitation methodologies and the role of experts as evaluators. Structured, facilitated workshops were held to foster free exchange of information and scientific debate of alternative hypotheses. In addition, the experts were provided feedback and had the opportunity to revise their assessments in light of the feedback.

Step 9—Documentation—The technical basis for the expert evaluations was thoroughly documented. This documentation includes the individuals involved in the elicitation project and their specific roles, the details of the process followed, and the results of the elicitation.

Sections 2.2 and 2.3.9 provide more information regarding the process and results of the saturated zone flow and transport analysis.

5.4.4 General References

Bell, M.J. 1998. "Revision 8 of the Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description Document." Letter from M.J. Bell (NRC) to A. Brownstein (OCRWM), March 16, 1998. ACC: MOL.19980416.0771.

Budnitz, R.J.; Apostolakis, G.; Boore, D.M.; Cluff, L.S.; Coppersmith, K.J.; Cornell, C.A.; and Morris, P.A. 1997. *Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on the Uncertainty and Use of Experts*. NUREG/CR-6372. Two volumes. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 235076.

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1996. *Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada.* BA0000000-01717-2200-00082 Rev. 0. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971201.0221.

CRWMS M&O 1997. *Unsaturated Zone Flow Model Expert Elicitation Project.* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971009.0582.

CRWMS M&O 1998a. *Probabilistic Seismic Hazard Analyses for Fault Displacement and Vibratory Ground Motion at Yucca Mountain, Nevada.* Milestone SP32IM3, September 23, 1998. Three volumes. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981207.0393.

CRWMS M&O 1998b. *Saturated Zone Flow and Transport Expert Elicitation Project.* Deliverable SL5X4AM3. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980825.0008.

DOE (U.S. Department of Energy) 1998a. *Quality Assurance Requirements and Description*. DOE/RW-0333P, Rev. 8. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19980601.0022.

DOE 1998b. *Viability Assessment of a Repository at Yucca Mountain.* DOE/RW-0508. Overview and five volumes. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.19981007.0027 through MOL.19981007.0032.

Kotra, J.P.; Lee, M.P.; Eisenberg, N.A.; and DeWispelare, A.R. 1996. *Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program.* NUREG-1563. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 226832.

Murray, M. 1999. Potential Sources of Conflict of Interest Forms for Seismic Experts and Ground Motion Experts. SCP: 8.3.1.17.3.6.2. Las Vegas, Nevada: U.S. Geological Survey. ACC: MOL.19990527.0043 through MOL.19990527.0068.

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

TABLES

Page

INTENTIONALLY LEFT BLANK

5.5 PLANS FOR INITIAL STARTUP ACTIVITIES AND TESTING

This section provides information that addresses the specific regulatory acceptance criteria in Section 2.5.5.3 of NUREG-1804. The information also addresses requirements contained in 10 CFR Part 63. The following table lists the information provided in this section, the corresponding regulatory requirement, and the applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference (and Changes to NUREG-1804 from HLWRS ISGs)
5.5.1	Compatibility of Testing Programs with Applicable Regulatory Guidance	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 6
5.5.2	Use of Experience from Similar Facilities	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 7 HLWRS-ISG-004 Section 2.5.5.3: Acceptance Criterion 7(1)
5.5.3	Methods Used to Develop, Review, and Approve Test Procedures and Methods to Evaluate Results	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 1
5.5.4	Format and Content of Test Procedures	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 2 Acceptance Criterion 4 Acceptance Criterion 5
5.5.5	Component Testing	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 1 Acceptance Criterion 2 Acceptance Criterion 3 Acceptance Criterion 10 Acceptance Criterion 11 Acceptance Criterion 12
5.5.6	Systems Functional Testing	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 2 Acceptance Criterion 3 Acceptance Criterion 10 Acceptance Criterion 11(4) Acceptance Criterion 12
5.5.7	Cold Integrated Systems Testing	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 2 Acceptance Criterion 3 Acceptance Criterion 8 Acceptance Criterion 10 Acceptance Criterion 11 Acceptance Criterion 12
5.5.8	Operational Readiness Review	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 11 Acceptance Criterion 12

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference (and Changes to NUREG-1804 from HLWRS ISGs)
5.5.9	Protection of Workers and the Public	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 8 Acceptance Criterion 11 Acceptance Criterion 12
5.5.10	Hot Testing (Initial Startup Operations)	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 8 Acceptance Criterion 10 Acceptance Criterion 11 Acceptance Criterion 12
5.5.11	Schedules	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 9
5.5.12	Testing and Evaluating Functional Adequacy of New or Untested Systems, Structures, and Components	63.21(c)(22)(iv)	Section 2.5.5.3: Acceptance Criterion 10

The U.S. Department of Energy (DOE) will conduct testing and startup activities for structures, systems, and components (SSCs) that are important to safety (ITS) and for SSCs that are important to waste isolation (ITWI). Startup activities and testing will be applied to SSCs and processes necessary to perform the operational mission based on the preclosure safety analysis and the total system performance assessment that address 10 CFR 63.21(c)(22)(iv). The objectives of startup testing are to ensure that components and equipment can be operated in a safe and dependable manner and will not adversely affect the health and safety of workers or the public by ensuring that ITS and ITWI SSCs:

- Have been properly constructed and installed
- Fulfill their operational and safety functions in accordance with their respective design basis requirements, including a hot test to confirm radiation levels and associated exposure times involving actual radioactive sources
- Meet regulatory and licensing requirements and are capable of complying with applicable license specifications.

Additional objectives of the Startup and Testing Program are to familiarize the repository operating and technical staff with operation of the facilities and to verify, to the extent practicable, that repository operating and emergency procedures are adequate.

Startup testing is based on the use of specific testing plans that will be developed to support each facility in phased startup as discussed in Section 5.5.11. The DOE will have conducted testing and startup activities for the first phase of repository operations or have detailed procedures for conducting testing and startup activities in place by the time of submittal of the updated license application for a license to receive and possess spent nuclear fuel (SNF) and high-level radioactive waste (HLW). Testing and startup activities for succeeding phases of repository operations, or

detailed procedures and schedules for developing and conducting testing and startup activities, will be developed to meet the needs of the Startup and Testing Program. The Startup and Testing Program will require that copies of the approved testing procedures be made available for U. S. Nuclear Regulatory Commission (NRC) inspection approximately 90 days prior to the intended use of those procedures. Subsequent changes to the testing plans or procedures will be controlled under management systems, and the changes will also be made available for inspection by the NRC. Organizational roles and responsibilities and personnel qualifications are described in Section 5.3. The roles and responsibilities of these individuals relative to the Startup and Testing Program include:

- Engineering and Construction Manager:
  - Early testing of components during the construction phase
  - Lead for construction functional component testing
  - Reviewing components test procedures
  - Developing test specifications that include appropriate acceptance criteria necessary to confirm key design criteria during startup testing
- Startup Manager:
  - Preparation of startup testing procedures
  - Lead for system functional testing and integrated testing
  - Coordination of system functional testing and startup functional component testing
  - Concurrence with procedures
  - Review and approval of cold integrated system test
  - Lead for cold integrated system testing
- Waste Handling Manager:
  - Preparation and approval of hot testing and operating procedures
  - Lead for hot testing
  - Concurrence with test procedures for key systems, as appropriate
  - Review of overall testing program results prior to waste receipt
- Operations Manager:
  - Review and approval of cold integrated system tests
  - Review and approval of hot testing and operating procedures
  - Review and approval of maintenance procedures
- Facility project engineers:
  - Review and approval of procedures before continued use and for placing system in operation

- Test Review Board:

  – Review of test procedures, including system functional test procedures
  – Review and approval of cold integrated system testing
  – Review and approval of test results.

Startup testing will include system and component tests required by the applicable design codes and standards, except for those that were performed and documented by the constructor or other approved testing services. Startup testing includes the testing necessary to demonstrate that the SSCs are capable of performing their intended functions, as designed, during normal and off-normal operations and during Category 1 or Category 2 event sequences and that measured parameters are bounded by the safety analysis. Results of these tests will be used to make necessary changes to equipment and procedures to ensure public and worker health and safety.

Startup testing will be described and controlled by the Testing Program Plan and testing procedures. The Testing Program Plan will outline the overall testing objectives, will define the types and source of design information to be verified in the testing, and will include the general steps to be followed when developing, reviewing, and approving testing procedures. The Testing Program Plan will establish methods for executing tests and requirements for documenting test results. The Testing Program Plan will include a testing specification that consists of a compilation of testable requirements from appropriate design requirement and regulatory documents. The Testing Program Plan will also discuss the type of tests to be performed, the method of test procedure approval, and the method for validating that the test for any component or system will generate the information needed and will define the method for establishing and reviewing corrective actions for unexpected or unacceptable test results.

Test procedures will be provided for SSCs that (1) are classified as ITS or ITWI, or (2) are assumed to function or for which credit is taken in the event sequence analysis in the preclosure safety analysis, or (3) will be used to process, store, control, measure, or limit the release of radioactive material. Test procedures will be used to establish conformance with limiting conditions for operations in the repository license specifications or to support or ensure that the operation of these SSCs is within design limits.

Startup testing consists of five parts:

- Component testing (Section 5.5.5)
- Systems functional testing (Section 5.5.6)
- Cold integrated systems testing (Section 5.5.7)
- Operational Readiness Review (Section 5.5.8)
- Hot testing (initial startup operations) (Section 5.5.10).

5.5.1 Compatibility of Testing Programs with Applicable Regulatory Guidance
[NUREG-1804, Section 2.5.5.3: AC 6]

It is noted that NUREG-1804, Section 2.5.5.3, identifies that the pre-startup test programs for geologic repository operations area SSCs should be consistent with applicable portions of Regulatory Guide 3.48. Regulatory Guide 3.48 was reviewed and it was determined to not be

applicable. Instead, startup testing plans and procedures for ITS and ITWI SSCs developed and included in the Testing Program Plan will be consistent with the guidance contained in NUREG-1804, Section 2.5.5, and in Regulatory Guide 1.68, Rev. 2 where its regulatory positions are applicable to repository SSCs and operations. As the test plans and procedures are developed, justification will be provided, as appropriate, for positions deviating from the guidance.

In addition, where appropriate, other NRC regulatory guidance will be considered during development of specific test procedures. Such additional guidance includes:

- Regulatory Guide 1.9, *Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants*

- Regulatory Guide 1.30, *Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment*

- Regulatory Guide 1.41, *Preoperational Testing of Redundant On-Site Electric Power System to Verify Proper Load Group Assignments*

- Regulatory Guide 1.52, *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmospheric Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*

- Regulatory Guide 1.116, *Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems*

- Regulatory Guide 1.128, *Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants*

- Regulatory Guide 1.140, *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*

- NUREG-0612, *Control of Heavy Loads at Nuclear Power Plants*.

Although the NRC developed the above guidance for application to nuclear power plants, the DOE has evaluated these documents to determine specific guidance that may be applicable to similar repository SSCs and will incorporate applicable guidance in the development of the Testing Program Plan and test procedures.

5.5.2 Use of Experience from Similar Facilities

[NUREG-1804, Section 2.5.5.3: AC 7; HLWRS-ISG-004, Section 2.5.5.3: AC 7(1)]

Relevant repository test results and operating lessons learned used at other facilities that perform similar operations will be evaluated, and the results of those evaluations incorporated in repository startup testing procedures. The DOE has implemented an extensive program for the management of operating experience to prevent adverse operating incidents and to expand the sharing of good work

practices among DOE sites. This program is called the DOE Corporate Operating Experience Program (Shearer 2006) and is described in more detail in Section 5.6. The program is intended to provide the systematic review, identification, collection, screening, evaluation, and dissemination of startup and operating experience from NRC-licensed facilities, including independent spent fuel storage installations; other United States and foreign government agencies; industry, professional societies, trade associations, national academies, and universities; and DOE and its contractors. Since the DOE operates many facilities with features similar to the repository surface handling facilities and also operates the Waste Isolation Pilot Plant, the DOE expects to derive considerable benefit from this program and apply it to the Yucca Mountain Repository.

5.5.3 Methods Used to Develop, Review, and Approve Test Procedures and Methods to Evaluate Results

[NUREG-1804, Section 2.5.5.3: AC 1]

Startup testing will be conducted using written, reviewed, and approved procedures. Test procedures for the first phase of repository operations will be prepared, approved, and implemented prior to submittal of the updated license application for a license to receive and possess SNF and HLW. Personnel preparing the test procedures will be qualified in accordance with the Testing Program Plan. Individuals leading these efforts will be experienced and qualified in the areas for which they are preparing procedures or performing tests.

Prior to preparing testing procedures, requirements will be compiled and described in a test specification. The test specification is appended to the Testing Program Plan. The specification, once reviewed and approved by the Test Review Board, will be used as a guide to write the testing procedures. The specification is used to establish the testing requirements and acceptance criteria for each component, system, or grouping of systems. This specification will help the testing organizations avoid duplication of testing (i.e., performing the same test on a component during more than one testing phase). The specification becomes a baseline document, and the test procedures are validated against the collected requirements of the specification. The final testing documentation consists of the specification, procedures, final testing report, and other documentation generated during the test.

The use of properly approved testing procedures is required for component testing, systems functional testing, and hot and cold integrated systems testing. The results of testing will be reviewed and approved by the Facility Project Engineers and the Test Review Board before tests are used as the basis of continuing the testing program or as the basis of placing a system into operation. Modifications to an SSC after completion of its respective testing will be evaluated based on the potential effects on the testing program. If it is determined that testing program results are invalidated by a system modification, the testing program or portions of the individual test affected by the modification will be revised, and the affected test or affected portions of the test will be performed again. The Startup and Testing Program will require that copies of the approved testing procedures be made available for NRC inspection approximately 90 days prior to the intended use of those procedures.

Prior to receipt of waste at a facility, the overall testing program results will be reviewed by the Waste Handling Manager and the Test Review Board to ensure that prerequisite testing is satisfactory for receipt of waste. The Onsite Safety Committee will review the testing program data

and conclusions. The committee is required to determine that prerequisites for receipt of SNF and HLW are met and to provide a recommendation to the Site Operations Manager that the facility is ready to receive waste.

Facility operation, emergency, and surveillance procedures, if available, are use-tested throughout the testing program and are used in the development of component, system functional, and integrated test procedures to the extent practicable. The trial use of operating procedures familiarizes operation personnel with systems and plant operation during the testing phases. Use testing also ensures the adequacy of the procedures under actual or simulated operating conditions.

Procedures that cannot be operationally tested during the testing program phase will be revised based on initial startup testing, operating experience, and comparison with the as-built systems. These revisions will ensure that these procedures are as accurate and comprehensive as practicable before they are used.

Responsibility for development, review, and approval of testing procedures is discussed in the introduction of this section. Qualification requirements for personnel assigned responsibilities for test procedure development will be addressed in the Testing Program Plan.

5.5.4 Format and Content of Test Procedures

[NUREG-1804, Section 2.5.5.3: AC 2, AC 4, AC 5]

The content of test procedures for ITS and ITWI SSCs will be consistent with the guidance of NUREG-1804. A consistent test procedure format will be described in the Testing Program Plan. Prerequisites and precautionary measures needed to protect workers and the public during startup tests will be addressed in the testing procedures.

Testing of ITS and ITWI SSCs, as well as other SSCs supporting those operations, will be performed in accordance with approved testing procedures that incorporate or reference the requirements and acceptance criteria contained in applicable design documents and specifications. The testing procedures will require that test results be documented and evaluated to ensure that testing requirements are satisfied. The testing procedures will also require that test results that fail to meet the requirements and acceptance criteria be properly documented and that appropriate corrective action be taken.

The testing procedures will address the following areas, as appropriate:

- The purpose and role of the test in evaluating the performance of the function of any SSC, including:
  - Design requirements
  - Applicable industry codes and standards

- Prerequisites such as:
  - Calibrations to be performed or checked
  - Instrumentation
  - Tools and special equipment
  - Checks or settings for equipment or controls
  - Checks of radiation, environmental, or other monitors for acceptable range
  - Verification that precautionary measures associated with startup tests needed to protect workers and the public are in place
  - Confirmation that maintenance activities, such as preventive maintenance, component replacements, and general maintenance activities necessary to support testing, are complete
- The description of preceding testing and a discussion of its relationship to the current testing being performed
- The types of tests to be performed, objectives of the tests, expected response to the tests, range of acceptability of differences from the expected response key parameters, method of test validation, acceptance criteria for each test, and the methods to determine the proper corrective action for unexpected or unacceptable test results, along with any prerequisites
- The description of the series of testing steps to be taken, including logging of results, projected duration for completing the test, controls to be used in test performance, and identification of any threshold limits requiring contingency actions
- Requirements for records, including any forms or logs to be completed during operation
- The disposition of records and the identification of parties to be notified upon successful or unsuccessful completion of a function evaluation.

5.5.5 Component Testing

[NUREG-1804, Section 2.5.5.3: AC 1, AC 2, AC 3, AC 10, AC 11, AC 12]

Component testing is performed on individual components of a system and is used to verify that installation was performed correctly, that the component is appropriately energized and controlled, and that indications are that the component will function as desired. Component testing will be performed by the construction organization during the construction acceptance test phase. Factory acceptance testing, performed by vendors as part of the procurement contract, will often augment this testing. For as low as is reasonably achievable considerations, as many of the

operating startup activities as possible are performed during this and other preoperational training phases before radiation sources are present. Component testing would include such things as:

- End-to-end testing of electrical and instrumentation runs, such as continuity testing, meggering, line calibrations, and terminations
- Bumping of motors, if safe to do so, and motor run-in tests
- Flushing and in-service and leak testing of piping systems
- Calibration of gauges and other items that require calibration
- Verification of proper tagging or labeling of components
- Completion of as-built drawings to a predetermined level.

Completion of component testing and formal turnover from construction must occur as a prerequisite to functional testing of a system or subsystem. As discussed above, construction turnover generally includes component testing. Design information and data from preconstruction performance tests or evaluations (e.g., factory acceptance tests typically performed by vendors) will be considered in the development of the startup testing procedures. In addition, this turnover follows completion of component tagging and labeling, completion and turnover of key as-built drawings, and resolution of any remaining items on the preturnover punchlist. This turnover from construction may include functional testing, which involves full-load testing and operation of equipment involved in the handling of waste on a case-by-case basis (e.g., a crane may be operationally tested as part of a vendor's procurement contract following installation).

In construction of the underground facilities, observation and documentation of the natural system parameters will occur to confirm conformance with the bases of the total system performance assessment and will be documented as part of construction and performance confirmation documentation. This will occur prior to construction turnover of underground facilities.

Records of tests will be maintained in accordance with the requirements specified in Section 5.2. These records will include specific testing schedules and the testing results and evaluations for ITS and ITWI components.

The Engineering and Construction Manager will be responsible for the coordination of component testing and for any functional testing performed by construction. Component testing procedures will be reviewed and approved by the Engineering and Construction Manager. Component testing procedures will be prepared in accordance with the Testing Program Plan.

5.5.6 Systems Functional Testing

[NUREG-1804, Section 2.5.5.3: AC 2, AC 3, AC 10, AC 11, AC 12]

As systems or portions of systems are turned over from construction to the startup organization, systems functional testing will begin. Systems functional testing will include testing of complete individual systems or subsystems to ensure that the systems and subsystems are operational,

constructed as designed, and ready to safely support integrated system-level testing and ultimate turnover to operations. Each test will be performed in accordance with an approved test procedure that will define the testable requirements and provide the acceptance criteria for the system being tested. Systems functional testing will include testing of whole waste processing systems; heating, ventilation, and air-conditioning cascade systems (test and balance); and support systems such as area heating, ventilation, and air-conditioning (vent and balance), breathing and instrument air, and communications. Systems functional testing will also include any remaining full-load testing of equipment that will handle waste. Operations representatives and operators will observe this testing whenever feasible.

Special emphasis will be placed on systems functional testing of ITS or ITWI systems. Systems functional testing will include system-level testing of major ITS or ITWI functions to initially determine facility parameters and to verify the capability of SSCs to perform their safety functions. Table 5.5-1 shows functional testing for typical systems. These systems are selected from ITS and ITWI SSCs identified in Section 1.9.

Results of systems functional testing activities will be evaluated by design and safety disciplines to determine that the safety basis has or has not been met and to identify if any updates to the Testing Program Plan, modifications of the system or component, or testing procedure revisions are necessary. Records of tests will be maintained in accordance with the requirements specified in Section 5.2. These records will include specific testing schedules and the testing results and evaluations for applicable ITS or ITWI SSCs.

Acceptance criteria will be established to ensure worker safety, reliable and efficient operation of the equipment or system, and verification of the performance of design functions.

The Startup Manager will report to the Operations Manager and will be responsible for the coordination of the systems functional testing and for any functional component testing performed after a system or component is turned over to startup.

Qualifications of personnel preparing the systems functional testing procedures and performing the testing will be defined in the Testing Program Plan. Individuals leading these efforts will be experienced and qualified in the areas for which they are preparing procedures or performing tests.

Systems functional testing procedures will be reviewed and approved by the Test Review Board, which will consist of experienced personnel from relevant and diverse experience backgrounds. The role of the Test Review Board will be defined in the Testing Program Plan. The Startup Manager will also concur with the procedures prior to performing the tests. The Waste Handling Manager will also be asked to concur with the testing procedures for key systems.

5.5.7 Cold Integrated Systems Testing

[NUREG-1804 Section 2.5.5.3: AC 2, AC 3, AC 8, AC 10, AC 11, AC 12]

The purpose of cold integrated systems testing is to ensure that multiple systems can be operated together to facilitate safe and orderly handling, packaging, and emplacement of waste and to ensure that ITS and ITWI SSCs perform their intended safety functions as designed. Cold integrated systems testing will include a dry run (cold test) of each radioactive waste stream before sources of

radiation are present. The results of cold integrated systems testing will be reviewed and approved by the Startup Manager, the Operations Manager, and the Test Review Board.

Cold integrated systems testing is conducted under applicable testing procedures and consists of integrated system testing on those SSCs and operational processes associated with SNF and HLW receipt, handling, packaging, aging, and emplacement under appropriately simulated operating conditions in a manner that protects the workers and the public. Simulated conditions may include thermal conditions, heavy loads, or the use of radioactive sources to simulate some operations. Cold integrated systems testing also includes testing of SNF and HLW waste package closure and associated welding techniques, nondestructive testing examination techniques, supporting equipment, and nondestructive examination methods. Once systems functional testing and cold integrated systems testing are complete for SSCs for the initial receipt, handling, and emplacement of waste, these systems and facilities will be turned over to Facility Operations. Testing will continue as described in the Testing Program Plan for additional facilities and those auxiliary systems not required for initial operation. Records of tests will be maintained in accordance with the requirements specified in Section 5.2. These records will include specific testing schedules and the testing results and evaluations for ITS and ITWI SSCs.

The repository facilities are designed to receive and process SNF and HLW in a number of different physical forms and containers. The different types of waste or SNF containers to be handled include DOE HLW canisters, DOE SNF canisters (including standard canisters and multicanister overpacks), naval SNF canisters, and commercial SNF in transportation, aging, and disposal canisters. Repository operations will include receiving these various packages, off-loading the canisters from their transportation conveyance, placing them into waste packages; closing the waste packages; and transporting waste packages for emplacement in the repository drifts. In addition, some commercial SNF will not arrive at the repository packaged in transportation, aging, and disposal canisters. Commercial SNF may arrive in dual-purpose canisters or uncanistered in transportation casks. The repository facilities are designed to remove SNF from this packaging and repackage the SNF in transportation, aging, and disposal canisters prior to eventual disposal in waste packages. As a result, the Wet Handling Facility is designed to handle a wide variety of commercial spent fuel designs with varying dimensions and grappling fixtures.

The requirement to handle such a wide variety of waste forms, package geometries, and SNF types is unique to the repository. In order to ensure that the various waste forms and packaging can be safely handled, the cold integrated testing will make extensive use of mock-ups of each package type and each SNF type to be handled. The types of dry runs and mock-up testing to be performed in each ITS facility are shown in Table 5.5-2.

Operations personnel will participate in the cold integrated systems testing process and will utilize procedures developed by the startup organization working in concert with operations. Cold integrated systems testing serves the additional benefits of allowing operators to become familiar with the systems and concurrently verifying the procedures while still using simulated wastes. The Startup Manager will be responsible for cold integrated systems testing and will assume responsibility for the operations personnel working under his or her direction during this testing phase.

Qualifications of personnel preparing the cold integrated systems testing procedures and performing the testing will be defined in the Testing Program Plan. Individuals leading these efforts will be experienced and qualified in the areas for which they are preparing procedures or performing tests. Cold integrated systems testing procedures will be reviewed and approved by the Test Review Board. The role of the Test Review Board will be defined in the Testing Program Plan. The Startup Manager and the Operations Manager will also approve the procedures prior to performing the tests.

5.5.8 Operational Readiness Review

[NUREG-1804 Section 2.5.5.3: AC 11, AC 12]

Along with cold integrated systems testing but prior to initial startup operations involving the receipt of SNF or HLW, an operational readiness review will be performed for each facility and phase of the repository. The purpose of operational readiness reviews is to verify the ability of each facility and repository staff to safely receive, package, and emplace SNF or HLW in the repository. The Operational Readiness Review will consist of a programmatic and procedure review, equipment and staffing review, and a performance assessment of operators, support staff, and management. Operational Readiness Reviews will be initiated after the completion of cold integrated testing and the resolution of any resulting deficiencies that would impact safe operations. The Waste Handling Manager will determine when a specific facility or group of facilities is ready to begin operations with SNF or HLW and is available for an Operational Readiness Review.

The makeup of each Operational Readiness Review team will be specified in the Testing Program Plan (e.g., number of reviews and expertise required). In general, the Operational Readiness Review teams will consist of repository personnel who do not have direct line responsibility for the areas under review, augmented as necessary by outside personnel with appropriate experience in startup or operation of similar or related facilities.

The reviews will cover the following areas for each facility:

- **Construction**—Construction activities are complete (as required), drawings are updated and available in the document control system, open items are resolved, nonconformances are corrected, the acceptance construction test is completed and approved, and inspections are performed and accepted.

- **Engineering and Technical Support**—Onsite technical staffing is adequate and available. Design control procedures are approved and required vendor information and manuals, design bases calculations, and as-built drawings are available as approved documents through the document control system.

- **Operations**—Operating, off-normal, surveillance, and emergency response procedures are approved, operationally tested, and available in the document control system. Cold integrated systems testing including corrective actions for identified deficiencies and nonconformances, as required, are complete. Operational staff is trained and adequate to support operations.

- **Training**—Training procedures are approved; facility staff have completed required training.

- **Radiological Controls**—Radiation protection procedures are approved, health physics personnel are trained, required radiological posting is completed, and radiological monitoring equipment has been tested and is operational.

- **Maintenance and Surveillance**—Maintenance and surveillance procedures are approved, required spare parts are identified and available, postmaintenance testing is complete as required, and surveillances necessary to receive fuel are completed and current.

- **Organization and Management**—Procedures affecting organization and management are approved and available through document control; adequately trained and qualified personnel are available.

- **Security**—Security procedures are approved; adequately trained and qualified personnel are available. Security equipment has been tested and is operational.

5.5.9 Protection of Workers and the Public

[NUREG-1804, Section 2.5.5.3: AC 8, AC 11, AC 12]

Prerequisites and precautionary measures needed to protect workers and the public during startup tests will be addressed in the testing procedures. In consideration of ensuring that radiation doses are as low as is reasonably achievable, each phase of startup testing will be conducted, as practicable, prior to the placement of a source of radiation exposure in the area. A review of planned startup activities and associated testing will be performed during startup to ensure that the aggregate effects of the startup test and activities support the overall evaluation of the geologic repository operation level of safety for workers and the public.

5.5.10 Hot Testing (Initial Startup Operations)

[NUREG-1804, Section 2.5.5.3: AC 8, AC 10, AC 11, AC 12]

The purpose of hot testing and initial startup operations will be to demonstrate the ability, using evolved operating procedures, to receive, package, and emplace waste in a manner that protects the workers and the public. The repository, once the license to receive and possess SNF and HLW is issued, will perform the hot test using SNF or HLW. This testing will begin once an operational readiness review has confirmed that the facilities, systems, and the operating personnel are prepared for hot operations. Operations personnel using approved operating procedures perform this activity. The Waste Handling Manager will be responsible for this testing.

The hot test will be performed in accordance with the Testing Program Plan and will include the following elements:

- Tests and confirmations of procedures and exposure times involving actual radioactive waste

- Direct radiation monitoring of casks and shielding for radiation dose rates, streaming, and surface hot spots

- Verification of effectiveness of heat removal procedures
- Tests of ITS SSCs as identified by the preclosure safety analysis that could not be adequately tested by component testing or cold integrated systems testing
- Documentation of results and test evaluations.

Prior to performance of a hot test, several activities must be completed. These include:

- Ensuring that the punchlist of any critical items is closed and that the closure is documented
- Ensuring that earlier testing phases, including the Operational Readiness Review, are complete and documented and that necessary corrective actions resulting from those tests are complete
- Verifying that operating and maintenance procedures are in place and approved as necessary to conduct the test
- Ensuring that operators and crafts are available with proper training qualifications to perform the test safely
- Verifying that the earlier testing demonstrated that, during an off-normal incident in the facility, the incident can be responded to appropriately
- Verifying that drawings needed for critical operations control and emergency situations are as-built and available.

Qualifications of personnel preparing the hot testing procedures and performing the testing will be defined in the Testing Program Plan. These procedures will be developed from the cold integrated systems testing procedures. Individuals leading these efforts will be experienced and qualified in the areas for which they are preparing procedures or performing tests.

Hot testing procedures will be reviewed and approved by the Waste Handling Manager, the Onsite Safety Committee, and key support organization management as defined in the Testing Program Plan prior to performing the tests. The hot testing procedures will be modified, as necessary, following the hot testing and will become the operating procedures to be used in sustained operations.

5.5.11 Schedules

[NUREG-1804, Section 2.5.5.3: AC 9]

Full operational capability of each facility in the geologic repository operations area will be achieved over distinct time intervals. Sections 1.2.1 and 1.3.1 describe the phased construction of the surface and subsurface facilities, respectively. Prior to each facility receiving waste, the Startup and Testing Program will test the capability of receiving, packaging, emplacing, and aging waste and limiting the release of radioactive materials, as appropriate. Startup testing will be completed

as specified in the Testing Program Plan. The Testing Program Plan will include plans specific to that facility to be developed, approved, and implemented prior to receipt of waste.

A summary schedule for conducting each phase of the testing will be provided in the Testing Program Plan, and this schedule will be compatible with schedules for waste receipt, repackaging, storage, and disposal, including activities that might overlap. Detailed procedures will be developed in a phased manner to support the initial operation of the facility. Likewise, subsequent phases will utilize procedures that are prepared and approved for testing specific to those phases.

The Startup and Testing Program will require that copies of the approved testing procedures be made available for NRC inspection approximately 90 days prior to the intended use of those procedures.

5.5.12 Testing and Evaluating Functional Adequacy of New or Untested Systems, Structures, and Components

[NUREG-1804, Section 2.5.5.3: AC 10]

New ITS or ITWI SSCs, or untested configurations of such SSCs, will be tested or otherwise validated and evaluated prior to receipt of radioactive waste. To the extent practicable, the design of the repository relies upon SSCs based on components whose reliability has been established by experience in the nuclear power or other industries. The surface facilities involve SSCs that are similar to those found at commercial nuclear power plants and elsewhere in other DOE facilities (e.g., cask handling cranes and spent fuel handling machines).

Some aspects of the repository, however, will utilize new applications or combinations of existing technology that are unique to the repository. In instances of new or untested SSCs, the Testing Program Plan and procedure basis development will account for this first-of-a-kind application. For example, vendor information, including test data, technical literature searches, engineering analyses reports, records of bases for development, and process analysis will be particularly important for developing a thorough basis for tests and procedures. During procedure performance, additional administrative controls including hold points, intermediate performance analyses, and expanded oversight will be applied. Expected system responses can be identified at intermediate steps in the procedure, limitations can be particularly stringent, and special attention can be committed to potential problems and hazards.

Consideration will be given to the use of dry runs using mock-ups and full load testing to ensure that the functional adequacy of such SSCs will be confirmed by the test program in accordance with the Testing Program Plan, as described above. The transport and emplacement vehicle, described in Section 1.3.3, is an example of this type of SSC. The transport and emplacement vehicle is a remotely operated, rail-based carriage with a shielded enclosure that carries the loaded waste packages and emplacement pallets from the surface handling facilities to their location in the emplacement drift. The transport and emplacement vehicle cold integrated testing will include dry runs of each aspect of transport and emplacement vehicle operation, from waste package loading at the surface to final waste package emplacement. These dry runs will be conducted using mock-ups that replicate the geometry and weight of expected waste packages.

5.5.13 General References

ASME NOG-1-2004. 2005. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*. New York, New York: American Society of Mechanical Engineers. TIC: 257672.

NRC (U.S. Nuclear Regulatory Commission) 1980. *Control of Heavy Loads at Nuclear Power Plants*. NUREG-0612. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 209017.

Regulatory Guide 1.9, Rev. 3. 1993. *Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238563.

Regulatory Guide 1.30. 1972. *Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238564.

Regulatory Guide 1.41. 1973. *Preoperational Testing of Redundant On-Site Electric Power System to Verify Proper Load Group Assignments*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 2706.

Regulatory Guide 1.52, Rev. 3. 2001. *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20060105.0199.

Regulatory Guide 1.68, Rev. 2. 1978. *Initial Test Programs for Water-Cooled Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20070906.0158.

Regulatory Guide 1.116. 1976. *Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20050406.0223.

Regulatory Guide 1.118, Rev. 3. 1995. *Periodic Testing of Electric Power and Protection Systems*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 223061.

Regulatory Guide 1.128, Rev. 1. 1978. *Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238334.

Regulatory Guide 1.140, Rev. 2. 2001. *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20050516.0416.

Regulatory Guide 3.48, Rev. 1. 1989. *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: HQX.19921111.0004.

Shearer, C.R.H. 2006. "Issuance of DOE O 210.2, DOE Corporate Operating Experience Program, dated June 12, 2006." Memorandum for distribution from C.R.H. Shearer (DOE) to Distribution, 0728065527, July 20, 2006. ACC: MOL.20060915.0089.

INTENTIONALLY LEFT BLANK

Table 5.5-1. Typical Systems Functional Testing

Structures, Systems, and Components	Summary of System Functional Testing
Cranes and trolleys	Functional tests of controls and interlocks and load testing (e.g., the testing requirements in ASME NOG-1-2004, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*
Heating, ventilation, and air-conditioning systems	Functional tests to include controls and interlocks, ventilation flow and balance, and high-efficiency particulate air filter efficiency
Transport and emplacement vehicle	Functional tests of controls and interlocks and load testing (e.g., the testing requirements in ASME NOG-1-2004)
Instrumentation and controls	Channel functional tests and channel calibrations
Electrical distribution system	Functional tests (e.g., testing as described in Regulatory Guide 1.118, *Periodic Testing of Electric Power and Protection Systems*)

Table 5.5-2. Types of Dry Run and Mock-Up Testing

Facility/SSC	Dry Runs/Mock-Up Testing
Initial Handling Facility	Demonstrate cask or canister handling capability using mock-ups of DOE HLW and naval SNF. Demonstrate capability to receive empty waste packages. Demonstrate capability to unload transportation casks using mock-ups. Demonstrate capability to load completed waste packages into the transport and emplacement vehicle using mock-ups. Demonstrate capability to close the waste packages using automated welding equipment.
Canister Receipt and Closure Facility	Demonstrate capability to handle HLW and DOE SNF canisters (not including naval SNF) and transportation, aging, and disposal canisters containing commercial SNF by using mock-ups. Demonstrate capability to close the waste packages using automated welding equipment. Demonstrate capability to load completed waste packages into the transport and emplacement vehicle using mock-ups. Demonstrate capability to identify damaged canisters and waste packages that can be repaired in the Canister Receipt and Closure Facility. Demonstrate capability to identify damaged canisters and waste packages that cannot be repaired in the Canister Receipt and Closure Facility and the capability to transport them to the Wet Handling Facility for repair. Demonstrate the capability to receive transportation, aging, and disposal canisters and to transfer them into aging overpacks.
Wet Handling Facility	Demonstrate cask or canister handling capability using mock-ups of transportation, aging, and disposal canisters and dual-purpose canisters. Dry runs will include the capability to unload truck- and rail-based transportation casks and transfer SNF canisters to the Wet Handling Facility pool. Demonstrate capability to handle range of commercial SNF types underwater and to transfer SNF from transportation casks and dual-purpose canisters into transportation, aging, and disposal canisters. Demonstrate ability to open various dual-purpose canisters using mock-ups. Mock-ups to demonstrate ability to close loaded transportation, aging, and disposal canisters using automated welding equipment. Demonstrate ability to load transportation, aging, and disposal canisters into shielded transfer casks or aging overpacks using mock-ups.

Table 5.5-2. Types of Dry Run and Mock-Up Testing (Continued)

Facility/SSC	Dry Runs/Mock-Up Testing
Receipt Facility	Demonstrate cask or canister handling capability using mock-ups of transportation, aging, and disposal canisters and dual-purpose canisters. Dry runs will include the capability to unload rail-based transportation casks containing transportation, aging, and disposal canisters and dual-purpose canisters. Demonstrate capability to transfer the transportation, aging, and disposal canisters and dual-purpose canisters from transportation casks into shielded transfer casks or aging overpacks. Demonstrate capability, including decontamination, to prepare unloaded transportation casks and railcars for return to the national transportation system. Demonstrate, using mock-ups, the ability to process low-level radioactive waste.
Aging Pads	Demonstrate, using mock-ups, the capability of crawler-type site transporters to move aging overpacks containing canisters of commercial SNF between aging pads and various surface facilities (Canister Receipt and Closure Facility, Receipt Facility, and Wet Handling Facility) and to position overpacks on designated aging pad locations.
Transport and Emplacement Vehicle/Subsurface	Using mock-ups, demonstrate the ability of the transport and emplacement vehicle to load completed waste packages from the Initial Handling Facility and Canister Receipt and Closure Facility and to deposit waste packages in a drift.

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5.6 PLANS AND PROCEDURES FOR CONDUCT OF NORMAL ACTIVITIES, INCLUDING OPERATIONS, MAINTENANCE, SURVEILLANCE, AND PERIODIC TESTING

This section describes plans and procedures for conducting operations, maintenance, surveillances, and periodic testing at the repository and addresses specific regulatory requirements contained in 10 CFR Part 63 and acceptance criteria contained in Section 2.5.6.3 of NUREG-1804. The following table lists the information provided in this section, the corresponding regulatory requirement, and the applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference (and Changes to NUREG-1804 from HLWRS ISGs)
5.6.1	Plans and Procedure Development	63.21(c)(22)(v)	Section 2.1.1.6.3: Acceptance Criterion 2(1) Section 2.5.6.3: Acceptance Criterion 1 Acceptance Criterion 2 Acceptance Criterion 3 Acceptance Criterion 4 HLWRS-ISG-004 Section 2.5.6.3: Acceptance Criterion 4(5)
5.6.3	Plans and Procedures for Normal Operations	63.21(c)(22)(v)	Section 2.5.6.3: Acceptance Criterion 1 HLWRS-ISG-004 Section 2.5.6.3: Acceptance Criterion 1(4)
5.6.4	Plans and Procedures for Maintenance	63.21(c)(22)(v)	Section 2.5.6.3: Acceptance Criterion 2 HLWRS-ISG-004 Section 2.5.6.3: Acceptance Criterion 2(4)
5.6.5	Plans and Procedures for Periodic Surveillance Testing	63.21(c)(22)(v)	Section 2.5.6.3: Acceptance Criterion 3 Acceptance Criterion 4 HLWRS-ISG-004 Section 2.5.6.3: Acceptance Criterion 3(5)

Pursuant to Section 2.5.6 of NUREG-1804, prior to the receipt and possession of waste, plans and procedures will be developed for the conduct of normal activities, including operations, maintenance, surveillance, and periodic testing of structures, systems, and components (SSCs) and processes, based on the preclosure safety analysis and the total system performance assessment. Such plans and procedures will be developed in a phased manner to support the operation of each handling facility as the construction of each facility is completed. The plans for phased startup activities and testing are presented in Section 5.5.

Plans and procedures will ensure that controlled methods govern the conduct of normal activities, including administrative procedures to control changes to such procedures. Procedures will also address the response to off-normal operations and accident conditions.

Normal activities include operations, maintenance, and surveillance and periodic testing of SSCs, including those important to safety (ITS) or important to waste isolation (ITWI). Plans and procedures for each handling facility will be available on site for U.S. Nuclear Regulatory Commission (NRC) inspection prior to receipt of waste at that facility. Broad categories of normal activities include:

- Acceptance of waste
- Aging of waste incident to disposal
- Packaging of waste into waste packages
- Receipt and return (reuse) of transportation casks or containers
- Emplacement of waste
- Support operations associated with the above activities, including preventive maintenance.

Startup and operations personnel will be involved in developing startup and operating procedures, which startup personnel will use as a basis for development of startup test procedures. The results of startup tests will be used, as applicable, to modify operating procedures to ensure a smooth transition from the startup phase to the operations phase. Startup testing is discussed in Section 5.5.

The Conduct of Operations Plan and the Conduct of Maintenance Plan will be developed in advance of receiving a license to receive and possess spent nuclear fuel and high-level radioactive waste. These plans will define the approach to operating the repository. Both plans will identify the SSCs to be included in their respective scopes and will be patterned after published nuclear industry guidelines for conduct of operations.

These plans will take into account simultaneous operations and construction activities within the geologic repository operations area. Since construction will continue after operations have begun, the integrity of the physical barriers, the operational control of activities that may impact either construction or operations, and control of security boundaries that separate the two ongoing activities will be administered by procedural controls that will ensure construction activities do not adversely affect operations and remain within the analyzed basis of the safety analysis. Communications systems will enable efficient coordination of the interfaces between operations and construction.

In the subsurface, the interface between construction activity and emplacement operations areas will be controlled by use of physical isolation barriers for operational, safety, radiological, and security purposes. Access and radiological controls will be in place to ensure authorized entry to

tunnels, turnouts, and emplacement drifts. Movement of the isolation barriers, as well as access to the North Portal, will be controlled by operations, as approved by the Site Protection Manager.

In the vicinity of the surface geologic repository operations area, the interface between construction activity and handling operations will be separated and controlled by a double fence with appropriate safeguard measures. This fence will be relocated as construction activities progress. Movement of the fence, as well as access to operating facilities, will be controlled by operations, as approved by the Site Protection Manager.

An emergency plan that takes into account both construction and operation activities will also be in place prior to the receipt of waste (Section 5.7). The repository organization, which includes both construction and operations functions and the responsibilities of the managers of those functions, is described in Section 5.3. The Site Operations Manager will manage the interfaces between receipt, processing, and aging of spent nuclear fuel and high-level radioactive waste and continuing site construction activities.

The operating organization will initiate staffing while facilities are under construction. Operators and maintenance craft personnel will be hired and trained in advance to provide support for preoperational and initial startup testing. Operators and maintenance craft personnel will be trained in accordance with the training program (Section 5.3.3). The responsibilities and duties of operators and maintenance craft personnel will be evaluated to determine qualification or certification requirements. Operators will be trained and certified to perform those responsibilities and duties, as appropriate. The Conduct of Operations Plan and Conduct of Maintenance Plan will define activities requiring procedural controls. Likewise, employees will receive training on the procedures governing their responsibilities and duties.

Surveillance and routine test plans and procedures will be developed consistent with the operating approaches to be described in the Conduct of Operations Plan and the Conduct of Maintenance Plan. Plans for surveillance and periodic testing are discussed in Section 5.6.5.

5.6.1 Plans and Procedure Development

[NUREG-1804, Section 2.1.1.6.3: AC 2(1); Section 2.5.6.3: AC 1, AC 2, AC 3, AC 4; HLWRS-ISG-004, Section 2.5.6.3: AC 4(5)]

Plans and procedures for operations, maintenance, surveillance, and periodic testing of SSCs and processes, including procedural safety controls, will be written, tested, and approved by the Waste Handling Manager prior to receipt of waste. Examples of normal activities that will be subject to procedural controls include:

- Accepting waste
- Handling waste
- Transferring waste from transportation casks into waste packages
- Transferring waste from transportation casks into aging overpacks

- Moving aging overpacks to and placing them on concrete aging pads and, after aging, returning them to the handling facility
- Transferring waste from aging overpacks into waste packages
- Welding waste packages
- Performing weld inspections
- Moving and placing waste packages underground
- Responding to alarms.

Procedures for operations, maintenance, surveillance, periodic testing activities, and removing systems from and placing systems in service will be developed in accordance with applicable NRC and industry guidance, and will be documented in the Conduct of Operations Plan. Procedures will contain descriptions of the activities to be performed. Development and distributions of procedures and revisions to procedures will be administratively controlled. Procedures, programs, and manuals required by license specifications are discussed in Section 5.10.

The management systems for operation of the repository include administrative and procedural safety controls. These procedural safety controls are activities performed by personnel to ensure that operations are within analyzed conditions of the preclosure safety analysis and total system performance assessment. Management systems implement administrative and procedural safety controls relied upon for safe operations.

Qualified safety, health, environmental, and quality assurance organization personnel who are independent of the operating management organization will review procedures and provide integrated comments for revisions to procedures prior to their implementation. The reviewers will collectively have the experience and competence required for reviewing issues in the following areas, although individuals may be competent in more than one of the areas listed:

- Quality assurance/quality control
- Nuclear engineering
- Operations
- Chemistry and radiochemistry
- Maintenance
- Metallurgy
- Nondestructive inspection and testing
- Instrumentation and control
- Radiological protection
- Mechanical, civil, electrical, and environmental engineering
- Fire protection
- Administrative controls and quality assurance practices
- Environment, safety, and health.

Administrative procedures will govern personnel safety, the working environment, procurement, and other general activities.

Administrative procedures that establish the process for the review, change, and approval of operations, maintenance, surveillance, and periodic testing procedures for ITS or ITWI SSCs will include appropriate management controls. These management controls will also address the approval process of on-the-spot procedure changes that may be necessary to address unanticipated conditions. The Onsite Safety Committee (Section 5.3.1.5) will review and concur on repository procedures and changes, as deemed appropriate by the Site Operations Manager. Operations will approve the procedures and changes.

Typically, procedures for normal activities performed on operating SSCs will contain the following information:

- Purpose
- Responsibilities
- Qualifications and training requirements
- Description of the activities necessary to perform operations, maintenance, surveillance, or periodic testing, considering the following:
  - Expected results of activities
  - Period of performance for completion of an activity
  - Expected instrument or gauge readings during the activity
  - Controls to be used while performing the activity
  - Threshold parameters requiring contingency actions
- Prerequisites to performance of the activities, including:
  - Calibrations to be performed or checked
  - Instrumentation required
  - Tools and special equipment needed
  - Notifications to other operations, maintenance, surveillance, and testing personnel, as appropriate, with associated lead times
  - Checks or settings for equipment or controls, including load limits, travel limits, calibration limits, and minimum testing frequency intervals
  - Operational checks of radiation, environmental, or other monitoring instrumentation and the presence of any safety or other information tags

  - Logs and records associated with the operation, maintenance, surveillance, or periodic testing activity

- Records to be developed and parties to be notified

- Lockout and tagout requirements

- Identification of actions required as a result of the activity.

5.6.2 Use of Experience from Other Facilities

Relevant repository operating experience and lessons learned used at other facilities that perform similar operations will be evaluated, and the results of those evaluations will be incorporated in the initial development and ongoing maintenance of repository operating procedures. The U.S. Department of Energy (DOE) has implemented an extensive program for the management of operating experience to prevent adverse operating incidents and to expand the sharing of good work practices among DOE sites. The program is intended to provide the systematic review, identification, collection, screening, evaluation, and dissemination of operating experience from the NRC, other U.S. and foreign government agencies, and industry, professional societies, trade associations, national academies, universities, and the DOE and its contractors. Since the DOE operates many facilities with features similar to the repository surface handling facilities and also operates the Waste Isolation Pilot Plant, the DOE expects to derive considerable benefits from those programs and apply them to the Yucca Mountain Project.

The DOE Corporate Operating Experience Program (Shearer 2006) has the following features:

- It is a formal process established to evaluate operating experience from the DOE and related government or industry programs, technologies, and facilities.

- Sources of operating experience are used to assess trends and safety issues that may have a bearing on the safety and success of DOE missions. Sources include DOE contractors; DOE programs and site offices, including naval reactors; external sources, including the NRC and other government agencies; and industry, both domestic and international.

- Operating experience is collected, stored, and retrieved through a central clearinghouse that allows ready access to and communication about collected information on a timely, unimpeded basis by all DOE elements. The Corporate Operating Experience Program Lead Office, which is responsible for operating the clearinghouse, ensures that data are sufficiently comprehensive and of sufficient quality to meet DOE needs and develops, promulgates, and maintains support systems needed to implement and sustain an effective program, including the computerized data systems for environment, safety, and health reporting.

- Performance indicators and trends, site-specific issues, generic technical issues, and management or institutional issues are incorporated into the program.

- Designated Corporate Operating Experience Program Lead Office feedback communications on identified environment, safety, and health operating experience issues with DOE Headquarters and field organizations, contractors, industry, and other federal agencies and the public are conducted through actionable or informative operating experience documents.

A variety of reports are issued under this program to communicate potentially applicable operating experience to DOE units. These reports are disseminated via formal correspondence, posted/pushed to users of the DOE Corporate Lessons Learned Database, and posted on the DOE lessons learned web page to facilitate communications.

5.6.3 Plans and Procedures for Normal Operations

[NUREG-1804, Section 2.5.6.3: AC 1; HLWRS-ISG-004, Section 2.5.6.3: AC 1(4)]

A Conduct of Operations Plan will be developed providing performance expectations to be implemented by procedures addressing the following topical areas:

- **Operations Management and Leadership—**These procedures will define and publish operating policies; identify leadership and accountability for the quality of work that could impact operations; define management directions and expectations; define planning for scope of work to be performed; provide requirements monitoring and assessing of requirements; investigate off-normal events with follow-up, reinforcement, and feedback to management; assess human performance for improvements; define warning flags representing conditions that may be precursors to poor performance or off-normal events; and define how operating experience will be utilized to make informed decisions.

- **Conduct of Operations—**These procedures will provide methods to develop and report status of ongoing activities; define control room environment and activities to allow personnel on official business only; define log-keeping of the status, events, and recording of other data; define operator rounds for specific equipment and conditions; define use of operating experience to provide timely in-house information to operations personnel; define chemistry for operating equipment (e.g., oil samples and boron concentration in the Wet Handling Facility); identify use of equipment performance and material condition data to support periodic reviews of single-point failures to identify and resolve vulnerabilities; define review requirements for scheduled maintenance and approval protocols for maintenance work prior to start of work; and identify that outages are planned and scheduled based on operations. Repository procedures are to be followed verbatim to ensure that activities are conducted safely and in accordance with regulatory requirements. If a procedure cannot be performed as written, the person performing the activity will stop the activity and, if necessary, place the system or component in a safe condition. The Shift Supervisor will be notified of procedure inadequacies and the activity will not resume until corrective actions have been implemented.

- **Operator Knowledge and Skills—**These procedures will define training requirements and qualification of operations personnel, define responsibilities for maintaining and administering operations training, and identify typical warning flags related to operator performance or training.

- **Operations Procedures—**These procedures will establish the use, approval, and control of operations procedures, establish operator aid guidelines, and identify conditions that may result in warning flags, as defined by operations management and leadership activities.

- **Operations Facilities and Equipment—**These procedures will establish methods to ensure facility housekeeping and proper equipment labeling and to ensure communication equipment is provided to support operational activities.

- **Facility Status and Configuration Control**—These procedures will establish methods to identify the facility status and ensure operating equipment is in the proper configuration, control the use of temporary modifications, define the tagging system implementation in conformance with the lock-and-tag procedures, define the proper use of caution (information) tags, provide component configuration control, and identify warning flags. These procedures will also provide for the control of instrument and control system setpoints.

- **Work Management Process—**These procedures will prescribe the work management process, establish protocols for adherence to maintenance requests, and establish review requirements for completed maintenance requests. These activities also establish plans for preventive maintenance activities and scheduling, coordination of maintenance activities, short-duration outage preplanning and scheduling, and postmaintenance and post modification test requirements.

- **Procurement of Parts, Materials, and Services—**These procedures will establish methodology for procurement, establish requirements for materials receipt and inspection and for handling parts and materials following receipt, and establish requirements for parts and materials storage, retrieval, and issuance.

- **Notifications—**These procedures will prescribe NRC and DOE notification requirements, identify notification responsibility, define procedures for maintenance of names and phone numbers, establish documentation requirements for completed notifications, and identify necessary communications equipment and use. Reporting requirements to the NRC are discussed in Section 5.2.

- **Operations Turnover—**These procedures will establish and place into use turnover checklists, define protocols for document review (e.g., logs) necessary at turnover, define control panel and console status reviews necessary at turnover, prescribe the performance of shift crew briefings at turnover, and establish shift change protocols for transfer of responsibility to relief personnel.

- **Required Reading—**These procedures will define reading assignments and establish time frames for completion of reading, requirements for documentation of required reading performed, and supervisory review of required reading status.

Operating procedures will provide instructions for activities necessary to be performed during normal and off-normal operation. The procedures will ensure that SSCs and their operating

limitations, as identified in the preclosure safety analysis, remain within their analyzed bases during operations. The procedures will also ensure that analytical bases of the total system performance assessment are satisfied appropriately in the performance of facility operations.

Operating procedures will include actions to be taken for normal and off-normal operations and Category 1 and Category 2 event sequences, as applicable, including responses to alarms. Contingency steps will be provided, as appropriate, for each operating procedure for ITS or ITWI SSCs.

5.6.4 Plans and Procedures for Maintenance

[NUREG-1804, Section 2.5.6.3: AC 2; HLWRS-ISG-004, Section 2.5.6.3: AC 2(4)]

This section identifies the processes, procedures, and programs that will be developed and implemented in support of the maintenance function which covers a wide range of topics such as the physical plant, configuration management and controls, and surveillance and testing. As a result, this section defines the process of how the maintenance program will comply with the functional requirements as established by the preclosure safety analysis and the postclosure performance assessment.

The maintenance function in support of the facility's SSCs will be performed in accordance with written, tested and approved procedures; documented instructions; checklists; and design or vendor drawings that conform to applicable codes and standards, specifications, and other appropriate criteria. The implementation of these processes and procedures will establish specific performance expectations based on the following topical areas.

5.6.4.1 Physical Plant Maintenance Philosophy and Strategy

Reliability Centered Maintenance is a systematic process by which equipment important to the repository's function is properly identified and specific maintenance activities are assigned and performed at the proper frequency to ensure reliability goals are achieved and/or maintained. The Reliability Centered Maintenance process consists of the following steps:

- **Step 1**—Identify ITS and ITWI SSCs based on 10 CFR 63.102(f) and (h).
- **Step 2**—Boundary Definition: Define the interface with other systems that have been or will be analyzed as part of this process.
- **Step 3**—Data Collection: SSC performance as applicable for the repository and/or based on operating experience from similar components in service at other locations. Pertinent system/component configuration and safety analysis documentation will be used to conduct an effective Reliability Centered Maintenance analysis.
- **Step 4**—SSC Functional Failure Identification and Failure Modes and Effects: Identify the possible failures that each SSC could experience based upon applicable functions for the system/component and the operations of the SSC.

- **Step 5**—Preventive Maintenance Task Recommendations: Identify or select an effective and applicable preventive maintenance task. Careful consideration must be applied to ensure that the proper appropriate task is selected to address failure modes and effects analysis output.

- **Step 6**—Preventive Maintenance Task Comparison: Once the preventive maintenance task selection has been determined, compare and reconcile the new preventive maintenance with the recommended task that may be identified by the original equipment manufacturer, where appropriate. This step represents the optimization step by insuring the proper preventive maintenance elements are in place and the task redundancy or inefficiencies are addressed and taken credit for.

The Reliability Centered Maintenance methodology will be the primary analytical tool in the development of the repository's basis for maintenance function and to insure that ITS and ITWI SSCs are operated and maintained to ensure the required degree of performance and reliability assumed by the preclosure safety analysis or the postclosure performance assessment. Table 1.9-1 contains the listing of ITS SSCs, and Table 1.9-8 contains the listing of ITWI SSCs.

In order to establish a comprehensive approach towards protecting the repository design bases, a maintenance philosophy will be developed that reflects a proactive approach towards preventing or mitigating Category 1 or Category 2 event sequences, as well as maintain non-ITS or non-ITWI SSCs.

The Yucca Mountain maintenance philosophy will reflect a condition-based maintenance strategy that represents the optimization of traditional preventive maintenance programs through the application of Reliability Centered Maintenance. A condition-based maintenance strategy consists of several distinct elements identified below. By applying the Reliability Centered Maintenance process, the correct preventive maintenance task and frequency will be applied.

"Run to Failure" Maintenance—SSCs that if operated until failure occurs will not affect safety, operation, or generate a significant loss or increased risk other than repair costs.

Time Based (Routine) Maintenance—Consists of periodically inspecting, testing (surveillance), servicing, cleaning, replacing, or overhauling components based on original equipment manufacturer recommendations.

Predictive Maintenance—Used to trend and monitor equipment performance and predict the need to perform corrective maintenance before failure occurs. The following are examples of predictive maintenance:

- Vibration analysis
- Lubricant analysis
- Thermography.

Corrective Maintenance—The restoration of equipment or components affecting personnel safety or facility reliability that have failed, are degraded, or do not conform to their original design, configuration, or performance.

5.6.4.2 Maintenance Program Implementation

To ensure maintenance activities, tests, surveillances, and modifications are in compliance with the SAR, the maintenance program will provide administrative controls for maintenance planning, work control, equipment control, measuring and test equipment, and special process controls.

5.6.4.2.1 Maintenance Activities

Maintenance activities are focused on maintaining or restoring SSCs to their as-designed condition, including activities that implement engineering design changes. Maintenance activities include troubleshooting; inspections; surveillances; calibration; refurbishment; maintenance-related testing; replacements; housekeeping; and similar activities that do not permanently alter the design (unless approved by engineering); performance requirements and operation or control of SSCs.

5.6.4.2.2 Maintenance Facilities, Tools, and Equipment

One key element of the maintenance program will be the focus on the repository's facilities, tools, and special equipment as identified in the SAR. Specific processes and supporting procedures will identify the applicable maintenance requirements and tool control protocols, as well as establish the appropriate protocols in support of controlling and monitoring measurement and test equipment per Section 5.6.4.9.

5.6.4.3 Equipment Controls

Maintenance performed on either isolated equipment or energized operating equipment is performed in accordance with applicable procedures and work controls.

5.6.4.3.1 Equipment Tagging and Isolation

Operations Department personnel hang the appropriate tags and manipulate equipment to isolate it for maintenance. Personnel to whom tags are issued are responsible for verifying proper tagging. Equipment tagging and isolation is implemented in accordance with the equipment tagging and isolation procedures as administered by the Operations Department.

5.6.4.3.2 Housekeeping and Material Condition

Housekeeping activities at the repository help ensure personnel and operational safety is maintained. Specific housekeeping requirements are stipulated during the preparation and execution of work control documents and procedures. Inspections are performed during and after maintenance activities to ensure that equipment is returned to service only when it meets applicable postmaintenance testing and material condition criteria.

5.6.4.3.3 Foreign Material Exclusion

The maintenance function will develop and implement the applicable processes and procedures in order to control the inadvertent introduction of foreign objects that could have a negative impact on

the safe and reliable operation of the repository's SSCs. Foreign material exclusion will be an important component of the work planning and maintenance functions.

5.6.4.3.4 Postmaintenance Testing

Processes and procedures will be developed and implemented in support of component and/or system testing following certain maintenance activities to verify that the equipment operates as designed. Examples are as follows:

- **Time Based**—Maintenance instructions and/or procedures will identify when and what postmaintenance testing is required. The testing requirements should normally be part of and controlled by the work order package.

- **Corrective Maintenance**—The work order package shall specify the postmaintenance testing required after corrective maintenance has been completed in order to verify operability.

5.6.4.4 Configuration Management

The maintenance function includes configuration controls to specify and control data in support of the design basis, design requirements, operational configuration, reliability requirements or other attributes associated with ITS and ITWI SSCs. The configuration management system is described in the introduction to Chapter 5.

5.6.4.5 Equipment Performance Monitoring

ITS SSCs will be operated and maintained in accordance with the preclosure safety analysis to ensure the required degree of performance and reliability is established and sustained. Similarly, applicable ITWI SSCs will be operated and maintained in accordance with the postclosure performance assessment. To ensure compliance, applicable processes and procedures will establish standards, provisions and approaches for monitoring and assessing equipment performance. Performance monitoring will address all applicable facets of the system down to the component level. Establishing effective performance metrics and the process of trending and analyzing these metrics will be critical elements of overall performance monitoring. Key components of effective performance monitoring consist of:

- System Walk-downs: Procedures will be established in support of conducting walk-downs to assess the material condition of systems/components as part of performance monitoring. Implementing procedures will provide guidance on how to identify and report areas of concern as well as establishing an overall trending and tracking process for system material condition. The results of system walk-down will be an input to the system/component health report process. Walk-downs are intended to reinforce the standards for aggressiveness and thoroughness in identifying and evaluating conditions and/or deficiencies prior to their imposing a negative effect on the system or component.

- System/Component Health Reports: Procedures will be established to develop system and/or component health reports which will provide management with an effective tool to focus attention and resources on systems/components that indicate degrading trends in performance or are not meeting established performance goals.

- Operating experience is valuable input for the maintenance engineer. Industry events shall be evaluated with respect to applicability to the facility (Section 5.6.2).

5.6.4.6 Maintenance Personnel Knowledge, Skills, and Training

Procedures will establish maintenance function requirements in support of developing and implementing maintenance personnel training and qualifications requirements in accordance with Section 5.3. These activities will establish requirements for maintenance personnel required training schedules, methods for the retention of qualifications, and program record-keeping requirements. In addition, these activities will identify who provides training program approval and will establish methods for determining maintenance training effectiveness and feedback evaluations, management and supervisory training protocols, and direct control of contractor and other personnel not normally assigned to the work area.

5.6.4.6.1 Training

Training and qualifications of maintenance personnel are controlled, conducted, and documented as described in Section 5.3.

5.6.4.6.2 Job Assignments

The qualifications and training of maintenance personnel are considered when maintenance activities are assigned. Minimum attributes used when determining specific job functions are:

- Familiarity of personnel with the maintenance activity
- Complexity of the maintenance activity
- Requirements for special training and/or specific qualifications requirements.

Personnel assigned to assist in performance of a task are not required to be qualified maintenance personnel, but may be permitted to perform work under the supervision of a qualified person.

Personnel who perform job briefings, assign hold points, and directly supervise staff or contractors during the performance of maintenance or modification activities on facility SSCs shall maintain a supervisor qualification.

Special processes, such as welding, heat treating, and nondestructive testing examination, are performed in accordance with appropriate procedures controlling such activities.

5.6.4.7 Work Management Process

Work management implementing procedures are intended to ensure operational and personnel safety by providing timely identification, selection and planning coordination and execution of

work necessary to maximize the availability and reliability of repository equipment and systems. In addition, work management activities are intended to manage risk, identify the impact of the work on the repository or facility, and maximize efficiency and effectiveness of staff and resources. Processes and procedures will be developed to implement work management activities.

5.6.4.8 Maintenance Procedures

Maintenance of SSCs shall be performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances.

5.6.4.8.1 Compliance with Written Instructions

Maintenance procedures will be written in accordance with the Conduct of Maintenance Plan.

5.6.4.8.2 Use, Development, and Approval

Maintenance procedures will establish protocols for procedure development, check of procedures prior to use, procedure approval and use, adherence requirements to procedure controls, and performance of periodic reviews and revisions to procedures.

5.6.4.8.3 Selective Use of Content

Maintenance procedures will be written and approved with the intent that applicable portions of a procedure may be used for corrective maintenance of limited scope.

5.6.4.9 Calibration and Testing

The maintenance function includes the development, implementation and control of activities and procedures in support of:

- The calibration of installed equipment
- The measuring and test equipment used to test and calibrate the installed equipment
- The calibration of the standards used to calibrate the installed equipment.

Processes and procedures will be developed to maintain and store records of calibration for each piece of designated measuring and testing equipment.

5.6.4.10 Special Process Controls

Use of special processes will incorporate the following attributes:

- Process qualifications will be established for special processes when the required level of quality cannot be or is disadvantageous to be measured by direct visual inspection. Such processes include, but are not limited to:

  – Welding
  – Heat treatment

  - Nondestructive testing
  - Specialty cleaning.

- Special processes, equipment and personnel shall be qualified in accordance with approved procedures.

- Special processes shall be performed in accordance with approved procedures, processes, travelers, standards, or equivalent documents.

- Special processes shall be completed under controlled conditions and in accordance with applicable codes, standards and specifications.

- Processes, equipment, and personnel qualifications shall be maintained and updated.

5.6.5 Plans and Procedures for Periodic Surveillance Testing

[NUREG-1804, Section 2.5.6.3: AC 3, AC 4; HLWRS-ISG-004, Section 2.5.6.3: AC 3(5)]

Surveillance and monitoring will be used to detect degradation and adverse trends so that action may be taken prior to component failure. The monitored parameters will be selected based upon their ability to detect predominant failure modes of the critical components. Data sources for surveillance include periodic and diagnostic test results, computer information (if applicable), as-found conditions, failure trending, and predictive maintenance. Surveillance procedures will describe the activities to be carried out in surveying these components and interfacing components or systems, as appropriate.

Periodic surveillance testing confirms the continuing capability of the SSCs and processes to meet performance requirements. Testing confirms that the facility:

- Complies with applicable regulatory and licensing requirements
- Continues to protect the health and safety of workers and the public
- Is capable of operating in a dependable manner and performing its intended function.

As described in Section 5.5, periodic testing will begin during startup testing and continue until closure.

A periodic testing schedule will be established to ensure that required testing is performed and properly evaluated on a timely basis. The schedule will be revised, as necessary, to reflect changes in the periodic testing requirements and to reflect experience gained during facility operation. Testing will be scheduled so that the safety of the facility is never dependent on the performance of an SSC or process that has not been tested within its specified testing interval.

Periodic testing procedures will be written for applicable SSCs. The procedures will describe acceptance criteria and activities to be carried out in testing each component and interfacing components or systems, as appropriate. The testing frequency will be sufficient to ensure that worker and public health and safety are protected.

If during surveillance testing, SSCs and processes are found to be operating outside the tolerance for normal operations, procedures will be in place to ensure that the SSCs are restored to normal operating conditions to protect the health and safety of workers and the public.

The following are examples of typical tests that will be conducted:

- For instrumentation:
  - Channel check
  - Channel calibration
  - Channel functional test
- For passive and active components:
  - Visual examination
  - Diagnostic testing
  - Load test of cranes and rigging
- For structures:
  - Visual inspection
  - Shielding
- Emergency power systems:
  - Starting
  - Load sequencing
  - Full load source testing
  - Load shedding
- Measuring and test equipment:
  - Calibration
- Miscellaneous:
  - Fuel oil properties
- Battery tests:
  - Electrolyte level
  - Specific gravity verification
  - Cell potential verification
  - Capacity testing

- Waste packages:
  - Waste acceptance inspection
  - Visual inspection of waste package surface
  - Closure weld examination
- Subsurface drifts:
  - Dimensional inspection
  - Visual inspection.

5.6.6 General References

Shearer, C.R.H. 2006. "Issuance of DOE O 210.2, DOE Corporate Operating Experience Program, dated June 12, 2006." Memorandum for distribution from C.R.H. Shearer (DOE) to Distribution, 0728065527, July 20, 2006. ACC: MOL.20060915.0089.

INTENTIONALLY LEFT BLANK

CONTENTS

Page

CONTENTS (Continued)

TABLES

Page

INTENTIONALLY LEFT BLANK

FIGURES

Page

INTENTIONALLY LEFT BLANK

5.7 EMERGENCY PLANNING

This section of the license application addresses the requirements of 10 CFR 63.21(c)(21) and 10 CFR 63.161 by providing a description of the Emergency Plan, based upon the criteria contained in 10 CFR 72.32(b), for responding to and recovering from radiological emergencies that may occur during operations at the repository. The details provided in this section address the specific regulatory acceptance criteria in Section 2.5.7.3 of NUREG-1804 and the attachment to ISG-16, "Emergency Planning" (NRC 2000). Personnel from the U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) are working with representatives of Nye County, Nevada, and offsite response organizations in developing the Emergency Plan.

As provided in 10 CFR 63.21(a), the information provided in this section is as complete as possible, in the light of information that is reasonably available. An Emergency Plan, fully compliant with 10 CFR 72.32(b), will be provided to the U.S. Nuclear Regulatory Commission (NRC) no later than 6 months prior to the submittal of the updated application for a license to receive and possess spent nuclear fuel (SNF) and high-level radioactive waste (HLW). Available information related to the material that will be included in the Emergency Plan is also provided in this section.

The Emergency Plan will establish the basis for procedures and practices for management control of radiological emergencies that may occur at the repository prior to permanent closure and dismantlement of the surface facilities. The Emergency Plan will not address specific actions to be taken for security-related events, but will provide guidance for classifying such events. Security-related actions will be governed by the Physical Protection Plan.

The following table lists the information provided in Section 5.7, the corresponding regulatory requirements, and the applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Reference	NUREG-1804 Reference
5.7	Emergency Planning	63.21(c)(21) 63.161 72.32(b)	Not applicable
5.7.1	Responsibilities for Developing, Maintaining, and Updating the Emergency Plan	63.161 72.32(b)(7)	Section 2.5.7.3: Acceptance Criterion 1(9)
5.7.2	Repository Description	63.161 72.32(b)(1)	Section 2.5.7.3: Acceptance Criterion 1(1)
5.7.3	Types and Classification of Potential Accidents	63.161 72.32(b)(2) 72.32(b)(3)	Section 2.5.7.3: Acceptance Criterion 1(2) Acceptance Criterion 1(3)
5.7.4	Detection of Accidents	63.161 72.32(b)(4)	Section 2.5.7.3: Acceptance Criterion 1(4)
5.7.5	Mitigation of Consequences	63.161 72.32(b)(5)	Section 2.5.7.3: Acceptance Criterion 1(5)
5.7.6	Assessment of Releases	63.161 72.32(b)(6)	Section 2.5.7.3: Acceptance Criterion 1(6)

SAR Section	Information Category	10 CFR Reference	NUREG-1804 Reference
5.7.7	Roles and Responsibilities for Repository Personnel during an Emergency	63.161 72.32(b)(7)	Section 2.5.7.3: Acceptance Criterion 1(7)
5.7.8	Notification and Coordination of Offsite Groups	63.161 72.32(b)(8)	Section 2.5.7.3: Acceptance Criterion 1(8) Acceptance Criterion 1(10)
5.7.9	Information to be Communicated	63.161 72.32(b)(9)	Section 2.5.7.3: Acceptance Criterion 1(11)
5.7.10	Training	63.161 72.32(b)(10)	Section 2.5.7.3: Acceptance Criterion 1(12) Acceptance Criterion 1(19)
5.7.11	Restoration of Repository Operations to a Safe Condition	63.161 72.32(b)(11)	Section 2.5.7.3: Acceptance Criterion 1(13)
5.7.12	Exercises, Communication Checks, and Drills	63.161 72.32(b)(12)	Section 2.5.7.3: Acceptance Criterion 1(14) Acceptance Criterion 1(15) Acceptance Criterion 1(16)
5.7.13	Hazardous Materials	63.161 72.32(b)(13)	Section 2.5.7.3: Acceptance Criterion 1(17)
5.7.14	Comments on the Emergency Plan	63.161 72.32(b)(14)	Section 2.5.7.3: Acceptance Criterion 1(18)
5.7.15	Offsite Assistance	63.161 72.32(b)(15)	Section 2.5.7.3: Acceptance Criterion 1(19)
5.7.16	Public Information	63.161 72.32(b)(16)	Section 2.5.7.3: Acceptance Criterion 1(20)

5.7.1 Responsibilities for Developing, Maintaining, and Updating the Emergency Plan

[NUREG-1804, Section 2.5.7.3: AC 1(9)]

5.7.1.1 Planning Goals

The Emergency Plan will identify positions in the organization described in Section 5.3 that will be responsible for developing, maintaining, and updating the Emergency Plan; for implementing procedures; for maintaining training documentation; and for maintaining related records. The roles and responsibilities for repository personnel during an emergency are discussed in Section 5.7.7.

The Emergency Plan will include coordination with other emergency plans and related actions, if any, for activities outside the geologic repository operations area (GROA).

5.7.1.2 Available Information Related to Responsibilities for Developing, Maintaining, and Updating the Emergency Plan

The Site Protection Manager (Section 5.3.1.2.7) is a key manager who will be located on site, will report to the Site Operations Manager, and will be responsible for developing and maintaining the emergency preparedness program in accordance with the license. Reporting to the Site Protection Manager is the Emergency Preparedness Manager, also located on site, who will be responsible for implementing the Emergency Plan to ensure emergency preparedness at the repository and surrounding area during operations. This manager is also responsible for interactions with local and State of Nevada authorities, as well as federal agencies, on matters related to the Emergency Plan. The Emergency Preparedness Manager ensures that emergency activities, including drills and exercises, will be carried out in accordance with the license and in such a manner that, in the event of an emergency, the health and safety of workers and the public will be protected. The Emergency Preparedness Manager ensures that the Emergency Plan and implementing procedures are reviewed periodically and updated to reflect changes in facility configuration, emergency planning policy or interface agreements, or operating procedures. Lessons learned, improvement items, weaknesses, and deficiencies noted during exercises will be used to determine the need for changes to the Emergency Plan, implementing procedures, training, and equipment upgrades. Actions to correct deficiencies identified during an exercise will generally be implemented before the next scheduled exercise. Findings that are of sufficient complexity that they are unable to be resolved prior to the next scheduled exercise will require an action plan for further consideration.

The Emergency Plan establishes the basic requirements for a functional, compliant emergency response organization. The Emergency Plan is implemented by procedures to address specific actions to limit or mitigate accident consequences. Additional implementing procedures will be written to identify specific drill and exercise procedures and address administrative elements of a complete emergency preparedness program.

Records are maintained for reviews and updates of the Emergency Plan, for notification of repository personnel and other onsite or offsite response organizations affected by an update of the Emergency Plan or its implementing procedures, and for review and acceptance of Emergency Plan or implementing procedure updates.

The Emergency Plan is coordinated with emergency response plans adopted by State of Nevada and local agencies. The emergency planning staff coordinate with local government authorities in the preparation of their emergency response plans and programs related to the repository facilities and activities, as needed. In addition, emergency planning staff coordinate with local government authorities in developing a public education and emergency public information program for the repository.

5.7.2 Repository Description

[NUREG-1804, Section 2.5.7.3: AC 1(1)]

5.7.2.1 Planning Goals

The Emergency Plan will describe the GROA and the surrounding area. Detailed maps will be included for the GROA, including supporting facilities and structures. In addition, detailed maps

and descriptions of the site, including locations of potential emergency significance within approximately 10 mi of the repository, will be provided.

5.7.2.2 Available Information Related to Repository Description

5.7.2.2.1 Description of Facility and Site

The Emergency Plan will include detailed maps of the site. Enlarged duplicates of the drawings suitable for use as wall maps will also be provided with the Emergency Plan. The detailed maps will be drawn to scale and show the following:

- Aging areas or structures, the Wet Handling Facility pool, intermodal transfer stations, and buffer areas for loaded transportation casks
- Onsite structures with descriptive labels (and building numbers)
- Other major site features, such as administrative and public access areas
- Bar scale in both meters and feet
- Compass indicating north
- Onsite roads and parking lots
- Onsite routes for transferring material to and from aging or buffer areas
- Site, owner controlled area, and restricted area boundaries, including locations of gates
- Liquid retention tanks and ponds (potentially contaminated tanks and ponds specifically identified as such)
- Roads and railroads in proximity to the site
- Groundwater sources on site and beyond the site boundary.

The emergency plan will include a concise description of site features affecting emergency response, including communications and assessment centers, assembly and relocation areas, and emergency equipment storage areas.

5.7.2.2.2 Site Location and Geography

Yucca Mountain is located on federal land in Nye County in southern Nevada, approximately 100 mi northwest of Las Vegas (GI Figure 1-2). Nye County is bordered by Clark, Lincoln, White Pine, Eureka, Lander, Churchill, Mineral, and Esmeralda counties in Nevada and Inyo County in California. Additional information on geology and demography (of the site and region) is provided in GI Section 5.2.1 and SAR Section 1.1.2, respectively. Information on meteorology and regional climatology is provided in Section 1.1.3.

5.7.2.2.3 Description of Site Features Affecting Emergency Response

Communications and Assessment Centers—The central point for the management of the repository response to an incident will be the Technical Support Center located in the Central Control Center Facility. The Central Control Center Facility will be staffed continuously. A backup to the Technical Support Center will be provided in the Administration Facility. These facilities provide, with modifications appropriate to a repository, capabilities consistent with the guidance contained in NUREG-0696, *Functional Criteria for Emergency Response Facilities, Final Report* (NRC 1981). The Central Control Center Facility will have a digital control and management information system and telephone, radio, and video capability to aid in incident assessment. It will also have alarm and public address systems to notify onsite and offsite personnel of an emergency.

An Emergency Operations Facility, with the capabilities consistent with the guidance provided in NUREG-0696 (NRC 1981), will be colocated with the OCRWM offsite offices. A Joint Information Center will be colocated with the Emergency Operations Facility.

Assembly and Relocation Areas—An area for the Operational Support Center has been identified in the Warehouse and Non-Nuclear Receipt Facility. A unaffected handling facility will be used as an alternate location. Additional assembly areas will be identified for nonessential personnel within nonnuclear facilities in and near the GROA sufficient to accommodate the expected staffing.

Emergency Equipment Storage Areas—Some emergency equipment will be stored in the Warehouse and Non-Nuclear Receipt Facility in support of the primary Operational Support Center. Other locations for the storage and stockpiling of emergency equipment will be identified in the Emergency Plan.

5.7.2.2.4 Description of Area Near Site

The Emergency Plan will include a general map. The standard general map would have an approximate radius of 10 mi; however, as noted in Section 1.1.2, there are no permanent residents within about 22 km (approximately 14 mi) of the North Portal. Figure 1.1-11 shows the population distribution within 84 km (approximately 52 mi) of the repository. Table 5.7-1 shows that the total projected population within an 84-km radius of the repository is approximately 36,000 in the year 2013. The general map will identify the following:

- Primary routes of access for emergency response equipment or for evacuation, as well as potential impediments to traffic flow
- Items and locations of potential emergency significance (fuel oil storage tanks, electrical transformers, and underground cable)
- Types of terrain and the land use patterns bordering the site.

The Emergency Plan will identify the location of hospitals, fire and police stations, and locations of other offsite emergency support organizations with which a memorandum of understanding has

been executed and training offered. In addition to the general map, a U.S. Geological Survey topographical map showing land at least 10 mi beyond the land ownership area will be included in the Emergency Plan.

5.7.2.2.5 Geologic Repository Operations Area Activities

The repository is designed to receive, package, and emplace canistered commercial SNF, canistered HLW, canistered DOE SNF, uncanistered DOE SNF of commercial origin, and canistered naval SNF.

The transportation casks enter the GROA at the Cask Receipt Security Station. Transportation casks will be taken directly to a handling facility or remain in a buffer area until the appropriate handling facility is available. The impact limiters are only removed while the casks are inside the handling facilities. The transportation casks are only opened while they are inside the Initial Handling Facility, Canister Receipt and Closure Facility, Wet Handling Facility, or Receipt Facility. At each facility, the transportation cask is opened, and its contents are removed and processed for disposal. After the contents have been transferred, the cask is closed and prepared for return shipment.

5.7.2.2.5.1 Surface and Subsurface Facilities

The surface facilities include the handling facilities, a surface transportation network, and balance of plant facilities and support systems necessary to safely receive, buffer, age, stage, transfer, and package SNF and HLW for disposal. The layout of the surface facilities is shown in Figure 1.2.1-2. A description of the major surface facilities is provided in Section 1.2.1. The subsurface facilities are described in Section 1.3.

The subsurface facility consists of the emplacement drifts, North Ramp, access mains, exhaust mains, and ventilation system intake and exhaust shafts. Also included are the South Ramp and North Construction Ramp. The general layout arrangement of the subsurface facility is shown in Figure 1.3.1-1.

5.7.3 Types and Classification of Potential Accidents

[NUREG-1804, Section 2.5.7.3: AC 1(2), (3)]

5.7.3.1 Planning Goals

The Emergency Plan will discuss each type of potential accident that could result in the release of radioactive material, as identified in the list of possible internal and external events presented in Section 1.7. The Emergency Plan will identify and address the likely processes by which radiological accidents could occur and the locations and potential consequences of such accidents.

The Emergency Plan will provide an accident classification system and corresponding emergency action levels.

5.7.3.2 Available Information Related to Types and Classification of Potential Accidents

Event sequences considered in Section 1.7 include random waste handling events such as a drop of a transportation, aging, and disposal canister or waste package and specific environmental events such as fire, flood, and seismic activity. These event sequences are evaluated for each surface and subsurface location potentially impacting the handling of radioactive waste.

The classifications of the emergencies from the evaluation of the event sequences are "alert" and "site area emergency" as required by 10 CFR 72.32(b)(3). An alert would be declared if the incident would potentially be expected to (1) affect only people, property, or the environment within the repository site, and (2) require only standard infrastructure and response forces. A site area emergency would be declared if the incident would potentially be expected to (1) affect people, property, or the environment beyond the repository site, and (2) involve active participation of nonstandard (offsite) response forces to protect persons off site.

5.7.3.2.1 Emergency Action Levels

Emergency action levels are specific, predetermined, observable criteria used to determine the emergency classification and the initial protective actions required for those emergencies which might be most likely to occur at the repository. Emergency action levels are developed from supporting information contained in the SAR. This information provides initiating conditions, accident mechanisms, postulated equipment or system failures, event indicators, and contributing events.

Events that represent a reduction in safety, or a hazard to personnel, public, or environment are classified by the Shift Manager using emergency plan implementing procedures which will contain specific guidance for the classification of events. Emergencies are initially recognized through direct observation, alarms, or process indications. The Shift Manager is the senior management representative on each shift and is located in the Central Control Center Facility which is staffed at all times. The Shift Manager has the responsibility and authority to classify the incident, make offsite notifications, initiate site protective actions, and activate the emergency response organization.

Once the Emergency Operations Facility is staffed and operational, the responsibility for event classification formally transfers from the Shift Manager to the OCRWM Emergency Director.

5.7.3.2.2 Alert

An alert is defined as an incident that has led or could lead to a release to the environment of radioactive or other hazardous material, but the release is not expected to require a response by an offsite response organization to protect persons off site.

Based on the potential impacts and the need for increased readiness status by repository personnel, any event sequence that has been determined to meet the criteria for a Category 1 event sequence is classified as an alert. When an incident is classified as an Alert, the Technical Support Center is activated, the on-shift emergency response organization is activated, the Technical Support Center

emergency response organization is activated, and standard repository infrastructure and response forces (e.g., firefighters, medical personnel, buses, and drivers) are utilized.

5.7.3.2.3 Site Area Emergency

A site area emergency is defined as an incident that has led or could lead to a significant release of radioactive or hazardous material and that could require a response by an offsite organization to protect persons off site.

While Category 2 event sequences are not expected to require emergency response actions to protect persons off site, the potential impacts and severity of a Category 2 event sequence are sufficient to warrant classification as a site area emergency. When an incident is classified as a Site Area Emergency, the Technical Support Center, Operational Support Center, Emergency Operations Facility, Joint Information Center are activated, as appropriate and the emergency response organization is fully mobilized with active participation of nonstandard response forces (i.e., Nye County fire and emergency medical, law enforcement, and hazardous materials) as necessary to protect persons off site.

5.7.4 Detection of Accidents

[NUREG-1804, Section 2.5.7.3: AC 1(4)]

5.7.4.1 Planning Goals

The Emergency Plan will provide a description of the means for detecting initiating events and accident conditions that apply to each identified accident. It will also describe the rationale for the locations and types of devices used to detect accidents as presented in Section 1.7.

5.7.4.2 Available Information Related to Detection of Accidents

Operating procedures will identify means of detection for the event sequences that lead to declaration of an alert or site area emergency.

Radiation and radiological monitoring systems described in Section 1.4.2.2 will be:

- Appropriate for the types, levels, and energies of radiation encountered
- Appropriate for existing and expected environmental conditions
- Periodically calibrated to traceable standards and maintained on an established frequency
- Routinely tested for operability.

The repository facilities have automatic fire sprinkler/fire suppression systems and manual fire alarm/system initiation pulls in accordance with the fire hazards analysis. In the event of a fire, these systems provide detection, alarm, and suppression capabilities.

Meteorological and seismic events are monitored by an environmental–meteorological monitoring system. The details of the monitoring system are described in Section 1.4.2.3. Seismic parameters are monitored for both surface and subsurface areas.

5.7.5 Mitigation of Consequences

[NUREG-1804, Section 2.5.7.3: AC 1(5)]

5.7.5.1 Planning Goals

The Emergency Plan will describe the means to mitigate consequences of each type of accident, as presented in Section 1.7. Such descriptions will include:

- Equipment and design features relied on to mitigate emergencies
- General actions that may be taken by repository personnel to mitigate emergencies
- Protective actions to be taken to protect the health and safety of workers and the public
- Arrangements for first-aid, medical, and hospital services and underground rescue
- Facilities available to support mitigation efforts
- Types and locations of response and communication equipment available to support mitigation efforts
- Processes for periodically inventorying, testing, and maintaining emergency equipment, including mitigation equipment.

5.7.5.2 Available Information Related to Mitigation of Consequences

Mitigation of event consequences is initiated by automatic activation of systems such as those associated with fire protection. In addition, activation of the emergency response organization, when warranted, permits initiation of onsite and supplemental fire department and emergency services, including structural firefighting, ambulance, emergency medical services, hazardous material protection, incident mitigation, rescue, and land range firefighting. Organizationally, mitigation of an event begins when the first individual to arrive at the scene of an emergency initiates communications with the Facility Manager, relaying an assessment of the on-scene situation. The Facility Manager directs specific mitigation strategies within the affected facility and reports the situation to the Shift Manager for classification and notification.

The repository emergency response organization uses the protective action guides published in *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (EPA 1992) as the basis for making protective action recommendations. For convenience, the U.S. Environmental Protection Agency manual divides the management of nuclear incidents into three phases: early, intermediate, and late. Radiological Protective Action Guides are generally specified for each phase. Decisions to implement radiological Protective Action Guides are based on the projected dose that would be received if the Protective Action Guides were not

implemented. In addition, the U.S. Environmental Protection Agency considered several other factors in establishing the Radiological Protective Action Guides, including:

- Doses that would result in acute effects are avoided
- The risk of delayed effects should not exceed the upper bounds that are judged to be adequately protective of public health under emergency conditions and are reasonably achievable
- Any reduction of risk to public health achievable at an acceptable cost should be carried out
- Regardless of the above factors, the risk to health from a protective action should not itself exceed the risk to health from the dose that would be avoided.

The Protective Action Guides do not imply an acceptable level of risk for normal (nonemergency) conditions. The guides also do not represent the boundary between safe and unsafe conditions. Rather, the guides are the approximate dose levels at which the associated protective actions are justified. Radiation doses presented in Section 5.7.5.2.1 refer to dose per individual.

5.7.5.2.1 Early Phase

The early phase (also referred to as the emergency or incident phase) covers the period at the beginning of a nuclear incident and, for purposes of planning, can extend up to 4 days after the incident or until the incident has been stabilized. Radiological exposures during the early phase are primarily attributable to three pathways: (1) radiation exposures from a plume of radioactive material, (2) direct immersion in the plume resulting in inhalation exposure and contamination of the skin and clothing, and (3) radiation exposure from radioactive materials deposited on the ground.

The Protective Action Guides for the early phase are based on the effective dose equivalent from external sources, and the committed effective dose equivalent and committed dose equivalent from radioactive material intake. The Protective Action Guides are stated in terms of projected dose. Doses incurred before initiation of a protective action are not normally included when considering whether or not to take a protective action. It is intended that the Protective Action Guide values be compared to the dose that can be avoided by taking protective action. Early or emergency phases of incidents require prompt action. Protective action(s) recommendations based on Protective Action Guides will be incorporated into emergency procedures for both repository and offsite agencies.

During the early phase, evacuation and sheltering (supplemented by personnel decontamination) are the principal protective actions. Table 5.7-2 provides guidance for implementing protective actions based on the quantity of projected radiological dose that would be avoided by implementing specific protective actions.

The repository implements the dose limits specified in Table 5.7-3.

5.7.5.2.2 Intermediate Phase

The intermediate phase begins after the source and releases have been brought under control and reliable environmental measurements are available for use as the basis for decisions on future protective actions. This phase extends until these additional protective actions are terminated. Some actions, such as decontamination of personnel, taken in support of the intermediate phase could start before the early phase is complete. Additionally, the intermediate phase may overlap the late phase and could last from weeks to many months.

5.7.5.2.3 Late Phase

The late phase, also referred to as the recovery phase, is the period beginning when the recovery action designed to reduce radiation levels in the environment to acceptable levels for unrestricted use is commenced and ending when recovery actions have been completed. This period may cover an extended period of time depending on the event or accident.

5.7.5.2.4 Emergency Response Facilities

The repository has identified specific facilities for the management, command, control, and response to emergencies. These facilities are described in the following sections.

5.7.5.2.4.1 Technical Support Center

The Technical Support Center is located in the Central Control Center Facility and provides management and technical support during emergency conditions. The Technical Support Center has the necessary technical data displays and records available to assist in the detailed analysis and diagnosis of offnormal conditions and any significant release of radioactivity to the environment. The Technical Support Center is the primary communications center for the repository during an emergency. While the Technical Support Center is designed to be habitable throughout emergencies, a backup facility is available in the Administration Facility.

5.7.5.2.4.2 Operational Support Center

The Operational Support Center is separate from the waste handling facilities and the Technical Support Center where operations support personnel not otherwise assigned report in an emergency. There is direct communications between the Operational Support Center and the waste handling facilities operating areas and between the Operational Support Center and the Technical Support Center so that the personnel reporting to the Operational Support Center can be assigned to duties in support of emergency operations. The Operational Support Center is located in the Warehouse and Non-Nuclear Receipt Facility. Should the Operational Support Center become unavailable for any reason, an unaffected waste handling facility can be used as a backup.

5.7.5.2.4.3 Emergency Operations Facility

The Emergency Operations Facility is a support facility for the management of overall emergency response (including coordination with federal, state, and local officials). The Emergency Operations Facility has appropriate technical data displays and records to assist in the diagnosis of

repository conditions to evaluate the potential or actual release of radioactive materials to the environment. The Emergency Operations Facility is located off site. A backup facility is available in the repository Administration Building should the Emergency Operations Facility become unavailable for any reason.

5.7.5.2.4.4 Joint Information Center

The Joint Information Center is a support facility for the assemblage, coordination, and dissemination of information to the media and the public on the response to emergencies at the repository. The Joint Information Center has the appropriate technical data and records to support its mission. The Joint Information Center has the capability to coordinate the release of information to the public with federal, state, and local response agencies and to conduct media briefings during an emergency. The Joint Information Center is colocated with but separate from the Emergency Operations Facility.

5.7.5.2.4.5 Communications

The communications system provides communication services for data, voice, and video transmissions throughout the repository, both the surface and the subsurface. The communications system permits reliable communications under anticipated circumstances during both normal and emergency conditions. The communication system supports safeguards and security, fire protection, employee safety and health, construction, operations, and emergency management.

The communications system is divided into several secured networks. These networks include the operations network, the safeguards and security networks, the site administrative network, the environmental safety and health network, the utility network, and the site telephone network. The site telephone communications employ dial-up, full-duplex, Voice over Internet Protocol. Wireless internet protocol telephones are provided in addition to wired internet protocol telephones in the subsurface. Communication services are configured, monitored, maintained, and managed through a network operations center. The communications system is supplied with an uninterruptible power supply from the emergency power system.

5.7.5.2.4.6 Emergency Communications

Two-way portable and mobile radio communications on the surface is provided for safeguards and security, fire protection, rescue, medical service, and environmental and radiation emergency service personnel. Telephone communications are available on the entire site for operations, maintenance, and administration, with redundant private branch exchange/Voice over Internet Protocol gateways and dedicated trunk line connections to the offsite public telephone system.

A high-speed computer-based automated callout system will be the primary means for contacting the Emergency Response Organization to respond to an emergency at the repository. It has the capability for notifications to specific groups or individuals via telephone, pager, fax, and e-mail providing immediate verification of message/instruction delivery. Information is provided to the NRC concerning emergencies via redundant communication links. The communications system transfers voice, video, and data information to designated offsite locations in a secure manner.

5.7.6 Assessment of Releases

[NUREG-1804, Section 2.5.7.3: AC 1(6)]

5.7.6.1 Planning Goals

The Emergency Plan will describe radiological sampling and monitoring methods, instrumentation, equipment, and procedures to be used to assess the extent of radiological releases. The Emergency Plan will also identify organizational positions for which training and qualification for assessment of radioactive releases is required.

5.7.6.2 Available Information Related to Assessment of Releases

The Operational Radiation Protection Program is addressed in Section 5.11. Fixed radiation monitoring instruments are provided under the Operational Radiation Protection Program to provide information on process, area, and effluent radiation levels. These instruments are supplemented by portable air-sampling and survey equipment, including air-sampling filter media. This equipment may be further supplemented by personal air samplers, where appropriate. Air-sampling equipment, support equipment, and other monitoring devices (e.g., dosimeters) necessary to support the environmental radiological monitoring program will be maintained.

As stated in Section 5.11.3.11.3, the consequences of actual and potential radioactive effluent releases during emergencies will be assessed by a process that will involve mathematical modeling based on the results of environmental sampling, direct radiation monitoring, radiological effluent monitoring, and meteorological monitoring.

Respiratory protection equipment, associated cleaning and maintenance equipment, and fit-test equipment will be available for use, as appropriate and as described in Section 5.11.3.6. This equipment will be maintained separately from respiratory protection equipment used outside restricted areas.

Equipment needed to minimize worker contamination or the spread of contamination will also be available, including protective anticontamination clothing, step-off pads, and decontamination supplies and equipment. Protective clothing will be staged for use at contaminated area ingress and egress points, along with collection containers for used equipment and supplies. Adequate supplies of radiological signs, labels, bags, drums, rope, and stanchions will be maintained to identify, mark, and control access to restricted areas.

5.7.7 Roles and Responsibilities for Repository Personnel during an Emergency

[NUREG-1804, Section 2.5.7.3: AC 1(7)]

5.7.7.1 Planning Goals

The Emergency Plan will identify the personnel responsible for ensuring that offsite notifications are performed promptly. The Emergency Plan will also identify the means to ensure that the communication chain for notifying and mobilizing emergency response personnel is maintained during normal and off-normal working hours (nights, weekends, and holidays).

The Emergency Plan will also describe:

- The emergency response organization and the responsibilities and authorities of key positions within the organization
- The responsibilities of repository personnel during a radiological incident
- Positions within the organization that have the responsibility for declaring emergencies during normal hours when key personnel and shift organization are present and during off-normal hours when only shift organization is present
- Methods for activating the staff necessary for implementation of the Emergency Plan
- The positions responsible for overall direction of emergency response and notification of local agencies and the NRC during normal and off-normal hours.

Responsibilities for developing, maintaining, and updating the Emergency Plan will be identified in the Emergency Plan, as discussed in Section 5.7.1.

5.7.7.2 Available Information Related to Roles and Responsibilities for Repository Personnel during an Emergency

5.7.7.2.1 Normal Organization

This section describes the senior management positions responsible for the implementation of the emergency management program. The responsibilities, authorities, and lines of communications for these positions are provided in this section. Responsible managers have the authority to assign tasks to other individuals reporting to them, but these managers retain the accountability for assigned tasks.

5.7.7.2.1.1 Director of the Office of Civilian Radioactive Waste Management

The Director is responsible for budget preparation to ensure that adequate funds are available to construct and operate the repository in a manner consistent with applicable regulations and license conditions. The Director carries out technical responsibilities through an experienced and qualified management team (Figure 5.3-1). The Director delineates clear roles, responsibilities, accountabilities, and authorities for that team, which will ensure implementation of management systems through procedures that comply with the Quality Assurance Program and applicable regulatory requirements. In the absence of the Director, the Deputy Director will fulfill the responsibilities of the Director. When the emergency response organization is activated, the OCRWM Deputy Director or designee assumes the position of OCRWM Emergency Director in the Emergency Operations Facility.

5.7.7.2.1.2 Site Operations Manager

The Site Operations Manager will be located on site, will report to the Director of OCRWM, and will be responsible for the management of repository construction and operations. As the Chief

Nuclear Officer, the Site Operations Manager ensures that the GROA will be constructed and operated in such a manner that the health and safety of workers and the public will be protected. The Site Operations Manager ensures that nuclear operations and maintenance, and repository facilities will be operated in accordance with the license. The Site Operations Manager ensures that the operations and maintenance resources will be appropriately prioritized and allocated.

After receipt of the license to receive and possess SNF and HLW, the Site Operations Manager will be the senior manager in charge of onsite licensed operations and activities, lines of communications, and safety decisions regarding operations. The Site Operations Manager will specifically address management of the interface between receipt, processing, and storage of SNF and HLW and continuing site construction activities. The Site Operations Manager also will be responsible for various feedback programs, such as corrective actions, self-assessments, benchmarking, and human performance.

When the emergency response organization is activated, the Site Operations Manager or designee assumes the position of Technical Support Center Director in the Technical Support Center.

The Site Operations Manager will have the following direct reports:

- Engineering and Construction Manager
- Licensing Manager
- Postclosure Performance and Confirmation Manager
- Site Protection Manager
- Radiation Protection Manager
- Operations Manager.

Section 5.3.1.2 provides additional details on the management functions and responsibilities within OCRWM during operations.

5.7.7.2.1.3 Delegation of Authority

The Site Operations Manager will develop a procedure for delegating authority for positions that have the responsibility to act in routine and emergency situations. The procedure will be developed prior to waste receipt and will also address minimum staffing requirements for each shift. The procedure will make clear that there is always a qualified individual on site with the responsibility and authority to make decisions in safety related matters, even during periods of suspended operations. The procedure will be revised, as necessary, to reflect changes in organizational structure and repository operation phases.

The procedure will also address the following considerations:

- Authority to issue “stop work” directives and declare a site emergency condition

- Essential services for repository operations, operations support, and security functions for shift crews

- Minimum staffing requirements for normal operations and for off-normal and emergency situations
- The processes for ensuring that minimum staffing requirements are met
- Minimum experience and skills necessary for key positions when delegating.

5.7.7.2.2 Emergency Response Concept of Operations

Emergencies are initially recognized through direct observation, alarms, or process indications. Once recognized, the individual detecting the condition informs other individuals in the area of the situation and then notifies the Shift Manager. The Shift Manager is the senior management representative on shift and the position is staffed at all times during the emergency. The Shift Manager has the responsibility and authority to classify the incident, make offsite notifications, initiate site protective actions, and activate the emergency response organization.

Once the decision is made to activate the emergency response organization, the emergency response organization will be notified and will begin activating the Technical Support Center, the Operational Support Center, the Emergency Operations Facility, and the Joint Information Center.

The Technical Support Center staffing is comprised of senior site management and operating staff necessary to assist the affected facility in response to the incident and in management of the site response. Once the Technical Support Center is staffed, command authority for the overall site response and initiate site protective actions will transfer from the Shift Manager to the Technical Support Center Director.

The Emergency Operations Facility staffing is comprised of personnel necessary to interface with DOE headquarters and NRC headquarters, and to provide oversight of the OCRWM response to the incident. Once the Emergency Operations Facility is staffed and operational, the responsibility for event classification and offsite notifications will formally transfer to the OCRWM Emergency Director from the Shift Manager. The Joint Information Center will be staffed with the necessary personnel to provide OCRWM interface with the public and the media on matters related to the response to the incident. While there are no specific requirements for the response times for the response facilities, it is expected that the Technical Support Center, Emergency Operations Facility, and Joint Information Center will be fully staffed and operational within about 2 hours of the initial classification of the incident during off-normal hours.

Operating personnel not directly involved with the incident response at the affected facility will assemble at the Operational Support Center. The Operational Support Center staff will be dispatched to assist the affected facility as directed by the Shift Manager as requested by the Facility Manager. Once the Technical Support Center is staffed, the responsibility for dispatching personnel from the Operational Support Center will transfer to the Technical Support Center. The Technical Support Center will also be responsible for any callouts of additional staff necessary to respond to the incident at the site. These additional personnel may augment the affected facility staff, the Technical Support Center staff, or the Operational Support Center staff (Figure 5.7-1).

5.7.7.2.2.1 Direction and Coordination

The repository has established an emergency response organization that has the authorities and responsibilities to direct and implement any necessary actions to respond to an incident at or affecting the repository. For each position within the emergency response organization, a member or organization from the normal organization is assigned primary responsibility for the position. Along with this assignment is the responsibility for the primary organization to provide suitable candidates for alternates to the position such that at least three individuals are fully trained and qualified for each position within the emergency response organization at all times. For emergency response organization positions not staffed during off-normal working hours, a duty roster will be established and maintained that provides reasonable assurance that trained and qualified personnel will be available for call in at all times to staff the emergency response organization.

The Shift Manager is the designated management representative on shift at all times with the authority and responsibility to implement and direct any emergency response. The Shift Manager may not delegate the decision-making responsibility for the classification, escalation, or termination of the emergency. This responsibility transfers to the OCRWM Emergency Director when the Emergency Operations Facility is operational. Overall direction of site response and coordination of response activities during an emergency is provided by the Shift Manager, and systems operation remains within the control of the facility operating staff as directed by the Facility Manager throughout the response to any incidents or events. The Shift Manager has the authority to:

- Issue directions to control the situation
- Make the decision to escalate or terminate the emergency condition
- Perform notifications of offsite response agencies, state and local governments, the NRC, and DOE headquarters
- Coordinate the site staff and offsite personnel who augment the staff
- Communicate with parties requesting information regarding the incident
- Request support from offsite agencies.

The emergency response organization (Figure 5.7-1) operates from the following specific emergency response facilities:

- Facility operating area(s)
- Technical Support Center
- Operational Support Center
- Emergency Operations Facility
- Joint Information Center.

5.7.7.2.2.2 Facility Operating Area(s)

Each operating facility contains a facility operating area from which the Facility Manager directs and controls operations within the facility. The facility operating area is staffed by the personnel necessary to operate the facility during normal conditions and has the capability to initiate and control mitigating actions for emergencies originating within the facility. The normal shift rotation and relief schedule provides adequate staff for incidents lasting longer than one working shift.

5.7.7.2.2.3 Technical Support Center

The Central Control Center Facility becomes the Technical Support Center once the emergency response organization is staffed and capable of performing its intended functions. The positions shown in Table 5.7-4 comprise the fully staffed Technical Support Center.

5.7.7.2.2.3.1 Technical Support Center Director

The Technical Support Center Director is the Site Operations Manager or designee. The Technical Support Center Director reports to the OCRWM Emergency Director and has responsibility for the overall direction of the site response to an emergency. The Technical Support Center Director directs the operations of the Technical Support Center and the actions of site personnel, including the affected facility. The Technical Support Center Director is also responsible for ensuring that communications are established and maintained with the Emergency Operations Facility once that facility is activated. The Technical Support Center Director declares the Technical Support Center operational when the Technical Support Center is capable of performing its assigned functions.

The Technical Support Center Director is not given emergency classification, escalation, or termination responsibilities. The Emergency Operations Facility and Technical Support Center would be expected to become operational in the same time frame during a normal shift with the Emergency Operations Facility expected to become operational much sooner during an off-shift. Therefore, these responsibilities can be handed off more efficiently directly from the Shift Manager to the OCRWM Emergency Director.

5.7.7.2.2.3.2 Operations Manager

The Operations Manager is the Waste Handling Manager or designee. The Operations Manager reports to the Technical Support Center Director and provides advice and assistance on the operation of the affected facility. The Operations Manager establishes and maintains communications with the affected Facility Manager and provides direction to unaffected Facility Managers. Once the Technical Support Center is activated, the Shift Manager assists the Operations Manager.

5.7.7.2.2.3.3 Radiological Response Manager

The Radiological Response Manager is the Radiation Protection Manager or designee. The Radiological Response Manager reports to the Technical Support Center Director and provides advice and assistance on radiation protection strategies for affected and potentially affected individuals. The Radiological Response Manager is responsible for ensuring that radiation dose

assessments are performed for potentially affected areas both within any affected facilities and external to any affected facilities. The Radiological Response Manager ensures that radiation exposures to personnel involved in the response and affected by the emergency are maintained as low as is reasonably achievable. Assisting the Radiological Response Manager is a Radiological Assessment Supervisor and an Environmental Assessment Supervisor. The Radiological Assessment Supervisor is primarily responsible for radiation protection and dose assessments within the GROA. The Environmental Assessment Supervisor is responsible for dose assessment activities beyond the GROA, including the direction of field monitoring teams. Field monitoring teams will be assembled and dispatched as necessary to perform confirmatory field measurements of projected direct radiation and airborne radioactivity levels.

5.7.7.2.2.3.4 Engineering Manager

The Engineering Manager is the Engineering and Construction Manager or designee. The Engineering Manager reports to the Technical Support Center Director and provides advice and assistance on the design and engineering aspects of the emergency response. The Engineering Manager is assisted by an engineering staff consisting of personnel with expertise in the following disciplines:

- Electrical
- Mechanical
- Criticality
- Radiation controls.

5.7.7.2.2.3.5 Technical Support Center Manager

The Technical Support Center Manager is the Site Protection Manager or designee. The Technical Support Center Manager reports to the Technical Support Center Director and is responsible for establishing and maintaining emergency communications links with the Emergency Operations Facility, the Operational Support Center, and any other locations specifically necessary to support emergency response. The Technical Support Center Coordinator is the administrative "troubleshooter" for the Technical Support Center. Assisting the Technical Support Center Coordinator are communicators, logistics support staff, information technology support, and administrative personnel. The Technical Support Center Coordinator ensures that a relief schedule for the Technical Support Center staff is developed for incidents lasting longer than one working shift. The relief schedule will be staffed with alternates trained for the positions being filled.

5.7.7.2.2.3.6 Security Manager

The Security Manager is the Physical Protection Manager or designee. The Security Manager reports to the Technical Support Center Director and is responsible for coordinating the actions of the protective force with the emergency response organization. The protective force supports the emergency response organization in the coordination of personnel accountability and the implementation of protective actions for site personnel. Support includes facilitating personnel egress from affected areas, traffic control, and facilitating emergency access for offsite response personnel.

The scope of the Security Manager's activities expands significantly if the incident is or becomes a security-related incident.

5.7.7.2.2.4 Operational Support Center

The Operational Support Center is located in the Warehouse and Non-Nuclear Receipt Facility and is the staging area for shift personnel not assigned other response functions. The positions shown in Table 5.7-5 comprise a fully staffed Operational Support Center.

The Operational Support Center Manager is a trained Senior Maintenance Supervisor. The Operational Support Center Manager reports to the Technical Support Center Director and is responsible for directing the actions of the Operational Support Center. The Operational Support Center staff assists the emergency response organization by implementing mitigation, troubleshooting, repair, and corrective actions as requested or directed by the Technical Support Center. A communicator, assigned from available staff, assists the Operational Support Center Manager in establishing and maintaining communications with the Technical Support Center. The Operational Support Center staff is comprised of available operations, maintenance, and radiation protection personnel from the shift staff who are not assigned to the affected facility. Operational Support Center teams are assembled from the available staff. The teams are briefed on the work to be accomplished, the expected conditions along the route to the area where work is to be performed, and expected conditions in the work area. Radiation protection personnel will advise or accompany Operational Support Center teams, as necessary, to provide adequate coverage for the work to be performed. The normal shift rotation and relief schedule provides adequate staff for incidents lasting longer than one working shift.

5.7.7.2.2.5 Emergency Operations Facility

A designated area associated with the OCRWM general office spaces becomes the Emergency Operations Facility once the emergency response organization is staffed and capable of performing its intended functions. The positions shown in Table 5.7-6 comprise the fully staffed Emergency Operations Facility.

5.7.7.2.2.5.1 OCRWM Emergency Director

The OCRWM Emergency Director is the OCRWM Deputy Director or designee. The OCRWM Emergency Director is the senior repository official with final decision-making responsibility and authority for repository emergency response activities. The OCRWM Emergency Director is responsible for overseeing the performance of onsite activities necessary to place the repository in a safe condition and for interfacing with DOE headquarters, offsite agencies, and the public.

5.7.7.2.2.5.2 Emergency Operations Facility Coordinator

The Emergency Operations Facility Coordinator reports to the OCRWM Emergency Director and has responsibility for ensuring that communications are established and maintained with the NRC, DOE headquarters, and any state or local agencies involved in the response. Assisting the Emergency Operations Facility Coordinator are designated and trained personnel who serve as communicators with the involved response authorities. In addition to the communicator staff in the

Emergency Operations Facility, the Emergency Operations Facility Coordinator dispatches a representative to each Emergency Operations Center established by the state or local government in response to the incident to serve as a Liaison between the Emergency Operations Facility and the respective Emergency Operations Center. The Emergency Operations Facility Coordinator ensures that a relief schedule for the Emergency Operations Facility staff is developed for incidents lasting longer than one working shift. The relief schedule will be staffed with trained alternates for the positions being filled.

5.7.7.2.2.5.3 Technical Support Manager

The Technical Support Manager is the Licensing Manager or designee. The Technical Support Manager reports to the OCRWM Emergency Director and is responsible for advising the OCRWM Emergency Director and the Public Information Manager on the technical aspects of the repository conditions during the emergency. Assisting the Technical Support Manager are designated and trained personnel with expertise in radiation protection, repository operations, and repository design.

5.7.7.2.2.5.4 Administrative Support Manager

The Administrative Support Manager is a designated member of the OCRWM staff. The Administrative Support Manager reports to the OCRWM Emergency Director and is responsible for the administrative operations of the Emergency Operations Facility, including providing administrative support to the other members of the Emergency Operations Facility staff, establishing and directing security for the Emergency Operations Facility, and directing Information Technology support to the Emergency Operations Facility.

5.7.7.2.2.5.5 Public Information Manager

The Public Information Manager is a designated senior member of the OCRWM staff. The Public Information Manager reports to the OCRWM Emergency Director and has responsibility for ensuring that accurate communications with the media and the public are accomplished in a coordinated and timely manner. The Public Information Director also directs the operation of the Joint Information Center.

5.7.7.2.2.6 Joint Information Center

A designated area associated with the OCRWM general office spaces becomes the Joint Information Center once the emergency response organization is staffed and capable of performing its intended functions. The positions shown in Table 5.7-7 comprise the fully staffed Joint Information Center.

5.7.7.2.2.6.1 Joint Information Center Supervisor

The Joint Information Center Supervisor is a trained and designated senior member of the External Affairs staff. The Joint Information Center Supervisor reports to the Public Information Manager and is responsible for providing ongoing direction of the Joint Information Center.

5.7.7.2.2.6.2 DOE Spokesperson

The DOE spokesperson is a trained and designated senior member of the OCRWM staff. The DOE spokesperson reports to the Joint Information Center Supervisor and is responsible for speaking to the public and the media on behalf of DOE and OCRWM. In addition, the DOE spokesperson moderates any media briefings and coordinates the release of information to the media and the public with any Public Information Officers representing agencies involved in the response to the emergency. Assisting the DOE spokesperson are a radiation protection spokesperson and a technical spokesperson. These additional spokespersons will have the training and expertise to answer more in-depth questions from the media and can provide additional background information related to the repository.

5.7.7.2.2.6.3 Joint Information Center Coordinator

The Joint Information Center Coordinator is a trained and designated member of the staff. The Joint Information Center Coordinator reports to the Joint Information Center Supervisor and is responsible for the operation of the facility. Assisting the Joint Information Center Coordinator are the Administrative Support Specialist, information technology support staff, and security personnel. The Joint Information Center Coordinator ensures that a relief schedule for the Joint Information Center staff is developed for incidents lasting longer than one working shift. The relief schedule will be staffed with trained alternates for the positions being filled.

5.7.7.2.2.6.4 Administrative Support Specialist

The Administrative Support Specialist is a trained and designated member of the staff. The Administrative Support Specialist reports to the Joint Information Center Coordinator and is responsible for directing the Administrative Supports staff, the Rumor Control staff, and the Media Monitoring staff. The Administrative Support staff provides general administrative assistance to members of the Joint Information Center staff and assists in distributing materials in support of media briefings. The Rumor Control staff answers any incoming phone calls from the media or the public and attempts to identify and resolve any rumors associated with repository response to the emergency. The Media Monitoring staff monitors national and local media outlets for reports on repository emergencies. Any errors or rumors identified are reported to the DOE spokesperson for correction.

5.7.7.2.2.6.5 Public Information Coordinator

The Public Information Coordinator is a trained and designated member of the staff. The Public Information Coordinator reports to the Joint Information Center Supervisor and is responsible for developing written materials for release to the media during an emergency. Assisting the Public Information Coordinator are a News Writer and Derivative Classifier. The News Writer combines prescreened written materials with information related to the specifics of the current emergency for release to the media. The Derivative Classifier reviews the written materials to provide assurance that classified or restricted information is not inadvertently released to the media. Any written materials released during an emergency must be approved by the OCRWM Emergency Director prior to release.

5.7.7.2.2.7 Emergency Response Records

Records resulting from an actual declaration of alert or site area emergency at the repository will be maintained. The response records to be maintained include, but are not limited to:

- Incident logs
- Procedure checklists
- Notification forms
- Press releases.

5.7.8 Notification and Coordination of Offsite Groups

[NUREG-1804, Section 2.5.7.3: AC 1(8), (10)]

5.7.8.1 Planning Goals

The Emergency Plan will describe the Technical Support Center, located at the repository, and the Operations Facility Center, located off site, as well as the organization responsible for activating the emergency response organization and for performing timely notifications under accident conditions during normal and off-normal hours. The Emergency Plan will identify the offsite location and describe the functions of the Joint Information Center. Additionally, the Emergency Plan will describe the means to notify offsite response organizations and the means to request offsite assistance, including medical assistance. Responsible offsite agencies will be identified in the Emergency Plan. Notification methods and equipment will be described and will be sufficiently diverse to ensure that notification and activation can be performed even if some personnel, equipment, or parts of the Emergency Operations Center are unavailable.

5.7.8.2 Available Information Related to Notification and Coordination of Offsite Groups

The Shift Manager takes actions as specified in the Emergency Plan and its implementing procedures. These actions include classifying the emergency, directing staff to assume emergency response roles, sounding the site emergency signal, and providing timely notification to appropriate federal, State of Nevada, and local agencies of the emergency. The implementing procedures will contain the necessary telephone, fax, address, and e-mail information necessary to achieve timely notification of responsible offsite agencies and points of contact. The NRC operations center will be notified upon completion of local notifications but not later than 1 hour after an alert or site area emergency has been declared. The means for performing this notification has not yet been determined. Notification could be by commercial telephone system or, if provided, the NRC emergency notification system.

Automated callout systems are being developed to expedite activation of the emergency organization. In the event of failure of the automated system, backup systems such as telephone trees will be implemented.

5.7.9 Information to be Communicated

[NUREG-1804, Section 2.5.7.3: AC 1(11)]

5.7.9.1 Planning Goals

The Emergency Plan will describe the types of information to be provided on repository status and radioactive releases and any recommended protective actions that will be communicated to offsite response organizations and to the NRC in the event of an emergency.

5.7.9.2 Available Information Related to Information to be Communicated

Information to be provided will be consistent with the NRC Event Notification Worksheet (NRC Form 361) modified for repository use. The modified form is provided in Figure 5.7-2.

5.7.10 Training

[NUREG-1804, Section 2.5.7.3: AC 1(12), (19)]

5.7.10.1 Planning Goals

The Emergency Plan will define the requirements to train repository personnel on how to respond to emergencies. It will also describe any special instructions and orientation tours in the training offered to offsite support personnel, including police, fire, and medical personnel who may be called upon to respond in an emergency.

5.7.10.2 Available Information Related to Training

As stated in Section 5.3, the repository utilizes a systematic approach to training. Through its systematic approach, the Training Program will identify tasks and personnel classifications that require training.

The repository's dynamic Training Program will change to reflect changes in repository design, development, or operation. Line managers will be responsible for ensuring that personnel are properly trained and capable of performing assigned tasks in a quality manner. Line managers will have direct input into the conduct and material used in training of their personnel.

The systematic approach to training will be used to identify any position-specific training necessary to implement the Emergency Plan. Lessons learned, improvement items, weaknesses, and deficiencies noted during exercises will be used to determine the need for additional training. Offsite governmental agencies such as Nye County, Nevada, and other emergency support organizations with which a memorandum of understanding has been executed will be offered training as required to respond appropriately to specific emergencies. The emergency response organization training program will provide mitigation training. The staff will be trained on its responsibility for coordination and management of direct mitigation activities. The emergency response organization training program will also provide the staff with information on how and where to obtain logistical support needed to mitigate an incident.

As described in Section 5.3, formal, documented training will be established for personnel assigned to the repository. Components of that program specific to the emergency preparedness program are described in the remainder of this section.

5.7.10.2.1 Emergency Preparedness Training Program

In addition to the training programs described in Section 5.3, the repository will develop and maintain an Emergency Preparedness Training Program. The Emergency Preparedness Training Program ensures that the personnel occupying repository emergency response organization positions can perform the tasks inherent to each assigned function and operate within the chain of command established for those program elements. The Emergency Preparedness Training Program ensures that staff and emergency response organization members are trained to perform their assigned functions in compliance with applicable federal regulations, state laws, and repository policies. Initial training and annual requalification training are provided for the instruction and qualification of emergency response organization personnel. The Emergency Preparedness Training Program is implemented using a systematic approach to training.

The goal of the Emergency Preparedness Training Program is to provide the repository with an emergency response organization that is prepared to respond to an emergency incident safely and efficiently. To meet that goal, certain objectives must be met:

- Provide training for individuals and teams that meet or exceed requirements
- Provide this training on a schedule that enables maintaining qualifications
- Ensure that accurate records are maintained on training performed and received.

The Emergency Preparedness Training Program is reviewed at least annually by the Emergency Preparedness Manager and is revised according to the evaluation of trainee written exam results and observation of personnel performance of job-related tasks during drills and exercises. Revisions also take place as necessary when there are changes in target population, task scope, regulations, and processes or procedures and following lessons learned from emergencies at NRC, DOE, and other industrial facilities.

5.7.10.2.1.1 Emergency Preparedness Manager

The Emergency Preparedness Manager has overall responsibility for the training of the emergency response organization staff. The Emergency Preparedness Manager must approve emergency preparedness training before implementation. The Emergency Preparedness Manager ensures that the following requirements associated with the Emergency Preparedness Training Program are completed:

- Interfacing with emergency planning staff to develop training requirements
- Developing and maintaining a comprehensive required training plan
- Ensuring training is provided to the emergency response organization staff in accordance with the Emergency Plan

- Identifying and coordinating adequate resources for training implementation, including facilities, equipment, and budget
- Identifying training needs and providing for development, scheduling, and delivery
- Ensuring that training is conducted by qualified personnel.

5.7.10.2.1.2 Schedule

Training (initial and refresher), drills, and exercises are scheduled according to repository needs and in consideration of repository operating schedules. Additional training is scheduled as needed.

5.7.10.2.1.3 Delivery

Qualified individuals designated by the Training Manager and approved by the Emergency Preparedness Manager deliver training. Training and classroom training attendance are recorded and tracked and forwarded to the Training Manager.

5.7.10.2.1.4 Initial Training Requirements

The Emergency Preparedness Training Program provides a structured approach by which emergency response organization members acquire required orientation and job-specific knowledge for application during an emergency. The emergency response organization consists of repository personnel whose work assignments and experience provide the background, expertise, and authority necessary to perform the functions of their respective positions during an emergency.

5.7.10.2.1.5 Exams

Trainee understanding of course concepts is regularly assessed through written exams, although not all emergency response organization training courses include a written examination. For those courses that include examinations, trainees must answer 80% of exam questions correctly to pass. Some emergency response organization training courses contain a practical component used by the instructor to determine trainee mastery of course concepts. Trainee performance is further assessed through drill participation.

A trainee who fails a written exam (receiving a grade lower than 80%) is required to take a second version of the exam following a review of the objectives for the exam items answered incorrectly. If the trainee answers less than 80% of the second exam questions correctly, the trainee is required to re-attend initial training on that topic and take the exam again.

5.7.10.2.1.6 Emergency Response Organization Position Qualification

Emergency response organization members are considered qualified to stand shift coverage duties on the date of the last required training completed or participation in an emergency drill or exercise, whichever occurs last. The official qualification date is the date of the final event completed. A training matrix or similar system identifies each position in the emergency response organization and the minimum training requirements.

If an emergency response organization position is temporarily vacant through employee absence, termination, or illness, it is necessary to have qualified personnel available to fill those positions in an emergency. The Emergency Preparedness Manager determines the replacement criteria.

5.7.10.2.1.7 Exceptions from Training/Credit for Previous Experience

Qualified personnel (who have satisfactorily completed training comparable in content and in performance standards) may be exempted from portions of training on an individual-case basis. Exceptions to training are based on a review of historical training records (e.g., transcripts), personal interviews, and/or on test-out exams based on the objectives stated for the training. The Emergency Preparedness Manager must approve any Emergency Preparedness training exception.

5.7.10.2.1.8 Requalification Requirements

Requalification training is conducted annually (calendar year). Instruction is based on topics/tasks identified as retrain items during job analysis; lessons learned during drills, exercises, and actual incidents; and changes to plans and procedures. Deficiencies and weaknesses identified during drills, exercises, and actual incidents are reviewed during these sessions. Annual requalification includes successful completion of an exam.

Emergency Plan and implementing procedure changes are distributed to affected emergency response organization members throughout the year in the form of required reading. In addition, requalification training discussions cover such changes. Completion of required reading assignments is tracked and documented. The Emergency Preparedness Manager must approve extensions.

5.7.10.2.2 Training Records

The training programs and maintenance of the training programs at the repository will be the responsibility of the Training Manager. The Training Manager is responsible for ensuring entry of training completion and qualification data into the electronic tracking system by providing originals of training attendance rosters and original exams to document control.

Training Program records consist of written lesson plans, electronic files of the same, instructional aids, etc., used in developing and delivering training and retraining. The training record is a legal document and must be retained in order to be able to reconstruct an individual's training history. Training records are maintained on each employee's qualifications, certifications, experience, training, and retraining. Training records are retained in accordance with the records management system.

5.7.11 Restoration of Repository Operations to a Safe Condition

[NUREG-1804, Section 2.5.7.3: AC 1(13)]

5.7.11.1 Planning Goals

The Emergency Plan will contain a description of the means for restoring the repository to a safe condition after an emergency in accordance with recovery procedures, as well as criteria for the

return to operations. Should the response result in the evacuation of areas, criteria for safe reentry will be provided.

5.7.11.2 Available Information Related to Restoration of Repository Operations to a Safe Condition

Emergency procedures will provide specific steps and criteria for both declaring an emergency and for terminating the emergency. These procedures will provide for radiological assessment in the event that evacuation is required, and will include guidelines for release rate calculations.

Reentry, termination, and recovery are separate but related activities, each with its own purpose and implementation concerns. Each of these activities is necessary, to some degree, as a part of returning the repository to normal operations following an incident.

- Reentry is typically for immediate rescue and may also be accomplished during recovery as in the initial entry(s) into the affected area.

- Termination is the determination of when it is appropriate to cease emergency response activities and of associated notifications.

- Recovery is to return the affected repository facilities and areas to normal operations following the termination of emergency response.

5.7.11.2.1 Reentry

Reentry may be conducted prior to incident termination or as part of the recovery effort. Individuals involved in reentry receive a hazards/safety briefing prior to implementing response activities. Reentry personnel will wear appropriate protective clothing as specified by radiological control and/or industrial hygiene procedures and practices. During entry into a radiological area, team members will wear appropriate dosimetry and be accompanied by radiation protection personnel.

After an emergency has been terminated, reentry into the affected area is carefully planned and controlled to minimize exposing personnel and equipment to radiation, unstable physical conditions, or other hazards. Reentry planning is performed by the recovery organization through development of the recovery plan. Normal operating procedures are used to the extent possible for reentry activities.

5.7.11.2.1.1 Reentry Planning

Event scenarios developed during the SAR analyses provide information concerning the type and nature of possible failures and associated radiological dose consequences. The Emergency Plan implementing procedures identify the positions within the emergency response organization with the authority and responsibility to authorize reentry activities and approve doses/exposures that may exceed occupational or administrative limits.

Reentry planning shall include security considerations. The planning effort should consider the possibility that an insider or outsider threat initiated the event and that additional security-related

hazards are yet unrecognized. Reentry prior to event termination will often involve high-risk, time-urgent actions. Therefore, the response structure for conducting reentry activities shall be flexible and capable of responding to a wide range of conditions. Reentry planning shall address methods for reducing the spread of contamination and ensuring that reentry activities do not inadvertently increase the actual or potential release of hazardous material.

Reentry preparation shall include contingency planning to ensure the safety of reentry personnel, such as planning for the rescue of reentry teams. Teams shall consist of the minimum number required to perform the job but not be fewer than two persons. Team members are chosen based upon job qualifications, training, proficiency in the use of protective equipment, radiological exposure history, and sensitivity to toxic materials. For very high-risk tasks, volunteers shall be used. Each volunteer shall be advised of the known or anticipated hazards prior to participation.

Immediately upon return from completing a reentry assignment, teams shall be debriefed. The purpose of the debriefing is to collect information relating to the job performed, facility status, conditions encountered, and exposure received.

5.7.11.2.1.2 Reentry for "Rescue and Recovery"

Planning for rescue and recovery is dependent upon the nature of the accident or hazard. The most severe event sequences for the repository include radiological hazards. As discussed in Section 5.7.5.2, the repository will use the guidance provided in *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (EPA 1992) for conducting operations in response to a radiological hazard.

Reentry for rescue and recovery address three types of emergency action: saving of human life; recovery of injured victims; and protection of health and property. For any one of these conditions, the following shall be considered:

- Actual and potential risks to rescue and recovery individuals against the benefits to be gained
- Volunteers shall perform rescue actions that might involve substantial risk
- The risk of injury to persons involved in rescue and recovery activities shall be minimized, to the extent practical
- Control of exposures shall be consistent with the immediate objectives of saving human life; recovering injured victims; and/or protection of health, property, and the environment.

5.7.11.2.2 Termination of an Emergency

Emergency conditions exist until adequate measures have been taken to protect personnel health and safety, protect the environment, stabilize conditions, and minimize operational disruption away from the scene. The termination process begins when personnel in charge of the response effort (Technical Support Center Director and Emergency Director) determine that conditions are

sufficiently stabilized. The NRC, DOE headquarters, and involved organizations may be consulted prior to termination, or at a minimum, are advised when the emergency is terminated. Termination of an emergency at the repository may be declared when:

- The emergency response organization, in consultation with appropriate offsite agencies, does not identify a valid reason to continue operating in the emergency response mode
- Radiation or hazardous material exposure levels are stable or decreasing with time
- The affected facility or location is in a stable condition, and there is a high probability that it can be maintained in that condition
- Fire, flood, earthquake, or similar emergency conditions no longer constitute a hazard to critical systems/equipment or to personnel
- Releases of hazardous material to the environment have ceased or are controlled within permissible regulatory limits
- Existing conditions no longer meet the established emergency classification criteria, and it appears unlikely that conditions will deteriorate
- The needs of contaminated/injured personnel have been fulfilled
- Initial emergency notifications have been completed
- Access to affected areas necessary for conducting recovery operations has been assessed
- The incident scene can be preserved until cognizant investigative authority concurs that recovery operations may begin
- Initial recovery activities have been clearly identified and prioritized
- The recovery staffing plan has been developed, approved, and can be implemented.

5.7.11.2.3 Recovery

Recovery is defined as those actions taken, after a facility has been brought to a stable condition, to return the facility to normal operation. Recovery is the process of assessing postemergency conditions and developing a plan for returning to pre-emergency conditions when possible and following the plan to completion. Recovery includes establishment of criteria for resumption of normal operations. Recovery also includes investigation of the root cause(s) of the emergency and

corrective action(s) to prevent recurrence. The following criteria for beginning recovery operations after terminating an emergency are considered when appropriate to the circumstances:

1. Conditions no longer meet any emergency classification criteria.

2. The repository is in a stable condition and can be maintained in that condition indefinitely.

3. Fire or other similar emergency conditions no longer constitute a hazard.

4. Incident scene can be preserved until the investigating authority concurs that a recovery or normal operations may be resumed.

5. Crime scene, if applicable, can be preserved and a sufficient number of security personnel are available to support required restrictions and precautions.

The types of activities that could be conducted during the recovery phase include damage assessment, environmental consequence assessment, long-term protective action determinations, facility and/or environmental restoration, and dissemination of information. The results of hazards surveys and assessments, including information provided in the SAR and other facility documentation, are used to help establish the basic criteria and organizational structure necessary for conducting recovery activities.

5.7.11.2.3.1 Recovery Organization

The recovery organization differs from the emergency response organization in that the use of the incident command system is discontinued and recovery teams are established to accomplish recovery actions. Emergency response organization members may be assigned to these teams. The recovery organization includes teams whose members are designated to handle specific operations, restore emergency response capability, and manage damaged facility stabilization and reconstruction. A Recovery Manager is assigned by the Emergency Director before the emergency is terminated. The Recovery Manager develops a recovery organization based on required recovery actions.

The composition of the recovery organization shall be based on the extent and nature of the emergency. Functional elements in the recovery organization shall include the following:

- A Recovery Manager who has the responsibility and authority to coordinate recovery planning; authorize recovery activities; protect the health and safety of workers and the public; and initiate, change, or recommend protective actions

- Technical advisers to the Recovery Manager; advisers may include radiation protection, industrial hygiene, industrial safety, fire protection, and other experts

- Maintenance and operations personnel and engineers with the technical expertise to direct postaccident assessment activities and to analyze the results

- A Public Information Specialist to deal with inquiries or concerns from employees, the public, the news media, and outside agencies.

5.7.11.2.3.2 Recovery Operations

Recovery planning and implementation will start with assessment of facility, site, and environmental conditions. There are three general areas of recovery operations: (1) accident assessment and investigation, (2) recovery planning and scheduling, and (3) repair and restoration.

5.7.11.2.3.2.1 Accident Assessment and Investigation

The following types of activities shall be considered for accident assessment and investigation:

- Repository management shall determine the root cause of the event and prepare a formal accident report

- Documentation generated during the emergency response and useful to accident investigation should be collected and organized

- Engineering/Maintenance/Operations personnel shall assess the condition of the facility, including structural integrity, equipment status, hazardous material confinement barriers, and safety systems

- A comprehensive assessment of contamination of affected areas shall be performed.

5.7.11.2.3.2.2 Planning and Scheduling

The following types of activities shall be planned and scheduled:

- Notification of establishment of the recovery organization to persons and agencies involved in the emergency response

- Evaluation of Emergency Plans to determine if adequate emergency preparedness status can be maintained during degraded facility conditions

- Establishment of specific criteria to be met prior to the resumption of normal operations or facility use

- Preparation of plans for the establishment of safe long-term conditions when the assessment indicates that the facility or affected area cannot be safely returned to normal operation or use

- Identification of required repair and restoration work based on the assessment results

- Plan for the proper handling and disposal of hazardous waste generated during recovery activities

- Continued evaluation of site or facility hazards and contamination levels as well as estimating exposures to workers.

5.7.11.2.3.2.3 Repair and Restoration

The following items shall be considered during repair and restoration activities:

- Ensure that occupational exposure limits are met

- Ensure that any discharges from recovery activity are controlled within regulatory and environmental compliance limits. If discharges are necessary beyond these limits, ensure that necessary documentation is prepared, approvals obtained, and notifications made

- Conduct recovery activities through normal work organizations, practices, limitations, and procedures to the extent practical.

5.7.11.2.3.3 Recovery Procedures

Repository recovery procedures shall establish the functions of the recovery organization, shall establish a framework for recovery operations, and shall specify general criteria for determining when recovery operations are terminated and normal operations may resume. Normal operating procedures are used to the extent possible for recovery activities. Otherwise, special procedures governing the activity being conducted shall be written and receive approval from the Recovery Manager. Further plans and procedures are developed in accordance with existing routine practice for safety analysis and procedure development.

The Emergency Plan and associated implementing procedures shall remain in effect during recovery. Temporary emergency response procedures for the recovery shall be developed if necessary. The emergency response organization shall maintain the ability to respond to an emergency condition at the repository during the recovery phase up to and including resumption of normal operations. If for any reason this ability is not possible or practical, suitable alternatives will be addressed in the recovery plan.

5.7.11.2.3.4 Normal Operations

The Recovery Manager declares recovery complete when the recovery plan actions are complete. The Site Operations Manager is responsible for returning the facility to normal operations once required approvals have been received. That is, the repository shall be returned to normal operations or use only when criteria established by the recovery plan have been met and approvals granted by cognizant organizations and agencies.

Federal, state, and local organizations shall be consulted prior to terminating recovery operations, if required by regulation or memorandum of understanding. Otherwise, notifications to these

organizations shall be made prior to the resumption of normal operations. Documentation of recovery operations shall be collected and processed for retention.

5.7.12 Exercises, Communication Checks, and Drills

[NUREG-1804, Section 2.5.7.3: AC 1(14), (15), (16)]

5.7.12.1 Planning Goals

The Emergency Plan will describe the drills and exercises that will be used to evaluate major portions of the emergency response capabilities and to maintain key response skills. Deficiencies identified as a result of drills and exercises will be corrected. The exercise program will include:

- Biennial onsite exercises in the form of simulated emergencies
- Semiannual radiological and health physics, medical, and fire drills
- The evaluation of exercises by individuals not having direct implementation responsibilities for conducting the exercises. Evaluations will assess appropriateness of the Emergency Plan, emergency procedures, activities and equipment, training of personnel, and the overall effectiveness of the response
- A provision for the correction of deficiencies identified by evaluations for both drills and exercises
- A commitment to maintain the confidentiality of exercise scenarios to the extent practicable
- An invitation to offsite response organizations to participate in biennial drills and exercises.

The Emergency Plan will also describe required communication checks, including quarterly communication and equipment checks, with offsite response organizations, and the updating of offsite response organization contact information.

5.7.12.2 Available Information Related to Exercises, Communication Checks, and Drills

5.7.12.2.1 Drill and Exercise Program

The repository drill and exercise program is designed to (1) enhance the training provided to the emergency response organization members, (2) evaluate the overall effectiveness of the emergency response organization, and (3) verify the adequacy of the interface with offsite emergency response organizations. Repository personnel will conduct sufficient drills of varying complexity to allow emergency response organization members to maintain proficiency in their response roles.

The Site Operations Manager is responsible for continued support of the Emergency Plan through development, conduct, and postexercise and drill activity, including implementing corrective actions to resolve identified deficiencies. The Facility Emergency Preparedness Manager is

responsible for developing and maintaining a coordinated program of drills and exercises integral to the emergency preparedness program.

Repository personnel will perform internal radiological/health physics, medical, and fire drills at least semiannually. Communications drills will be accomplished quarterly. Table 5.7-8 shows typical drills and exercises over a 2-year cycle. Activities demonstrated in exercises (e.g., offsite communications, health physics, medical, and fire) may satisfy drill requirements for the period in which the exercise is conducted.

5.7.12.2.2 Drills

A drill is a supervised "hands-on" training session, which may be evaluated, for individuals or teams that develop or maintain a specific operational or emergency response capability. The scope of a drill can be limited to a specific emergency response function or may be expanded to include multiple functions and facilities. Drills may be only internal, used to test the effectiveness of the repository internal response without activation of the emergency response organization, or may be a coordinated drill encompassing several facilities. Drills are conducted to provide emergency response training in a particular operation and to forecast an organization's capability to respond effectively to an emergency. Drills may be used to maintain proficiency of the emergency response organization members, prepare for exercises, resolve deficiencies, improve performance, and mentor individuals in specific functional areas.

Drills may also be used to validate the closure of corrective actions required because of audits, exercises, or other similar activities. Drills are of sufficient scope, duration, and frequency to ensure adequate training and proficiency of the emergency preparedness program. The scope of drills includes operational aspects to support the Emergency Plan, implementing procedures, and operations training. Drill objectives may include specific activities such as notification, emergency communication, fire, medical response, hazardous material, radiological control, security events, personnel accountability, evacuation, emergency categorization, decontamination, facility activation, public information, and reentry/recovery.

5.7.12.2.3 Tabletop Drills

Tabletop drills consist of supervised training that involves "talking through" responses and instructions with minimal performance activities. Tabletop drills conducted by repository personnel are documented through training records maintained by the Training Manager.

5.7.12.2.4 Walk-Through Drills

Walk-through drills consist of a supervised instruction period that involves talking through and completing actual response actions using response equipment. Drill controllers/evaluators present the scenario information and control activities. Performance can be evaluated. Walk-through drills are summarized and documented through drill reports and/or attendance records maintained by the Training Manager.

5.7.12.2.5 Communications Drills

Quarterly communications drills are conducted by operations personnel with offsite response organizations to verify and update necessary telephone numbers. These drills may contain a scenario message or solely test the communications equipment. Drills containing scenario messages requiring action must be coordinated in advance.

5.7.12.2.6 Exercises

An exercise is a comprehensive, evaluated performance test of the integrated capability of multiple aspects of an emergency response. Exercises are conducted to formally assess the repository organization's capability to respond effectively to an emergency and to provide to offsite response organizations an opportunity to participate with the repository organization.

Exercises will be conducted biennially, at a minimum, to test the adequacy and effectiveness of organizational command and control, implementing procedures, notification and communication networks, emergency equipment, response organization performance, and the overall emergency preparedness program. Exercises are designed and conducted for maximum realism and attempt to duplicate the sense of stress inherent in an actual emergency situation.

Exercises will be designed to test integrated response capabilities of the repository and offsite response agencies, the NRC, and the DOE headquarters organization. Offsite response organizations (including the NRC and DOE headquarters organization) shall be invited to participate in the biennial exercises; however, their participation is not required.

A scenario development committee is responsible for the planning and conduct of exercises. The scenario development committee is comprised of the Emergency Preparedness Manager, a representative from each participating organization (including the Yucca Mountain Repository Drill/Exercise Coordinator, and DOE, federal, state, tribal, and local agencies, as applicable), and individuals with expertise related to each objective. The scenario development committee develops the scenario and prepares the exercise package.

Committee members will be familiar with emergency plans and procedures relative to their areas and should be experienced with scenario development. Sufficient meetings shall be conducted to plan the schedule for scenario development activities and develop the scenario outline. The committee chairman (chief controller) shall convene periodic meetings of the entire group to ensure the timely development of a cohesive and integrated scenario package. To ensure the credibility of the scenario, information from the following sources may be considered:

- SAR
- Critique reports from actual emergencies
- Past exercise packages
- Facility operating experience
- Identified weaknesses and deficiencies from inspections or appraisals.

The exercise scenario development committee shall include provisions for adequate logistics support with specific attention directed toward arrangements for transportation, food, shelter,

medical care and equipment, and materials that are not readily available. Members of the committee are used as controllers and possibly evaluators during the exercise.

The drill/exercise package provides the mechanisms to conduct and evaluate the exercise. Packages are closely controlled to prevent premature disclosure to participants. Information included in the package is dependent on the scope and complexity of the exercise. Typical elements of the package includes:

- **Participants**—Participants consist of players, controllers, evaluators, and observers. Nonparticipants are those personnel outside the scope of play who continue to perform their routine duties throughout the conduct of the drill/exercise.

- **Players**—Members of the emergency response organization and other players comprise the majority of participants in a drill or exercise. Players include staff, engineering, or other personnel who perform required actions based on the scenario. Other participants include controllers, evaluators, and observers.

- **Controllers**—Controllers are trained individuals with expertise in the areas to be demonstrated who are responsible for the safe and effective conduct of drills and exercises. One controller will be designated as the lead controller and will have overall responsibility for the control of the drill or exercise. Controller communications will be through a designated radio net or telephone. Controllers shall be familiar with the objectives and scope of the drill/exercise and the possible responses.

- **Evaluators**—Evaluators are trained individuals with expertise in the areas to be demonstrated who are responsible for observing, evaluating, and critiquing exercises, including the performance of the exercise controllers. The number of evaluators necessary is based on the evaluation criteria, objectives, geographical area, and extent of response team activation. A lead evaluator is identified as the primary point-of-contact for evaluators. The lead evaluator conducts drill/exercise critiques and reports to the lead controller. Evaluators shall be familiar with the objectives and scope of the drill/exercise and the possible responses.

- **Observers**—Observers may be present for official and/or educational purposes. The attendance of observers, their locations, and their rules of conduct are directed by the controller.

- **Safety**—Personnel and facility safety is paramount during drills and exercises. The planning process and the management of drills/exercises ensure that sufficient precautions and limitations are established and adhered to for safe conduct. Any participant in a drill or exercise can suspend the drill or exercise if personnel safety is at risk.

- **Security**—Security is an essential factor in the planning and management of drills and exercises. Adherence to security requirements during drills and exercises is required.

- **Exercise Confidentiality**—Scenario information must be strictly limited to those individuals preparing, controlling, authorizing, and evaluating the event. It is the responsibility of each individual involved to limit release of the scenario and related information.

- **Simulation and Realism**—Simulation should be kept to a minimum and realism should be emphasized. Whenever possible, activity and response action is to be carried out as it would be if the emergency events were real. Exercises should attempt to duplicate the sense of stress inherent in a real emergency situation and be commensurate with personnel and facility safety and security.

- **Offsite Coordination**—Drills and exercises conducted at Yucca Mountain that have the potential to affect the offsite population, either directly or indirectly, include provisions to prevent public concern, rumor, or inconvenience. The planning process and the management of drills and exercises provide for coordination with appropriate NRC, tribal and local authorities, the media, and the public.

- **Controller and Evaluator Training**—Training is conducted for the individuals participating as controllers and evaluators. Emphasis is placed on safety, security, and controller and player interface, including criteria for controllers to intercede in player actions. Controller and evaluator qualification is accomplished by attending controller/evaluator training and is maintained by participating in a drill or exercise as a controller/evaluator at least once every 3 calendar years.

- **Player Briefing**—The player briefing shall not include any information related to the scenario. Players may receive briefing for drills or exercises that include information on:

  – Safety and security
  – Rules of conduct
  – Expected player performance
  – Activities approved to be simulated or walked-through
  – Methods for participant identification
  – Special administrative, logistic, or communications arrangements in effect.

- **Controller and Evaluator Briefing**—Controllers and evaluators receive a briefing to provide familiarity with the scenario, expected participant actions, and their duties and responsibilities. This briefing includes information on:

  – Safety and security
  – Rules of conduct
  – Area assignments
  – Review of main sequence of events
  – Review of scenario data
  – Familiarization with message and data format
  – Delivery of data to the participants
  – Simulation rules
  – Interaction with participants

– Communications for drill/exercise team members
– Methods for handling unexpected participant actions
– Critique responsibility.

5.7.12.2.7 Exercise Conduct

Scenario information, data, and evidence shall be presented to the players as they would be found, measured, or indicated, with maximum realism. Whenever possible, data sheets, recorder charts, and instrument output information shall be provided in the scenario. Props and other aids shall be used to provide visual evidence whenever possible. If possible, the event should appear to the players as if it were actually occurring.

Players will be provided with scenario information commensurate with the occurrence of specific events or specific actions taken by the players. Information will be provided to players by controllers, to control the progress of a drill/exercise. Players are expected to acknowledge that they have received and understood message information by repeating it back to the controller who provided the input. Exercise controllers shall not prompt or correct participants in completing their performance functions. Prompting occurs when players attempt to complete an action and the controller provides assistance to ensure satisfactory completion of a task or function.

Exercise conduct typically includes the use of free play. Free play is an extension of realism, and players should be permitted to make decisions and take actions they consider appropriate to the scenario. Controllers shall allow the players to proceed with appropriate actions and should notify the lead controller that a deviation is occurring. If the players' intended actions compromise safety or security, the controller shall intervene to stop the action and should document the intended action. Solutions to actual equipment or procedure problems identified during free play activities afford a valuable evaluation of knowledge and the safety culture of the players. Controllers stop free play under the following conditions:

- It deviates too far from the scenario such that objectives will not be met
- Personnel safety is jeopardized
- Plant, facility, or environmental safety is jeopardized
- The actions impact security
- The actions exceed established drill/exercise scope or limitations.

5.7.12.2.8 Communications

Communications equipment and procedures are used and evaluated during drills/exercises. Communications shall clearly indicate that the event is a drill or exercise. Personal information, such as the actual names or phone numbers of individuals, shall not be transmitted on systems that can be monitored by the public or the media (e.g., radio, cell phone, satellite phone). Communications during a drill or exercise begin and end with the statement, "This is a drill."

5.7.12.2.9 Exercise Termination

At any time, the lead controller can suspend or terminate the drill/exercise for one of three conditions:

1. Players successfully reach the appropriate termination point, consistent with the purpose, scope, and objectives.

2. The drill/exercise deviates to the extent that the objectives cannot be adequately demonstrated.

3. An actual event/alarm occurs during the drill/exercise such that continuation is not practical.

5.7.12.2.10 Evaluation and Corrective Action

5.7.12.2.10.1 Evaluations

Each exercise that the repository conducts is evaluated. Exercise participants are evaluated to assess their performance against the objectives of the exercise. Repository evaluators are trained to ensure that they have a general understanding of the objectives, scenario, security and safety issues, and an in-depth understanding of their respective areas of responsibility.

The evaluation process includes provisions for documenting observations, maintaining a chronology of events, and retaining copies of the player's documentation (such as logs and checklists). Instructions, standardized evaluation forms, and chronological data sheets are provided for the evaluators as part of the drill/exercise package. Established standards and criteria are used as the basis for the evaluation.

5.7.12.2.10.2 Exercise Critiques

Critiques are held following drills and exercises to allow participants, controllers, and evaluators to share their observations, discuss positive and improvement-needed aspects, and suggest refinements or changes to emergency plans or procedures. Critiques are open, honest, constructive, and target improvements and strengths of the emergency preparedness program and affiliated support organizations.

5.7.12.2.10.3 Exercise Report

Feedback obtained from evaluation forms, critiques, and participant observation forms is reviewed for its potential effect on programmatic needs. Data gathered are reviewed for validity, consistency, and relevance. The overall exercise performance is incorporated in the final exercise report. The report addresses the exercise scope, objectives, and recommendations for improvement actions.

5.7.12.2.10.4 Corrective Actions

Action plans are developed to implement appropriate lessons learned and improvement items, and to correct weaknesses. Lessons learned, improvement items, weaknesses, and deficiencies are used to determine the need for change in the Emergency Plan, implementing procedures, training, and equipment upgrades.

Issues identified during exercises as weaknesses and deficiencies are entered into the repository corrective actions program for tracking through resolution.

5.7.13 Hazardous Materials

[NUREG-1804, Section 2.5.7.3: AC 1(17)]

5.7.13.1 Planning Goals

The Emergency Plan will include a certification that the repository has complied with the requirements of the Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. 11001 et seq.) with respect to hazardous materials within the GROA.

5.7.13.2 Available Information Related to Hazardous Materials

As required by 10 CFR 72.32(b)(13), the Yucca Mountain repository is in compliance with the Emergency Planning and Community Right-To-Know Act of 1986 with respect to hazardous materials.

Limited inventories of hazardous chemicals are used at the GROA. A list of chemicals likely to be used at the repository is provided in Table 5.7-9. This list is updated periodically to reflect site conditions.

5.7.14 Comments on the Emergency Plan

[NUREG-1804, Section 2.5.7.3: AC 1(18)]

5.7.14.1 Planning Goals

The Emergency Plan will be provided to offsite response organizations identified in the Emergency Plan for review prior to submittal to the NRC. The offsite response organizations will have 60 days to review and comment on the Emergency Plan. Offsite response organization comments, if provided, will be included with the Emergency Plan submitted to the NRC. Comments from offsite response organizations, as appropriate, will be dispositioned in subsequent revisions to the Emergency Plan. If subsequent revisions to the Emergency Plan affect the offsite response organizations, future revisions will also be provided to those organizations for review. The comment period for subsequent revisions to the Emergency Plan will be 60 days. Comments provided by offsite organizations during this period will again be included with the revised Emergency Plan submitted to the NRC.

5.7.14.2 Available Information Related to Comments on the Emergency Plan

DOE is actively working with potential local response organizations to plan and establish fully integrated response capabilities for the repository. As these plans are developed, they will be incorporated into the Emergency Plan.

5.7.15 Offsite Assistance

[NUREG-1804, Section 2.5.7.3: AC 1(19)]

5.7.15.1 Planning Goals

To facilitate a coordinated and planned emergency response, provisions for advance arrangements with offsite organizations will be addressed in the Emergency Plan. These arrangements include:

- Identification of offsite response organizations that have agreed to provide support, as well as other support organizations capable of augmenting the planned onsite response
- Means for requesting offsite assistance
- Provisions for prompt communications among principal response organizations with offsite emergency personnel who would be responding
- Provisions for providing and maintaining emergency response facilities and equipment to support the emergency response
- The availability of adequate methods, systems, and equipment for assessing and monitoring actual or potential consequences of a radiological emergency
- Provisions for medical services for contaminated or injured individuals
- Arrangements for radiological emergency response training to be offered to offsite support organizations that may be called upon to assist in an onsite emergency
- Documentation of assistance agreements in the form of letters of agreement or memoranda of understanding.

5.7.15.2 Available Information Related to Offsite Assistance

Participation in broad multiagency emergency response and planning activities will include many governmental agencies in Nye County, Nevada. Some of the specific topics identified include:

- Fire and emergency medical aid
- Law enforcement
- Hazardous materials assistance
- Emergency preparedness coordination.

Significant additional response resources are also available from the Nevada Test Site. The Nevada Test Site response resources have a long history of support for the repository and are expected to be participants in the integrated planning efforts for the future operations of the repository.

As specific support arrangements are developed, agreements and memoranda of understanding will be developed to describe these arrangements.

Copies of letters of agreement and memoranda of understanding will be included in the Emergency Plan.

5.7.16 Public Information

[NUREG-1804, Section 2.5.7.3: AC 1(20)]

5.7.16.1 Planning Goals

The Emergency Plan will describe arrangements for providing timely information to the public in the event of an emergency.

5.7.16.2 Available Information Related to Public Information

Information is disseminated to the media and the public through the Joint Information Center. The Joint Information Center staff facilitates the release of information to the media, responds to questions from the media and the public, and communicates emergency news information to repository workers. The staff facilitates communications among interested public affairs staff from other organizations. Joint Information Center staff monitors media reports of the incident and analyzes those reports to ensure accuracy. Personnel who staff the Joint Information Center during an emergency are considered to be part of the emergency response organization. The Joint Information Center personnel receive training appropriate to their emergency response positions.

While the responding agencies retain the right to release information regarding their specific agency's response to an incident, information regarding repository response activities will be released only with the approval of the Director of OCRWM.

5.7.16.2.1 Repository Emergency Public Information Program

The Repository Emergency Public Information Program establishes the means for providing accurate and timely information to workers on the repository site and the general public through the media. This program also provides for an annual familiarization session to acquaint the news media with the methods for obtaining information during an emergency, as well as information about the overall emergency preparedness program for the repository.

The repository's public information policy is to ensure that any information released by repository personnel to the public is factual and consistent. In general, information concerning emergency conditions at the repository is not released to any agency outside of OCRWM, the Management and Operating contractor, the NRC, or associated emergency response agencies without prior approval of the OCRWM Emergency Director and the Public Information Manager, except as required during emergency notifications in accordance with approved emergency procedures. The Derivative

Classifier in the Emergency Operations Facility provides guidance to ensure that security is not compromised when information is released to the public.

News releases related to an emergency at the repository are reviewed and approved by the OCRWM Emergency Director or designee. If the Emergency Operations Facility has not been activated, the Public Information Manager approves the release.

5.7.16.2.2 Joint Information Center

Information is disseminated to the media and the public through the Joint Information Center. The Joint Information Center staff facilitates the release of information to the media, responds to questions from the media and the public, and communicates emergency news information to repository workers. It facilitates communications among interested public affairs staff from other organizations. Joint Information Center staff monitors media reports of the incident and analyzes those reports to ensure accuracy.

Personnel who staff the Joint Information Center during an emergency are assigned from a rotating roster of Public Information staff. The Joint Information Center personnel have received training appropriate to their emergency response positions. A list of names, phone numbers, and organization positions for Joint Information Center staff is maintained by procedure.

The Public Information Manager or designee reports to the Emergency Operations Facility for a repository event. Repository Joint Information Center staff report to the Joint Information Center Supervisor. The Joint Information Center staff responds to technical questions from the media, provides background on the facility processes involved in the emergency, prepares press releases, monitors external media reporting, provides rumor control, and may participate in press briefings. The Joint Information Center organization is further described in Section 5.7.7.2.2.6.

5.7.16.2.3 Public Education

A visitors center for the repository is located at 2341 Postal Drive in Pahrump, Nevada. The general public is invited during normal business hours, Monday through Friday. The facility includes displays, brochures, pictures, drawings, simulations, and demonstrations of the repository mission.

Public Information personnel from outside public agencies and area news media representatives are invited to participate in repository biennial exercises. Public outreach activities include:

- Ensuring that emergency plans and implementing procedures used at the repository are coordinated with emergency response plans adopted by state and local agencies
- Coordinating and assisting state and local governments in preparing emergency response plans and programs related to repository facilities and activities
- Coordinating with the state and local governmental authorities in developing public education and information materials for Yucca Mountain repository emergencies.

The objective of these activities is to inform the public of the Yucca Mountain repository emergency preparedness programs.

5.7.16.2.3.1 News Media

News media perform a vital function in keeping the public informed during an emergency at the repository. In conjunction with state and local agencies, the repository shall conduct an annual orientation for local news media to acquaint them with information that assists them in providing informed coverage of an event and lessen the possibility of errors in reporting. Information provided during media orientation includes, but is not limited to, the following:

- Potential hazards and emergencies
- Emergency classification system
- Emergency response actions
- Joint Information Center facilities and operations
- Points of contact for emergency information.

Emergency media information packets are available for members of the media. These packets provide background information about the repository and the mission.

5.7.17 General References

BSC (Bechtel SAIC Company) 2007. *Population Projections to 2075 for the Yucca Mountain Radiological Monitoring Grid.* 950-PSA-MGR0-00100-000 REV 000. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070905.0012.

Emergency Planning and Community Right-to-Know Act of 1986. 42 U.S.C. 11001 et seq.

EPA (U.S. Environmental Protection Agency) 1992. *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*. EPA 400-R-92-001. Washington, D.C.: U.S. Environmental Protection Agency. TIC: 216382.

NRC (U.S. Nuclear Regulatory Commission) 1981. *Functional Criteria for Emergency Response Facilities, Final Report*. NUREG-0696. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 102319.

NRC 2000. "Emergency Planning." Interim Staff Guidance–16 (ISG-16). Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 253645.

INTENTIONALLY LEFT BLANK

Table 5.7-1. 2013 Projections of the Resident Population Located within 84 km of the Repository

States and Counties	Population Areas	2013 Projected Population
NEVADA		
Nye County	Amargosa Valley area	2,223
	Beatty area	1,879
	Pahrump area	29,311
Clark County	Indian Springs area	2,284
Esmeralda County	—	0
Lincoln County	—	0
	NEVADA SUBTOTAL	35,697
CALIFORNIA		
Inyo County	Death Valley area	472
	CALIFORNIA SUBTOTAL	472
	GRAND TOTAL	**36,169**

Source: BSC 2007, Table II-1.

Table 5.7-2. Protective Action Guides for the Early Phase of a Nuclear Incident

Protective Action	Protective Action Guide (Projected Dose)	Comments
Evacuation (or sheltering)[a]	1 to 5 rem[b] (0.01 to 0.05 Sv)	Evacuation (or for some situations, sheltering) should normally be initiated at 1 rem.
	1 to 10 rem[b] (0.01 to 0.1 Sv)	Where evacuation is impractical or for particularly vulnerable populations (e.g., those people who are not readily mobile).
	50 to 250 rem (skin) (0.5 to 2.5 Sv)	Exposure to the skin should seldom, if ever, be the controlling pathway for protective action.
	5 to 25 rem (thyroid) (0.05 to 0.25 Sv)	Based on the release of radioactive iodine.
Administration of stable iodine	25 rem[c] (0.25 Sv)	Requires approval of repository medical officials.

NOTE: [a]Sheltering may be the preferred protective action when it provides protection equal to or greater than evacuation based on consideration of factors such as source-term characteristics and temporal or other site-specific conditions.
[b]The sum of the effective dose equivalent resulting from exposure to external sources and the committed effective dose equivalent from significant inhalation exposure pathways during the early phase.
[c]Committed dose equivalent to the thyroid from radioiodine.

Source: EPA 1992.

Table 5.7-3. Guidance on Dose Limits for Workers Performing Emergency Services

Dose Limit[a] (rem)	Activity	Condition
5 (0.05 Sv)	Any	—
10 (0.1 Sv)	Protecting valuable property	Where lower dose is not practicable
25 (0.25 Sv)	Lifesaving or protection of large populations	Where lower dose is not practicable
>25 (>0.25 Sv)	Lifesaving or protection of large populations	Only on a voluntary basis to persons fully aware of the risks involved

NOTE: [a]Sum of the external effective dose equivalent and the committed effective dose equivalent to nonpregnant adults from exposure and intake during an emergency situation. Workers performing services during emergencies should limit the dose to the lens of the eye to three times the listed values and the dose to any other organ (including skin and extremities) to 10 times the listed value. The limits apply to doses from an incident, except doses received in unrestricted areas as members of the public during the intermediate phase of the incident. No specific upper limit is given for thyroid exposure.

Source: EPA 1992.

Table 5.7-4. Technical Support Center Emergency Response Organization

Functional Area	Major Tasks	Emergency Response Organization Positions	Normal Organization Position or Organization
Emergency Direction and Control	Command and Control	Technical Support Center Director	Site Operations Manager
Notification and Communication	Emergency Communications	Technical Support Center Coordinator	Site Protection Manager
	Plant Status	Communicator	Operations Technical Staff
	Emergency Communications	Communicators	Technical Staff
Radiological Assessment	Radiation Protection	Radiological Response Manager	Radiation Protection Manager
	In Facility Radiation Protection	Radiological Assessment Supervisor	Radiation Protection Staff
	Site/Offsite Surveys	Environmental Assessment Supervisor	Radiation Protection Staff
	Dose Assessment	Radiological Assessment Specialist (1)	Radiation Protection Staff
	Dose Assessment	Radiological Assessment Specialist (2)	Radiation Protection Staff
Plant System Engineering, Repair, and Corrective Actions	Technical Support/ Accident Analysis	Engineering Manager	Project Engineering Manager
	Technical Support/ Accident Analysis	Criticality Engineer	Engineering Staff
	Technical Support/ Accident Analysis	Mechanical Engineer	Engineering Staff
	Technical Support/ Accident Analysis	Electrical Engineer	Engineering Staff
	Technical Support/ Accident Analysis	Operations Manager	Waste Handling Manager
	Technical Support/ Accident Analysis	Radiation Controls Engineer	Engineering Staff
	Repair and Corrective Actions	Maintenance Supervisor	Maintenance Manager
Site Access Control and Personnel Accountability	Security and Accountability	Security Manager	Physical Protection Manager

Table 5.7-4. Technical Support Center Emergency Response Organization (Continued)

Functional Area	Major Tasks	Emergency Response Organization Positions	Normal Organization Position or Organization
Resource Allocation and Administration	Logistics	Logistics Support Staff	Work Control Staff
	Facility Support	Information Technology Support Staff	Information Technology Staff
	Administration	Administrative Staff	Clerical Staff

Table 5.7-5. Operational Support Center Emergency Response Organization

Emergency Response Organization Positions	Normal Position or Organization
Operational Support Center Manager	Senior Maintenance Supervisor
Mechanical Maintenance	Mechanical Maintenance Staff
Electrical/Instrumentation and Controls Maintenance	Electrical/Instrumentation and Controls Maintenance Staff
Radiation Protection Supervisor	Radiation Protection Staff
Operations	Operations Shift Staff not otherwise assigned

Table 5.7-6. Emergency Operations Facility Emergency Response Organization

Functional Area	Major Tasks	Emergency Response Organization Positions	Normal Organization Position or Organization
Emergency Direction and Control	Command and Control	OCRWM Emergency Director	Deputy Director OCRWM
Notification and Communication	Emergency Communications	Emergency Operations Facility Coordinator	OCRWM Staff
	Emergency Communications	Headquarters Communicator	OCRWM Staff
	Emergency Communications	Communicators	OCRWM Staff
	Emergency Communications	State/Local Communicator	OCRWM Staff
	Governmental	State/Local Liaisons	Training Staff
	Plant Status	Operations Advisor	Licensing Technical Staff
	Technical Activities	Operations Advisor	Licensing Technical Staff
	Governmental	Regulatory Liaison	Licensing Manager
Plant System Engineering, Repair, and Corrective Actions	Technical Support/ Accident Analysis	Technical Support Manager	OCRWM
Resource Allocation and Administration	Logistics	Administrative Support Manager	Administrative Manager (OCRWM)
Public Information	Information Development	Public Information Manager	Director Internal and External Affairs (OCRWM)

Table 5.7-7. Joint Information Center Emergency Response Organization

Major Tasks	Emergency Plan Positions	Positions
Facility Operation and Control	Joint Information Center Supervisor	External Affairs Staff
Media Interface	DOE Spokesperson	Senior OCRWM Staff
Media Interface	Radiation Protection Spokesperson	OCRWM Radiation Protection Specialist
Media Interface	Technical Spokesperson	OCRWM Technical Specialist
Information Development	News Writer	External Affairs Specialist
Information Development	Derivative Classifier	OCRWM Derivative Classifier
Information Development	Public Information Coordinator	External Affairs Specialist
Facility Operation	Administrative Support Specialist	OCRWM Administrative Support Manager
Media Monitoring and Rumor Control	Media Monitoring Staff	External Affairs Staff
Media Monitoring and Rumor Control	Rumor Control Staff	External Affairs Staff
Facility Operation and Control	Joint Information Center Coordinator	External Affairs Staff
Facility Operation and Control	Security	OCRWM Security
Facility Operation and Control	Information Technology Support Staff	OCRWM Information Technology Staff
Facility Operation and Control	Administrative Staff	OCRWM Administrative Staff

Table 5.7-8. Typical Repository Drill/Exercise Frequency

Drill/Exercise	Year 1 Quarter				Year 2 Quarter			
	1	2	3	4	1	2	3	4
Communications check with offsite response organizations	X	X	X	X	X	X	X	X
Radiological/health physics drill	X		X		X		X	
Medical	X		X		X		X	
Fire drills	X		X		X		X	
Biennial exercise							X	

Table 5.7-9. Inventory of Typical Hazardous Chemicals

Chemical	GROA Location
Diesel fuel	Emergency Diesel Generator Fuel Oil Day Tank A (Section 1.2.8.2.2)
Diesel fuel	Emergency Diesel Generator Fuel Oil Storage Tank (underground) Tank A
Diesel fuel	Emergency Diesel Generator Fuel Oil Day Tank B (Section 1.2.8.2.2)
Diesel fuel	Emergency Diesel Generator Fuel Oil Storage Tank (underground) Tank B
Diesel fuel	Diesel Fuel Storage Area (Area 70A) (Table 1.2.8-1)
Diesel fuel	Fueling Stations (Area 70B), underground tank
Gasoline	Fueling Stations (Area 70B), underground tank
Boric acid	Boron makeup system makeup tank, Wet Handling Facility, Room 1013 (Section 1.2.5.3.2.1.2)
Flammable maintenance items	Various locations in approved flammable storage cabinets. Controlled quantities in accordance with fire hazards analysis
Flammable nondestructive testing materials	Various locations in approved flammable storage cabinets. Controlled quantities in accordance with fire hazards analysis
Sulfuric acid	Batteries in various locations (Section 1.4.1.3.1)

INTENTIONALLY LEFT BLANK

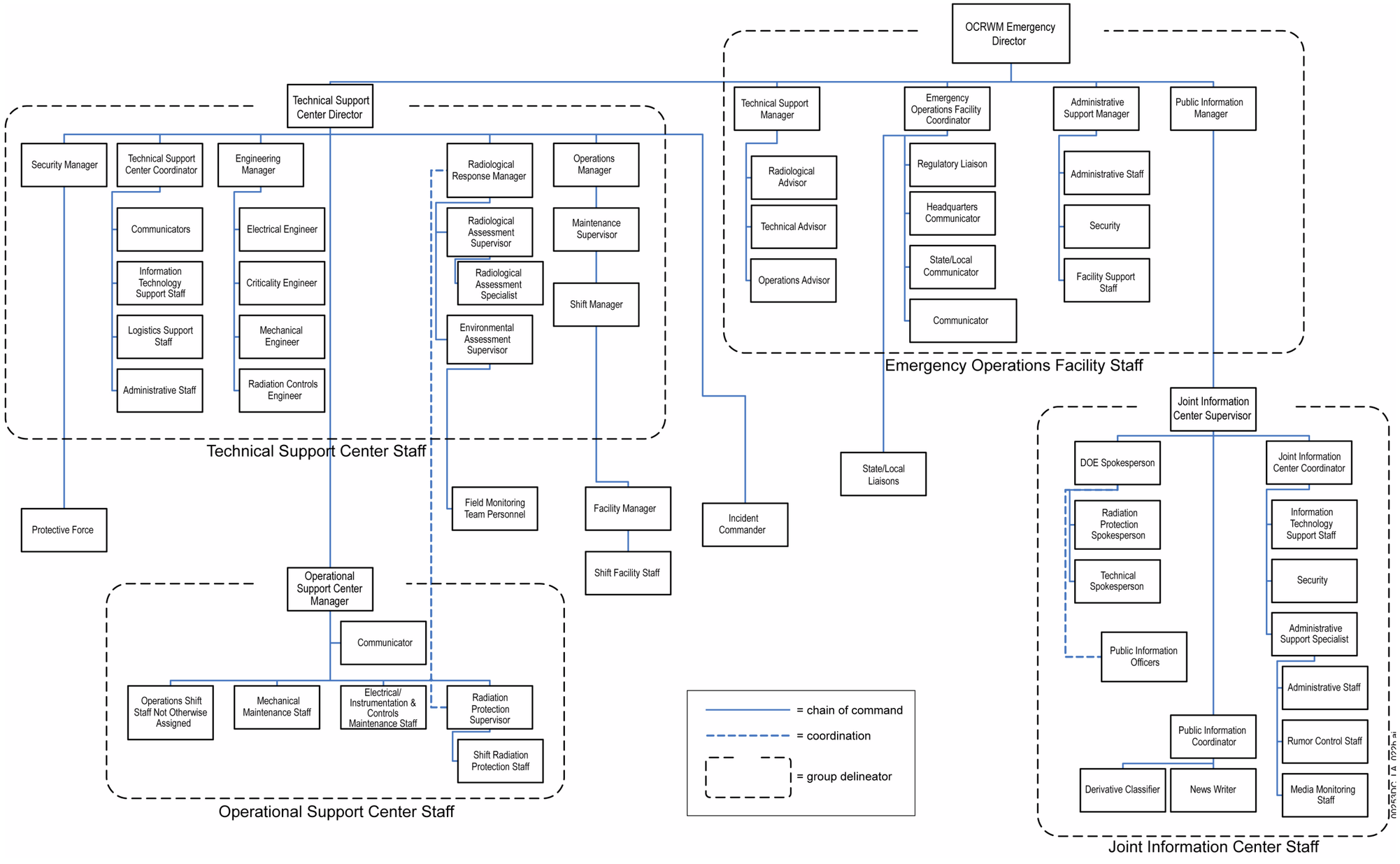

Figure 5.7-1. Organization Chart for the Technical Support, Operational Support, and Joint Information Center Staffs, and the Emergency Operations Facility Staff

INTENTIONALLY LEFT BLANK

YUCCA MOUNTAIN REPOSITORY
Emergency Notification Page of

1. Message Number:	2. Reason for Notification: ☐ Emergency ☐ Drill/Exercise	3. Incident Location: Yucca Mountain Repository Nye County, NV	4. Facility:

5. Emergency Categorization/Classification:
☐ Alert Date/Time: _____
☐ Site Area Emergency Date/Time: _____
☐ Termination Date/Time: _____
☐ Other (specify): Date/Time: _____

6. Onsite Protective Action Taken:
☐ None ☐ Shelter ☐ Evacuate
Area or Distance:

7. Offsite Protective Action Recommendation (PAR):
☐ None ☐ Shelter ☐ Evacuate
Area or Distance:

8. Offsite Agency Support Requested:
☐ No ☐ Yes (specify):

9. Meteorological Information:
Wind Direction From (in degrees): _____
Wind Speed: _____ mph Temp: _____ °F
Stability Class (check one): ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F
Precipitation: ☐ Yes ☐ No
Type (specify):

10. Release Information:
☐ No Release Expected ☐ A Release is Imminent
☐ A Release is Occurring ☐ A Release Has Stopped
Substance Released: _____
Estimated Quantity Released: _____
Release to: ☐ Air ☐ Water ☐ Ground
Time Release Began: _____ Stopped: _____

11. Radiological Information: ☐ **N/A**
Projected Offsite Dose Exceeding EPA PAGs
☐ Yes ☐ No ☐ New ☐ Unchanged ☐ Unknown
Projected Based On:

12. Joint Information Center (JIC):
☐ Is Operational ☐ Is **NOT** Operational
Telephone: _____

13. Description of Incident/Condition: (Continue on Continuation Page if necessary)

14. Primary Contact Telephone Numbers:

NRC Operations:	Primary – (301) 816-5100 or (800) 532-3469 Backups – 1) (301) 951-0550 or (800) 449-3964 2) (301) 415-0550 3) (301) 415-0553	Time: _____
DOE HQ:	(800) 342-5363 or (202) 586-5000	Time: _____
State of Nevada:	(775) 687-0300; after hours (775) 687-0477	Time: _____
Nye County:	(775) 751-4278	Time: _____

15.
Notification Made By: _____
Call Back Number: _____

16. Approval:
Title/Name: _____
Signature: _____

00253DC_LA_023.ai

Emergency Notification (Rev. 10/17/2007)

Figure 5.7-2. Yucca Mountain Repository Emergency Notification Form

NOTE: EPA = U.S. Environmental Protection Agency; HQ = headquarters; PAG = protective action guideline.

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

FIGURES

Page

INTENTIONALLY LEFT BLANK

5.8 CONTROLS TO RESTRICT ACCESS AND REGULATE LAND USES

This section provides information that addresses specific regulatory acceptance criteria in Section 2.5.8.3 of NUREG-1804. The information also addresses requirements contained in 10 CFR 63.21(c)(24); 10 CFR 63.111(a) and (b); 10 CFR 63.121; 10 CFR 63.302, and 10 CFR 63.51(a)(3) (i) and (ii). In particular, this section identifies that:

- The geologic repository operations area (GROA) will be located in and on lands that are either acquired lands under the jurisdiction and control of the U.S. Department of Energy (DOE) or will be permanently withdrawn and reserved for its use. The lands upon which the GROA will be located will be held free and clear of encumbrances, if significant, such as rights arising under the general mining laws; easements for right-of-way; and other rights arising under lease, rights of entry, deed, patent, mortgage, appropriation, prescription, or otherwise.

- Additional controls will be provided for permanent closure of surface and subsurface at or outside the GROA. These controls will consist of appropriate jurisdiction and control over surface and subsurface estates to prevent adverse human interactions that could significantly reduce the ability of the repository to achieve waste isolation.

- Additional controls will be applied through permanent closure, including areas outside the GROA. The DOE will exercise jurisdiction, as required, to ensure that the requirements of 10 CFR 63.111(a) and (b) are met. The controls include the authority to exclude members of the public.

- Appropriate steps have been taken to secure water rights to accomplish the purposes of the repository.

- The conceptual design of monuments to identify the location of the repository and the postclosure controlled area after permanent closure has been provided.

The following table lists the information provided in this section, the corresponding regulatory requirements, and the applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.8.1	Ownership of Land	63.21(c)(24) 63.121(a)	Section 2.5.8.3: Acceptance Criterion 1
5.8.2	Controls for Permanent Closure	63.21(c)(24) 63.121(b) 63.302	Section 2.5.8.3: Acceptance Criterion 2 Acceptance Criterion 3
5.8.3	Additional Controls through Permanent Closure	63.21(c)(24) 63.111(a) 63.111(b) 63.121(c)	Section 2.5.8.3: Acceptance Criterion 3

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.8.4	Water Rights	63.21(c)(24) 63.121(d)	Section 2.5.8.3: Acceptance Criterion 4
5.8.5	Conceptual Design of Monuments and Markers	63.21(c)(24) 63.51(a)(3)(i) 63.302	Section 2.5.8.3: Acceptance Criterion 5
5.8.6	Records Storage	63.51(a)(3)(ii)	Not applicable

5.8.1 Ownership of Land

[NUREG-1804, Section 2.5.8.3: AC 1]

In accordance with 10 CFR 63.121(a)(1), the GROA must be located in and on lands that are either acquired lands under the jurisdiction and control of the DOE or lands permanently withdrawn and reserved for its use. The DOE is currently examining appropriate courses of action that will conform to the requirements of 10 CFR Part 63, including a legislative land withdrawal, to establish effective jurisdiction and control of the land prior to the U.S. Nuclear Regulatory Commission granting construction authorization. Figures 5.8-1 and 5.8-2 depict the different boundaries and areas discussed in this section.

The GROA and surrounding land, shown as within the land withdrawal area boundary on Figure 5.8-1, include about 150,000 acres of land currently under the control of the DOE, the U.S. Department of Defense, and the U.S. Department of the Interior (DOE 2002, Section 1.4.1). The eastern portion of this land, about 79,700 acres, is located on the western portion of the DOE Nevada Test Site. This portion of the Nevada Test Site was withdrawn from the Nellis Air Force Range by Public Land Order 2568 on December 19, 1961 (26 FR 12292). The southwestern portion of the area consists of an estimated 45,300 acres that are public lands under the administration of the Bureau of Land Management and are open to public access (DOE 2002, Section 3.1.1.3). The northwestern portion of this area, about 23,000 acres, is located on the U.S. Air Force Nevada Test and Training Range. This land was originally withdrawn as a bombing and aerial gunnery range by Executive Order 8578 (5 FR 4313). This land was most recently withdrawn by the Military Lands Withdrawal Act of 1999, Public Law No. 106-65, 113 Stat. 885, which legislatively extended the existing land withdrawal until November 6, 2021.

5.8.1.1 Current U.S. Department of Energy Land-Use Interests

On March 6, 2007, the DOE submitted (Bodman 2007) to the Congress a bill entitled the "Nuclear Fuel Management and Disposal Act." This bill, if passed by Congress and signed by the President, would, among other things, permanently withdraw the above lands for use by the DOE for the construction and operation of a repository at Yucca Mountain. In the meantime, the DOE already holds legal interests in much of the subject land depicted in Figure 5.8-1. The land on which the GROA will be located is covered by these legal interests, which take the form of two rights-of-way, an administrative land withdrawal, and a public land order. These legal interests are monitored and discussed further in the report *Land Records for the Proposed Land Withdrawal Area of the Yucca Mountain Repository* (DOE 2007), which is periodically updated to reflect

current land status. Currently, these legal interests do not authorize the construction and operation of the repository:

- Right-of-way N-48602 was granted to the DOE by the Bureau of Land Management subject to concurrence by the United States Air Force on October 10, 1989, and renewed on June 28, 1994; January 5, 2001; and April 8, 2004. The most recent renewal of this right-of-way expires in 2014 (BLM 2008). This right-of-way reservation covers a portion of the Nevada Test and Training Range. The Bureau of Land Management retains the right to issue rights-of-way on the Nevada Test and Training Range, with the concurrence of the U.S. Air Force, under Section 3011(b)(5)(E) of the Military Lands Withdrawal Act of 1999, Public Law No. 106-65, 113 Stat. 885 (October 5, 1999). The current right-of-way covers a portion of the GROA and the northwestern portion of the surrounding land. The land within this right-of-way has been withdrawn from all forms of appropriation under the public land laws, including mining laws and geothermal leasing laws.

- Right-of-way N-47748 was granted to the DOE by the Bureau of Land Management on January 6, 1988, and renewed on January 5, 2001 and December 20, 2007. The right-of-way expires on December 31, 2014. Most of this right-of-way is located within the southwestern portion of the area. This right-of-way covers public land administered by the Bureau of Land Management (BLM 2007).

- Public Land Order 7653 is a land withdrawal for a period of 10 years to evaluate the lands for the potential construction, operation, and maintenance of a rail line (Caliente Rail Corridor) for transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) to a geologic repository at Yucca Mountain (70 FR 76854).

- Public Land Order 6802 (55 FR 39152) was executed by the U.S. Department of the Interior on September 25, 1990, and extended by Public Land Order 7534 (67 FR 53359) on July 31, 2002. It expires on January 31, 2010. These public land orders cover 4,255.5 acres and withdraw the land from the operation of the mining and mineral leasing laws and overlay a part of right-of-way N-47748 (BLM 2007). While these public land orders do not grant the DOE additional land-use rights above those specified in the right-of-way, they do preclude the staking and filing of mining claims.

In addition, a Memorandum of Agreement between the predecessor offices of the DOE National Nuclear Security Agency Nevada Site Office and the DOE Office of Civilian Radioactive Waste Management (Aquilina and Nelson 1994) allows the use of about 58,000 acres on Nevada Test Site land for Yucca Mountain project activities. Figure 5.8-1 shows the agreement area, which is known as the “ranch boundary.”

5.8.1.2 Legal Documentation of Ownership and Control

The DOE anticipates completing its permanent land acquisition activities prior to the U.S. Nuclear Regulatory Commission granting construction authorization. In the case of a legislative withdrawal, a citation to the legislation, with inclusion of pertinent provisions of the legislation, will be included

in a revision to the license application. In the case of other land acquisition activities, a sufficient index of ownership and control will be available to satisfy a purchaser of record.

5.8.2 Controls for Permanent Closure

[NUREG-1804, Section 2.5.8.3: AC 2, AC 3]

The DOE anticipates that it will obtain the sole rights, in perpetuity, to the land for the GROA and the land area surrounding it. 10 CFR 63.121(b) requires certain controls for permanent closure of the repository. Section 5.8.4 provides a discussion of the control of water rights. In addition, a system of monuments and markers is discussed in Section 5.8.5. These monuments and markers, which will be located at the perimeter of the proposed land ownership area and over designated areas of the GROA (Figure 5.8-2), provide a passive form of control.

The DOE will exercise jurisdiction and control over surface and subsurface domains necessary to prevent adverse human actions that could significantly reduce the ability of the repository to achieve isolation of SNF and HLW. Appropriate controls necessary to prevent such adverse human actions will be implemented at the repository. The boundaries of the surface GROA, shown in Figure 5.8-2, are consistent with the design of the facility and the surrounding natural features. Figure 5.8-2 also shows the location of the GROA with regard to underground waste emplacement. The proposed land ownership area is shown. The postclosure controlled area is also shown. To ensure the ability of the repository to achieve waste isolation following closure and to reduce the risk of human activity that could adversely impact waste isolation, various activities relating to surface and subsurface facilities are discussed below.

As described by the subsurface facility layout considerations in Section 1.3.2.2.1, the size and boundaries of the GROA and the area outside the GROA are consistent with the design or natural features to ensure the ability of the repository to achieve isolation and to reduce the risk of human activity that could adversely impact waste isolation.

5.8.2.1 Legal Interests and Documentation

While the DOE does not have sole rights in perpetuity to the area shown in Figure 5.8-1, the DOE does possess certain legal interests in the area for the repository. These legal interests currently do not permit activities needed to construct or operate the repository. It is anticipated that the DOE will obtain appropriate ownership interests in the land prior to construction authorization.

5.8.2.2 Encumbrances on Land Surrounding Yucca Mountain

The encumbrances discussed below are associated with areas outside of, but in the vicinity of, the GROA. The land on which the GROA will be located will be free and clear of encumbrances after completion of the land withdrawal or other acquisition process identified in Section 5.8.1.

The status and occurrence of land encumbrances are dynamic. Therefore, a detailed evaluation and discussion of additional land encumbrances are presented in the report *Land Records for the Proposed Land Withdrawal Area of the Yucca Mountain Repository* (DOE 2007), which is periodically updated to reflect current land status.

5.8.2.2.1 Patented Mining Claim

A patented mining claim involves the conveyance of fee title to a parcel of land from the United States to a private claimant, based upon discovery of a valuable mineral deposit. Effective October 1, 1994, Congress imposed a moratorium on spending appropriated funds for the acceptance or processing of mineral patent applications that had not yet received the First Half Final Certificate or were not in Washington, D.C., for Secretarial review of the First Half Final Certificate on or before September 30, 1994. Until the moratorium is lifted, the Bureau of Land Management will not accept any new applications. There is only one patented mining claim within the area shown in Figure 5.8-1.

Patent 27-83-0002 (BLM 1982) is a 203-acre plot owned by Cind-R-Lite within Section 36, T.14S. R.48E and is located approximately 10 miles south of Yucca Mountain. Mining activities associated with patent 27-83-0002 have been assessed, and that assessment has determined that because the claim is physically remote and down the aquifer gradient from Yucca Mountain, the mining activities do not present an adverse human action that reduces the ability of the repository to isolate waste.

An access road and a transmission line, located in T.15S. R.48E., Section 1, are associated with patent 27-83-0002 (BLM 1982). The access road right-of-way, N-43366, is 40 ft wide and runs from U.S. Highway 95 to the mining claim area (Collins 1986). The right-of-way for the transmission line, Nev 066289, is 10 ft wide and runs from the main power line to the patent area (Collins 1986). Activities within these rights-of-way are sufficiently remote, approximately 10 mi, from the GROA, that they do not present an adverse human action that reduces the ability of the repository to isolate waste.

5.8.2.2.2 Unpatented Mining Claims

An unpatented mining claim is a parcel of federal land that, pursuant to the Mining Law of 1872 (30 U.S.C. 21) and applicable regulations, has been identified by a member of the public as potentially containing a valuable mineral deposit. The staking of an unpatented mining claim provides the claimant with the right to occupy the land within the boundaries of the claim while searching for valuable minerals. Two types of mining claims—lode (Length of Claims on Veins or Lodes, 30 U.S.C. 23) and placer claims (Placer Claims, 30 U.S.C. 35)—provided for in the Mining Law of 1872, are discussed below. A lode claim is any zone of mineralized rock lying within boundaries that separate it from neighboring rock. Generally, maximum dimensions of a lode claim are 1,500 ft long by 600 ft wide. A placer claim is a claim on gravel or decomposed mineralized rock that has potentially flowed from a vein or lode. The maximum size is 20 acres for a single claim.

The unpatented lode and placer mining claims are primarily located in the far southwestern part of the depicted area on land administered by the Bureau of Land Management. Figure 5.8-1 also shows the unpatented mining claims that are located in the south-central part of this area on land administered by the Bureau of Land Management. Additional information for these claims, including the status of surface or subsurface activities, is presented in *Land Records for the Proposed Land Withdrawal Area of the Yucca Mountain Repository* (DOE 2007). The analysis summarized in Section 1.6.3.4 concludes that, due to their remoteness from the repository surface

facilities, any activities related to these claims would have no adverse impact on repository operations.

5.8.2.2.3 Other Encumbrances

This section describes the type, location, and land holder for notable land encumbrances such as rights-of-way associated with monitoring wells and free-use permits. Additional information for these and other encumbrances within the proposed land withdrawal area are described in the *Land Records for the Proposed Land Withdrawal Area of the Yucca Mountain Repository* (DOE 2007).

Pursuant to right-of-way N-62848 (BLM 2000), Nye County, Nevada, has drilled several monitoring wells within the area depicted in Figure 5.8-1 as part of its Early Warning Drilling Program. The locations of the individual drill sites are shown in Figure 5.8-3. It is expected that Nye County will continue the Early Warning Drilling Program and other scientific investigations.

Since these drilling activities occur farther than 5 mi from the GROA, repository operations are not expected to be impacted (Section 1.6.3.4). The impact of these activities on the ability of the repository to meet performance objectives has been evaluated and found to have no adverse effect.

The Bureau of Land Management issued free-use permits N-51530 (BLM 1990), and N-84150 (Chatterton 2008) to the DOE for the development of borrow pits to furnish materials for construction (Figure 5.8-1). The first permit, N-51530, applies to an area located in T.12S., R.49E., Sections 25 and 36, and T12S., R.50E., Section 31 (BLM 1990). The borrow pit covered by N-51530 was never developed and the DOE has requested relinquishment of this permit. The second permit, N-84150, replaces permit N-63370, and applies to the same area covered by N-63370 located in T.13S., R.49E., Section 12. Permit N-84150 will expire on January 7, 2018. Activities within free-use permit area N-84150 would be sufficiently remote from the GROA that repository performance would not be adversely impacted. The borrow pit covered by N-84150 will be reclaimed to near-original ground condition prior to repository closure.

Free-use permit N-82254 was issued to the DOE by the Bureau of Land Management for the excavated rock (the muck pile) that resulted from the tunneling operations associated with the Yucca Mountain Exploratory Studies Facility. Permit N-82254 is located in T.12S. R.50E., Sections 31 and 32 (BLM 2006). This muck pile rock will be removed during repository construction. Prior to such removal, portions of the rock may be used for construction activities.

5.8.2.3 Administering and Controlling Ownership Rights

Upon obtaining perpetual ownership of the land shown in Figure 5.8-1, the DOE will develop a management plan for administering and controlling ownership rights. The management plan will include land-use restrictions and the authority to exclude members of the public consistent with the requirements of 10 CFR Part 63.

5.8.3 Additional Controls through Permanent Closure

[NUREG-1804, Section 2.5.8.3: AC 3]

Prior to receipt of a license to receive and possess SNF and HLW, and in accordance with 10 CFR 63.121(c), controls will be implemented to ensure that the requirements of 10 CFR 63.111(a) and (b) are met. The site boundary, as shown in Figure 5.8-2, will be considered as the boundary of the preclosure controlled area under the definition of 10 CFR 20.1003. Such land use controls will include ensuring that U.S. Air Force flight activities in the proximity of the GROA remain within the repository performance analysis considerations of existing and projected U.S. Air Force flight activity (Section 1.6.3.4.1). The flight restrictions are:

- Flights by fixed-wing aircraft are prevented in DOE Nevada Test Site or U.S. Air Force Nevada Test and Training Range airspace within 4.9 nautical miles (5.6 statute miles) of the North Portal and below 14,000 ft mean sea level.

- The number of overflights by fixed-wing aircraft at altitudes greater than 14,000 ft mean sea level within the flight-restricted airspace (i.e., within 4.9 nautical miles (5.6 statute miles) of the North Portal) is limited to 1,000 per year; and the overflights are limited to straight and level flights (i.e., maneuvering is not permitted).

- Carrying ordnance over the flight-restricted airspace (i.e., within 4.9 nautical miles (5.6 statute miles) of the North Portal) is prevented.

- Aircraft are prevented from engaging in electronic jamming while over the flight-restricted airspace (i.e., within 4.9 nautical miles (5.6 statute miles) of the North Portal).

Additionally, helicopter flights are prevented within 0.5 miles of surface facilities that process, stage, or age nuclear waste forms. This restriction and those above will be in place prior to receipt of the license to receive and possess SNF and HLW.

A postclosure access control program will also be implemented to provide controls to restrict access and to prevent disturbance of the GROA and the site pursuant to 10 CFR 63.43(b)(5), 10 CFR 63.111, and 10 CFR 63.113.

5.8.3.1 10 CFR 63.111(a) and (b) Requirements

Section 1.8 contains information to demonstrate compliance with 10 CFR Part 20 and 10 CFR 63.111(a) and (b) and shown in Table 1.8-1, for GROA restricted areas, site preclosure controlled areas, and for public exposure in unrestricted areas outside the site boundary both in the general environment and in areas outside the general environment. Section 1.8 indicates that the direct radiation dose to members of the public in unrestricted areas is expected to be very low, because radiation sources (such as transportation casks, waste packages, or other casks temporarily located at the repository) are processed at remote locations well within the site boundary and far from areas where members of the public would have access.

The management plan, discussed in Section 5.8.2.3, will require land-use restrictions to control public access. In addition, a physical protection plan, discussed in GI Section 3, will further limit access to structures, systems, or components associated with the processing of waste.

The consequence analysis performed in Section 1.8 considered the size and boundaries of the GROA and the site, and the locations of the highest airborne concentrations in the general environment and in areas outside the general environment. The locations of the maximally exposed individuals for preclosure consequence analyses are at those locations of highest airborne concentrations as discussed in Section 1.8.1.4.3.

5.8.3.2 Legal Documentation

Matters of legal documentation, jurisdiction and control, and encumbrances are discussed in Section 5.8.2.

5.8.4 Water Rights

[NUREG-1804, Section 2.5.8.3: AC 4]

The DOE received water appropriation permits from the State of Nevada to support the repository site characterization phase. The permits were issued for wells J-12 (Turnipseed 1992a), J-13 (Turnipseed 1992b), VH-1 (Turnipseed 1992c), and the C-Wells complex (Turnipseed 1994a; Turnipseed 1994b; Turnipseed 1994c; DOE 2002, p. 3-66). These permits, with the exception of VH-1, expired on April 9, 2002 (Ricci 2002). The DOE has filed proof of beneficial use to establish a permanent right to 2.3 acre-ft of water annually from well VH-1. This supply from VH-1 will not provide for the projected water demands to construct and operate the repository (DOE 2002, pp. 4-27 and 4-30, Table 4-11).

To meet the projected demands for water, the DOE filed a water appropriation request with the Office of the Nevada State Engineer on July 22, 1997, for permanent rights to 430 acre-ft of water annually. These applications were for the five well sites at J-12, J-13, and the C-Wells complex. The use is considered industrial and includes but is not limited to road construction, facility construction, drilling, dust suppression, tunnel and pad construction, testing, culinary and domestic uses, and other uses related to the site (Dixon 1997a; Dixon 1997b; Dixon 1997c; Dixon 1997d; Dixon 1997e). These water appropriation permit applications have been denied by the Nevada State Engineer. The U.S. Department of Justice, on behalf of the DOE, continues its appeal of this decision in U.S. District Court.

The DOE request for 430 acre-ft of water annually meets the expected water demands and leaves sufficient margin for contingencies to accomplish the purposes of the GROA. The period of highest water consumption will occur during the initial construction phase. The DOE will ensure that additional temporary water rights, if required, will be obtained to meet the demand.

5.8.5 Conceptual Design of Monuments and Markers

[NUREG-1804, Section 2.5.8.3: AC 5]

This section provides information regarding the conceptual design for the monuments and markers that will be constructed and erected at the time of permanent closure, in accordance with 10 CFR

63.51(a)(3)(i), along with relevant design considerations for the monuments and markers. The site perimeter, postclosure controlled area, and the GROA will be identified by monuments and markers that are designed, fabricated, and emplaced to be as permanent as is practicable.

Two types of monuments and one type of marker will be constructed and erected: site perimeter monuments and GROA monuments and postclosure controlled-area markers. These types of monuments and markers are discussed further below.

Defining the postclosure controlled area, 10 CFR 63.302 also calls for the surface of the controlled area to be identified by passive institutional controls. The passive institutional controls include monuments and markers that are as permanent as practicable and that are placed on the surface of the earth. Other such controls will involve the placement of records in the archives and land record systems of local, state, and federal government agencies and archives elsewhere in the world that would likely be consulted by human intruders. Such records would identify the location of the GROA, including the underground facility, boreholes, shafts, ramps, and the boundary of the site and the nature and hazard of the waste. Institutional controls will also include government ownership and regulations regarding land or resource use and other methods of preserving knowledge of the GROA and the hazardous nature of the waste in the repository. Figure 5.8-2 indicates the location of the geologic repository underground panels and surface facilities. The figure also shows the site, the postclosure controlled area boundary, and pertinent geographic features of the site.

Monuments and markers are components of a system of passive institutional controls designed to restrict access, regulate land use, and maintain records to minimize the potential for intrusion after closure of the repository. Preservation of records is addressed in Section 5.2, and land-use controls are addressed in Sections 5.8.2 and 5.8.3.

5.8.5.1 Design Considerations

Characteristics of the site that can affect the design and placement of the monuments and markers were considered in their conceptual design.

Climatic and Geomorphic Factors—Meteorological conditions that could affect the longevity of monuments and markers were considered. Assessment of climatic effects on candidate materials indicates that their durability is affected by the environment to which they are exposed (Kaplan 1982, pp. 33 and 66). Analogue studies indicate that marker survivability is enhanced by a dry climate (DOE 1996, Appendix EPIC, Section 5.2.2).

There are no perennial streams or surface water bodies near Yucca Mountain that could adversely impact marker and monument placement, provided that known flood-prone areas are avoided. The topography in the Yucca Mountain area allows flexibility in monument and marker placement to avoid potential flood damage.

Placing the inscriptions on the monuments and markers more than 1 m above the land surface will inhibit degradation of the inscriptions from abrasion by wind-blown particles. Studies indicate that the relative density of wind-blown sand flow falls off sharply above a few centimeters over a sand surface and less than 10 cm over a pebble-strewn surface (Bagnold 1965a; Bagnold 1965b).

Surface erosion in the absence of disruptive events at the site is a minor consideration in placement and durability. Erosion in the vicinity of the site has proceeded slowly. Long-term average erosion rates of unconsolidated material from the Yucca Mountain slopes are less than 0.6 cm per thousand years, and the rate of erosion of bedrock on ridge crests ranges from 0.04 to 0.27 cm per thousand years. Cosmogenic nuclide dating of lava flow surfaces at Black Cone in Crater Flat, which is shown by potassium-argon dating to be 1 million (±0.1 million) years old, yields maximum removal of 20 cm of material since being deposited, 0.02 cm per thousand years.

Large temperature swings, high precipitation levels, and abrasion of materials by wind-blown particles are conditions that could influence the selection of candidate materials and monument and marker location. The potential failure mechanisms and design solutions for these conditions were evaluated in a marker system proposed for the DOE Waste Isolation Pilot Plant near Carlsbad, New Mexico (DOE 1996, Appendices EPIC, AIC, and PIC). These studies were used as a basis for the selected system described in Section 5.8.5.2.

Potential Seismic and Volcanic Activity—The potential for seismic activity at or near the Yucca Mountain site is also considered in the conceptual design. The assessment of seismic hazards and characteristics at the Yucca Mountain site has focused on characterizing ground motion and fault displacement associated with future earthquake activity in the vicinity. Studies of precariously perched or balanced rocks near Yucca Mountain indicate that there are many instances where these rocks have maintained their current position for several thousand years, surviving regional seismic events during that time (Brune and Whitney 2000). Probabilistic studies indicate that displacement of structures not located on major block-bounding faults would either be small (0.1 cm) or would occur less than once in 100,000 years, so surface monuments and markers will be located to avoid identified faults.

Silicic volcanism last occurred in the southwestern Nevada volcanic field about 7.5 million years ago. Since the monuments are planned to be on the order of 25 ft high, there is no credible potential for disruption by burial of the entire monument system by either silicic or basaltic volcanic activity, including the potential for ash fall sufficient to bury the monuments.

5.8.5.2 Monuments and Markers

10 CFR 63.21(c)(24) requires that the SAR include a conceptual design of the monuments to be used to identify the site after permanent closure. A conceptual design for monuments and markers has been developed based upon the extensive evaluations completed for the system proposed for the Waste Isolation Pilot Plant near Carlsbad, New Mexico (DOE 1996). The areas appropriate for site monuments and markers are shown in Figure 5.8-2. The three areas are the site perimeter, the postclosure controlled area, and the GROA.

The conceptual design includes numerous layers of information and warnings with redundant messages. The conceptual design is composed of a number of strategically located components, each bearing its own message and method of communicating that message. These components include site perimeter monuments, postclosure controlled-area markers, and GROA monuments (Figures 5.8-4, 5.8-5, and 5.8-6) and are described below. The proposed material for the conceptual design is also discussed below. The specific composition of the material will be selected prior to the license amendment for permanent closure.

Site Perimeter Monuments—Monuments, fabricated from solid granite or basalt material selected to be as permanent as is practicable, will stand along the perimeter boundaries of the site. Each monument will stand approximately 25 ft above the ground surface. The monuments will be spaced at an appropriate distance and will display engraved messages in seven languages that will provide warnings and information about the buried waste. Figure 5.8-4 illustrates the conceptual design of the site perimeter monuments.

Postclosure Controlled-Area Markers—These markers will be distributed in a converging pattern within the postclosure controlled area. Each marker will be essentially identical to the perimeter monument (Figure 5.8-4), with a message tailored for the postclosure controlled area. The markers will be spaced at an appropriate distance, and each will carry a warning message in one of seven languages. Figure 5.8-5 illustrates the conceptual emplacement of these markers.

GROA Monuments—The GROA monuments will be surface structures approximately 40 ft in diameter and will stand approximately 25 ft above the ground surface. One monument will be constructed on Yucca Crest, and one will be constructed at the North Portal area. The granite exterior walls of the monuments serve as information centers containing engraved messages in multiple languages that provide warnings and information about the buried waste. The GROA monuments will have solid roofs to prevent rainfall from entering the structures. Provisions will be made for rainfall drainage. Figure 5.8-6 illustrates the conceptual design of the GROA monuments that will define the location of the GROA, including the repository footprint.

The general locations of the GROA monuments, site perimeter monuments, and postclosure markers as conceptualized are within the area shown in Figure 5.8-2. The text of messages to be embedded in the monuments will be similar to that described in the Waste Isolation Pilot Plant study (DOE 1996, Appendices EPIC, AIC, and PIC). As further proposed in the Waste Isolation Pilot Plant study, the messages will be written in seven languages: the six official languages of the United Nations (English, French, Spanish, Chinese, Russian, and Arabic) and a Native American language determined to be appropriate for the Yucca Mountain region. The final design, spacing of monuments and markers, and the text of the messages will be developed and provided in time to support the application by the DOE for the permanent closure of the repository in accordance with 10 CFR 63.51(a)(3)(i).

5.8.6 Records Storage

In accordance with 10 CFR 63.51(a)(3)(ii), appropriate records will be stored, controlled, and maintained in locations around the world that are likely to be consulted by potential human intruders. These locations or archives are not part of the marker system but are another component of the system of passive institutional controls listed in 10 CFR 63.302. The records management and document control program governing these archives is described in Section 5.2.

5.8.7 General References

5 FR 4313. Executive Order 8578. Withdrawal of Public Land for Use of the War Department as an Aerial Bombing and Gunnery Range; Nevada.

26 FR 12292. Public Land Order 2568. Transferring Land from Department of the Air Force to Atomic Energy Commission.

55 FR 39152. 43 CFR Public Land Order 6802. Withdrawal of Public Land to Maintain the Physical Integrity of the Subsurface Environment, Yucca Mountain Project, Nevada.

67 FR 53359. Public Land Order No. 7534. Extension of Public Land Order No. 6802; Nevada.

68 FR 74965. Notice of Proposed Withdrawal and Opportunity for Public Meeting; Nevada.

70 FR 76854. Public Land Order No. 7653. Withdrawal of Public Lands for the Department of Energy to Protect the Caliente Rail Corridor; Nevada.

Aquilina, N.C. and Nelson, R.M., Jr. 1994. "Memorandum of Agreement (MOA) between DOE Nevada Operations Office and the Yucca Mountain Site Characterization Office." Memorandum of Agreement between the DOE Nevada Operations Office and the Yucca Mountain Site Characterization Office of the Office of Civilian Radioactive Waste Management. ACC: MOL.19950510.0055.

Bagnold, R.A. 1965a. "The Effect of Sand Movement on the Surface Wind." Chapter 5 of *The Physics of Blown Sand and Desert Dunes.* London, England: Methuen & Company. TIC: 254468.

Bagnold, R.A. 1965b. "Wind-Tunnel Observations." Chapter 3 of *The Physics of Blown Sand and Desert Dunes*. Pages 25-37. London, England: Methuen & Company. TIC: 254469.

BLM (Bureau of Land Management) 1982. Patented Mining Claim Seal Date November 29, 1982. Patent Number: 27-83-0002. Reno, Nevada: Bureau of Land Management. ACC: MOL.20050913.0108.

BLM 1990. Free Use Application and Permit, Vegetative or Mineral Material, to be Used for Pad and Road Construction for Site Characterization Activities. Permit Number: N-51530. Washington, D.C.: U.S. Bureau of Land Management. ACC: NNA.19910118.0030.

BLM 2000. Right-Of-Way Grant Amendment. Serial Number: N-62848. Las Vegas, Nevada: Bureau of Land Management. ACC: MOL.20050808.0241.

BLM 2006. Free-Use Permit. Permit Number N-82254. Washington, D.C.: U.S. Bureau of Land Management. ACC: MOL.20070829.0058.

BLM 2007. *Right-of-Way Grant N-47748 Issued*. N-47748. Las Vegas, Nevada: Bureau of Land Management. ACC: MOL.20071227.0033.

BLM 2008. *Right-of-Way Grant N-48602 Issued*. N-48602. Las Vegas, Nevada: Bureau of Land Management. ACC: MOL.20080109.0227.

Bodman, S.W. 2007. Transmittal of Legislative Proposal Entitled "Nuclear Fuel Management and Disposal Act." Letter from S.W. Bodman (DOE) to R.B. Cheney (President of the Senate), March 6, 2007, with enclosures. ACC: MOL.20070410.0043.

Brune, J.N. and Whitney, J.W. 2000. "Precarious Rocks and Seismic Shaking at Yucca Mountain, Nevada." Chapter M of *Geologic and Geophysical Characterization Studies of Yucca Mountain, Nevada, a Potential High-Level Radioactive-Waste Repository.* Whitney, J.W., and Keefer, W.R., eds. Digital Data Series 058. Denver, Colorado: U.S. Geological Survey. TIC: 249438.

Chatterton, M.R. 2008. "Free Use Permit N-84150 for 1,000,000 CY of Mineral Materials." Letter from M.R. Chatterton (BLM) to R.E. Spence (DOE), March 13, 2008, 0317086444, with enclosures. ACC: MOL.20080331.0001.

Collins, B.F. 1986. Executed Right-of-Way Grant N-43366. Letter from B.F. Collins (BLM) to H.O. Allen, October 7, 1986, with enclosure. ACC: MOL.20050629.0184.

Dixon, W.R. 1997a. Application for Permit to Appropriate the Public Waters of the State of Nevada. Serial No. 63263. Carson City, Nevada: State of Nevada. ACC: MOL.19971124.0428.

Dixon, W.R. 1997b. Application for Permit to Appropriate the Public Waters of the State of Nevada. Serial No. 63264. Carson City, Nevada: State of Nevada. ACC: MOL.19971124.0429.

Dixon, W.R. 1997c. Application for Permit to Appropriate the Public Waters of the State of Nevada. Serial No. 63265. Carson City, Nevada: State of Nevada. ACC: MOL.19971124.0430.

Dixon, W.R. 1997d. Application for Permit to Appropriate the Public Waters of the State of Nevada. Serial No. 63266. Carson City, Nevada: State of Nevada. ACC: MOL.19971124.0431.

Dixon, W.R. 1997e. Application for Permit to Appropriate the Public Waters of the State of Nevada. Serial No. 63267. Carson City, Nevada: State of Nevada. ACC: MOL.19971124.0432.

DOE (U.S. Department of Energy) 1996. *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant.* DOE/CAO-1996-2184. Twenty-one volumes. Carlsbad, New Mexico: U.S. Department of Energy, Carlsbad Area Office. TIC: 240511.

DOE 2002. *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*. DOE/EIS-0250. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020524.0314 through MOL.20020524.0320.

DOE 2007. *Land Records for the Proposed Land Withdrawal Area of the Yucca Mountain Repository.* TDR-MGR-ND-000003, Rev. 1, Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20071126.0033.

Kaplan, M.F. 1982. *Archaeological Data as a Basis for Repository Marker Design.* ONWI-354. Columbus, Ohio: Battelle Project Management Division, Office of Nuclear Waste Isolation. ACC: HQS.19880517.2731.

Length of Claims on Veins or Lodes. 30 U.S.C. 23.

Military Lands Withdrawal Act of 1999. Public Law No. 106-65, 113 Stat. 885.

Mining Law of 1872. 30 U.S.C. 21 et seq.

The Placer Act of July 9, 1870. 30 U.S.C. 35.

Ricci, H. 2002. "Re: Extensions of Time for Permits 57373, 57374, 57376, 58827, 58828 and 58829." Letter from H. Ricci (State of Nevada) to S.A. Wade (DOE), February 7, 2002. ACC: MOL.20020920.0319.

Turnipseed, R.M. 1992a. Application for Permit to Appropriate the Public Waters of the State of Nevada. Permit No. 57373. Carson City, Nevada: State of Nevada, Office of the State Engineer. ACC: MOL.20010612.0216.

Turnipseed, R.M. 1992b. Application for Permission to Change Point of Diversion, Manner of Use and Place of Use of the Public Waters of the State of Nevada Heretofore Appropriated. Permit No. 57376. Carson City, Nevada: State of Nevada, Office of the State Engineer. ACC: MOL.20010612.0219.

Turnipseed, R.M. 1992c. Application for Permission to Change Point of Diversion, Manner of Use and Place of Use of the Public Waters of the State of Nevada Heretofore Appropriated. Permit No. 57375. Letter from R.M. Turnipseed (State of Nevada) to U.S. Department of Energy (NVOO), October 23, 1992, with enclosures. ACC: MOL.20010612.0224.

Turnipseed, R.M. 1994a. Application for Permit to Appropriate the Public Waters of the State of Nevada. Permit No. 58827. Carson City, Nevada: State of Nevada, Office of the State Engineer. ACC: NNA.19940204.0090.

Turnipseed, R.M. 1994b. Application for Permit to Appropriate the Public Waters of the State of Nevada. Permit No. 58828. Carson City, Nevada: State of Nevada, Office of the State Engineer. ACC: NNA.19940204.0091.

Turnipseed, R.M. 1994c. Application for Permit to Appropriate the Public Waters of the State of Nevada. Permit No. 58829. Carson City, Nevada: State of Nevada, Office of the State Engineer. ACC: NNA.19940204.0092.

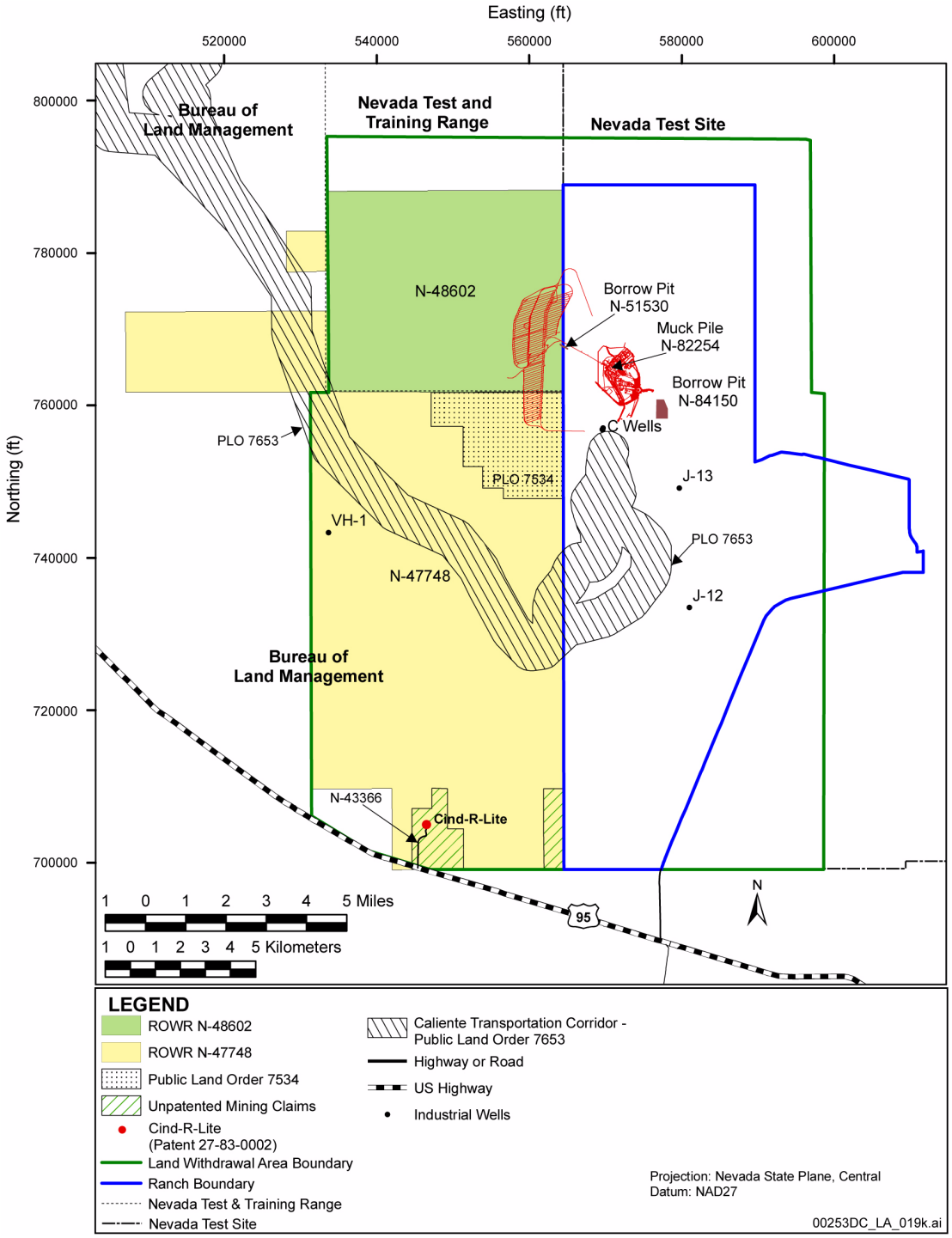

Figure 5.8-1. Land Use and Ownership

NOTE: ROWR = right-of-way reservation.

Source: ROWR N-48602 (BLM 2008); ROWR N-47748 (BLM 2007); Patent 27-83-0002 (BLM 1982); Public Land Order 7534 (67 FR 53359); Public Land Order 7653 (70 FR 76854); N-51530 (BLM 1990); N-84150 (Chatterton 2008); N-82254 (BLM 2006); N-43366 (Collins 1986); DOE 2002; and 68 FR 74965.

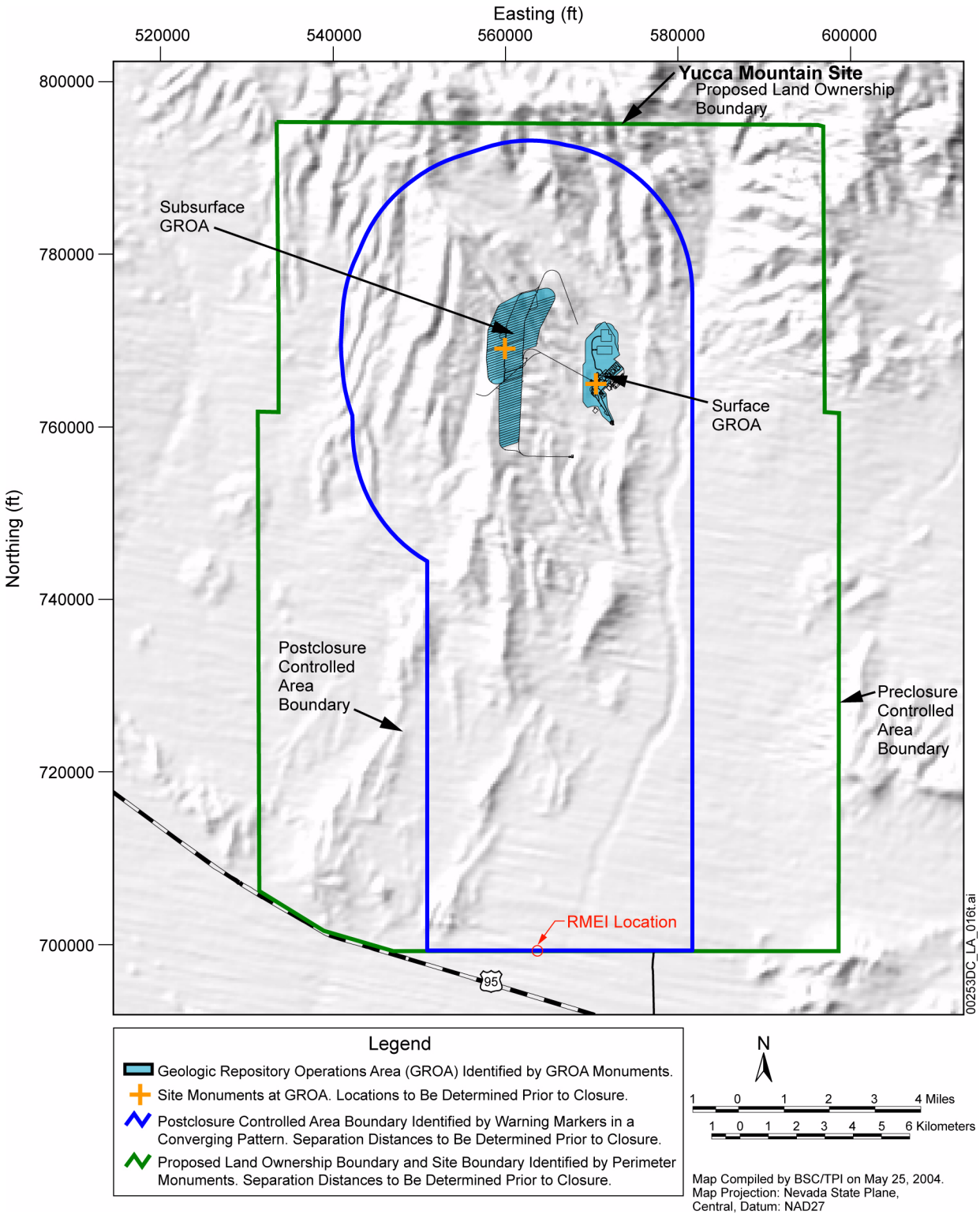

Figure 5.8-2. Site, Controlled Areas, and Proposed Land Ownership Area Boundaries

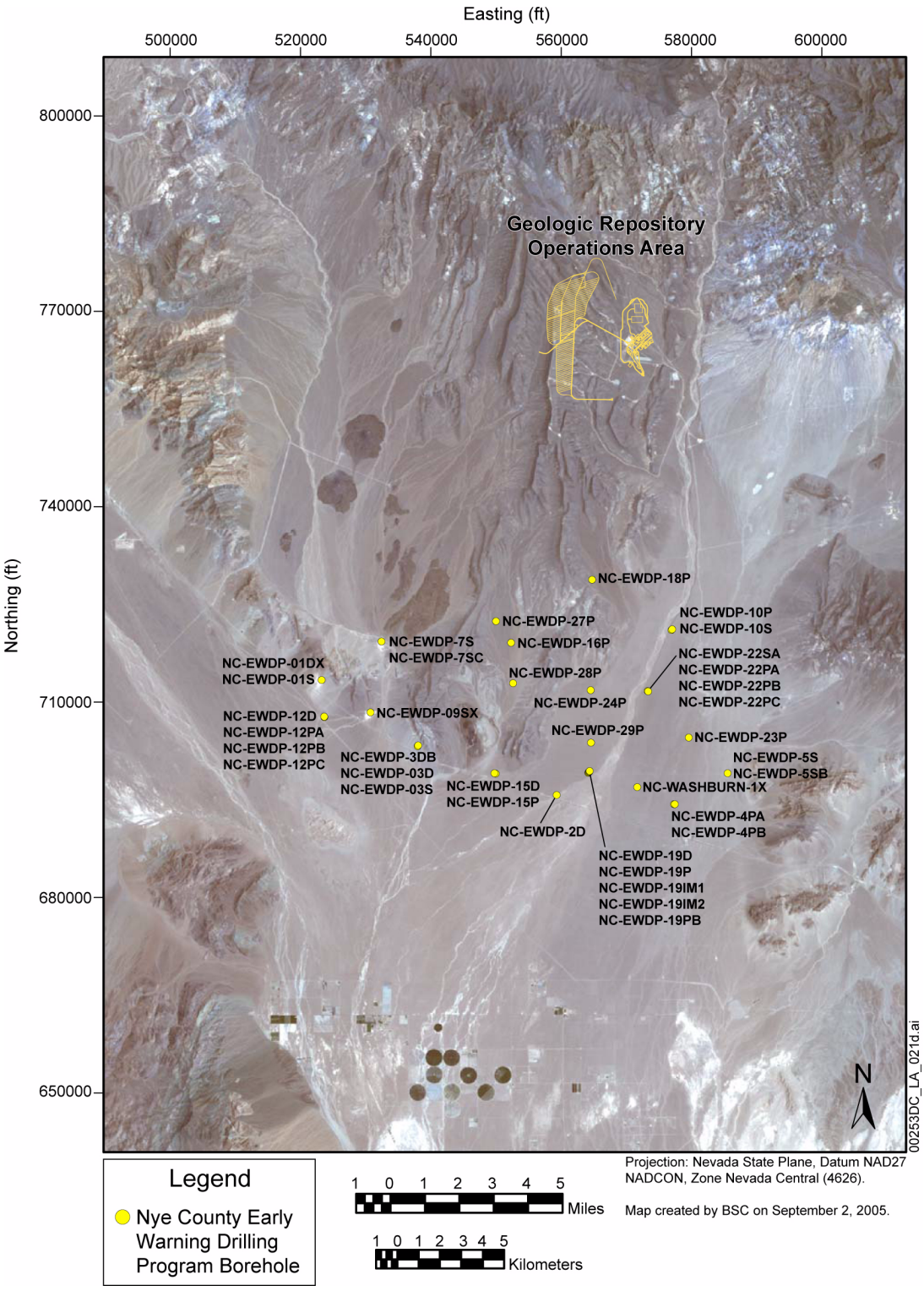

Figure 5.8-3. Locations of Nye County Monitoring Wells

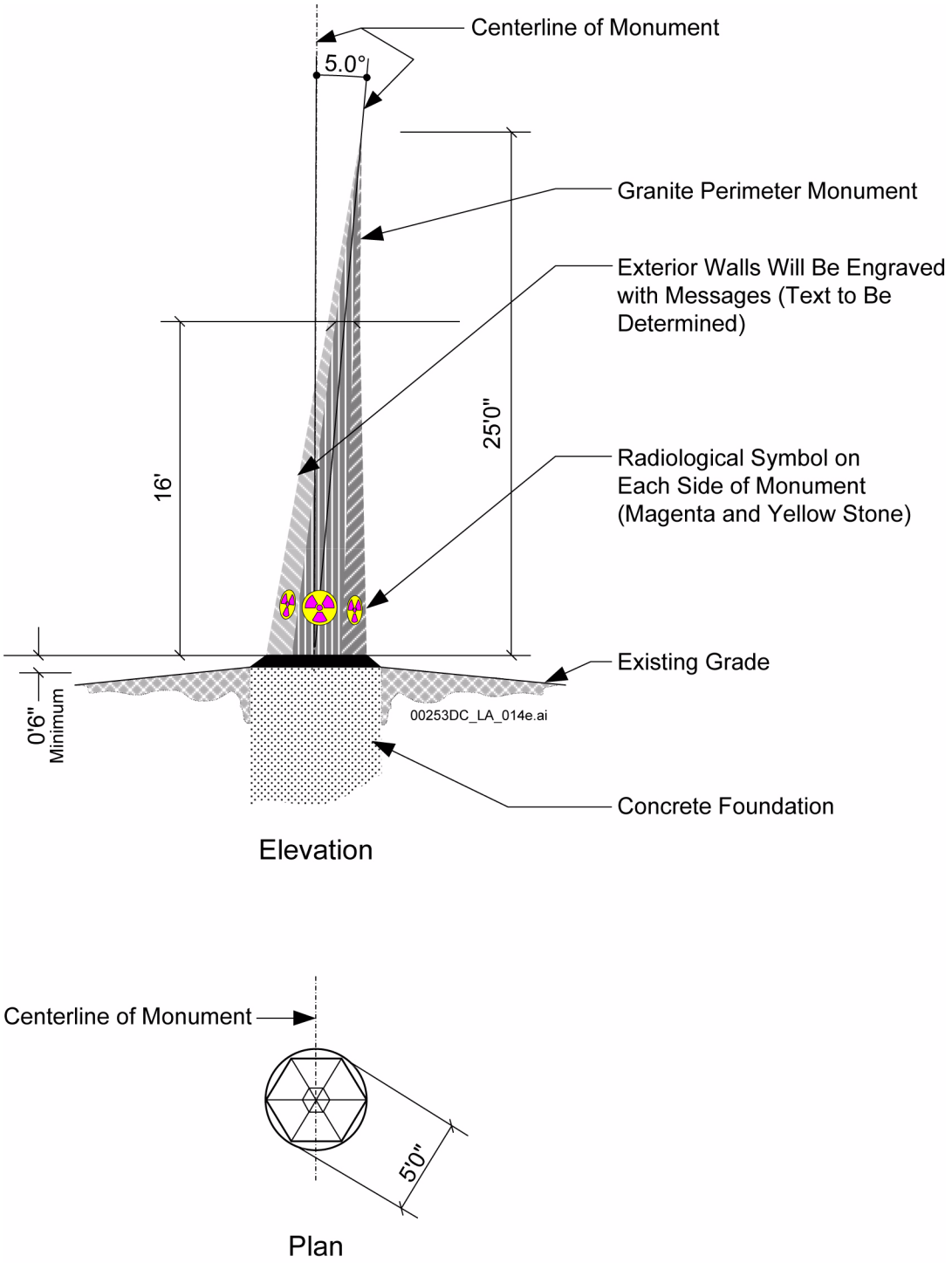

Figure 5.8-4. Site Perimeter Monuments and Postclosure Controlled Area Markers

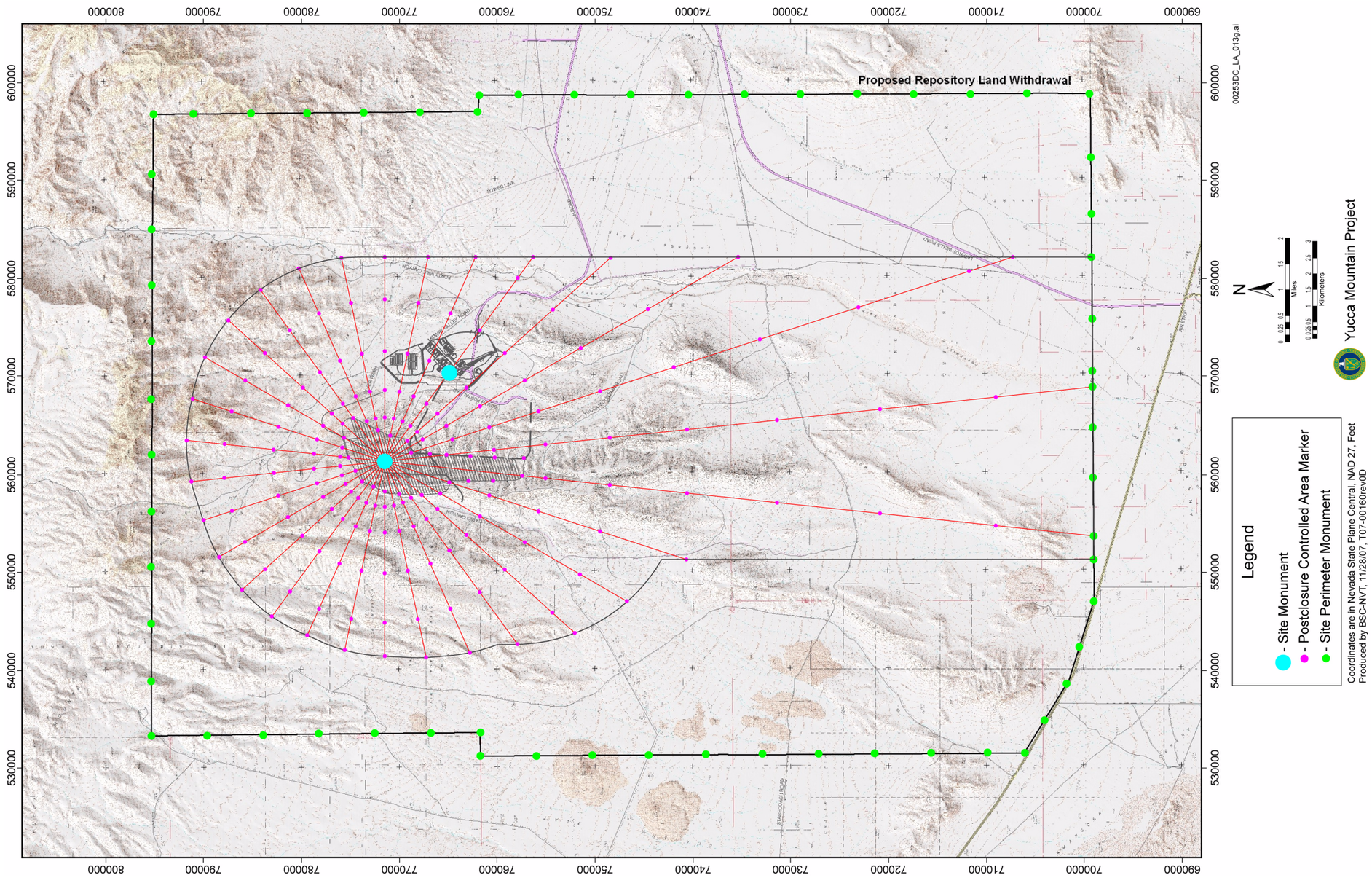

Figure 5.8-5. Postclosure Controlled-Area Markers

INTENTIONALLY LEFT BLANK

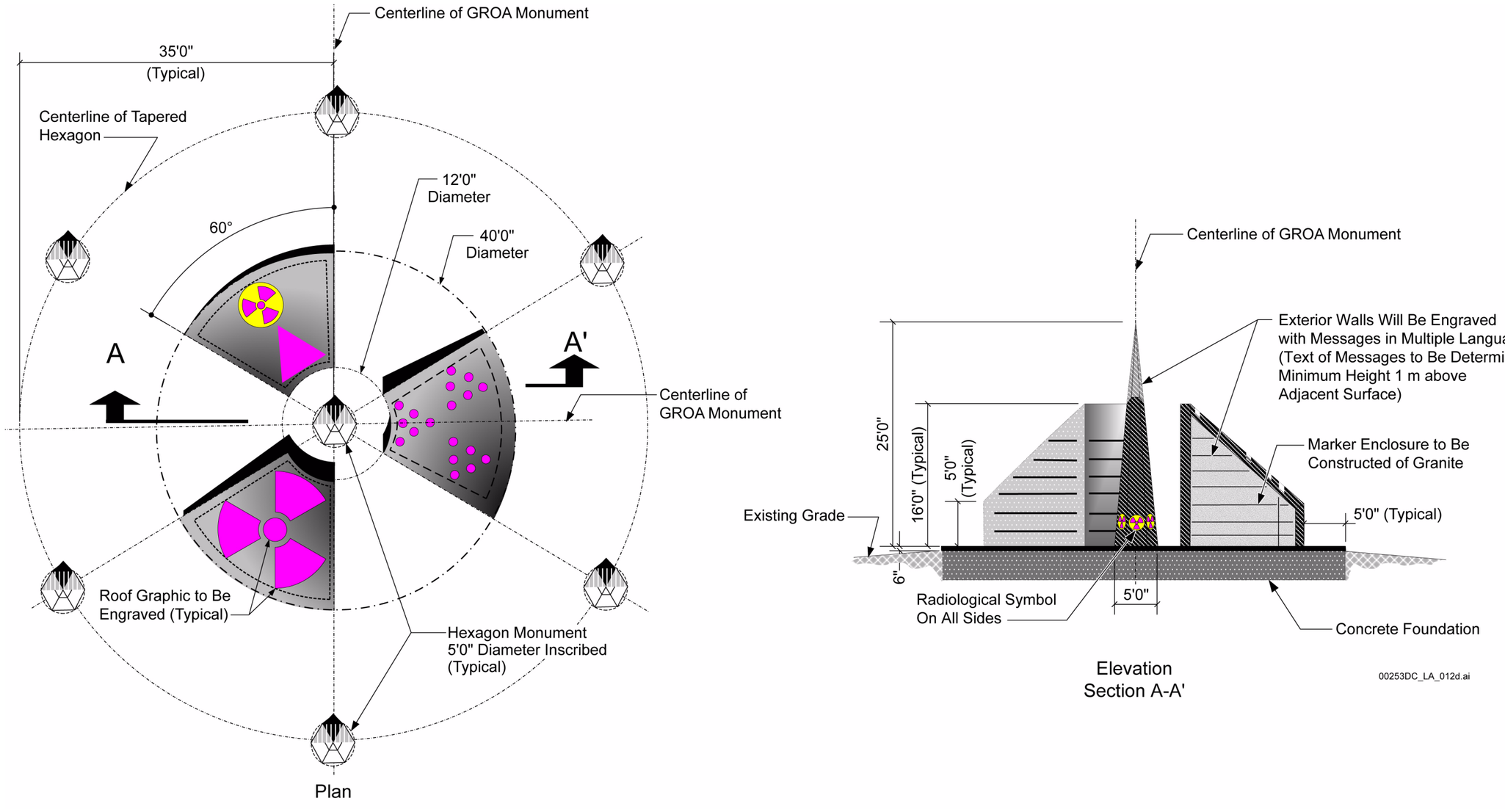

Figure 5.8-6. Geologic Repository Operations Area Monuments

INTENTIONALLY LEFT BLANK

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5.9 USES OF THE GEOLOGIC REPOSITORY OPERATIONS AREA FOR PURPOSES OTHER THAN DISPOSAL OF RADIOACTIVE WASTES

The U.S. Department of Energy (DOE) does not intend to use the geologic repository operations area (GROA) for purposes other than disposal of spent nuclear fuel and high-level radioactive waste. However, ongoing DOE activities within the GROA to protect the environment will continue. This section addresses whether activities at the GROA for purposes other than disposal of radioactive waste present a potential impact to safe repository operation in accordance with 10 CFR 63.21(c)(22)(vii). This section provides information that addresses specific acceptance criteria in Section 2.5.9.3 of NUREG-1804. The following table lists the information provided in this section, the corresponding regulatory requirement, and the applicable acceptance criteria from NUREG-1804. No long-term interim storage of waste is planned as part of repository operations; however, aging incident to disposal is addressed in Section 1.2.7.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.9.1	Potential Activities Other Than Disposal	63.21(c)(22)(vii)	Section 2.5.9.3: Acceptance Criterion 1
5.9.2	Procedures for Potential Activities that Potentially Affect Structures, Systems, and Components	63.21(c)(22)(vii)	Section 2.5.9.3: Acceptance Criterion 2

5.9.1 Potential Activities Other Than Disposal

[NUREG-1804, Section 2.5.9.3: AC 1]

The GROA includes both surface and subsurface areas at which waste handling activities are conducted. Figure 5.8-2 identifies the GROA on the surface and subsurface. Potential activities in the GROA other than waste handling activities may include Native American cultural activities, independent performance monitoring by groups other than the U.S. Nuclear Regulatory Commission (NRC) and the DOE, and activities related to protection of flora and fauna.

Activities outside of the GROA on the repository site are also discussed in the following sections because of their proximity to the GROA. Generally, recreational activities, such as camping, hiking, biking, or hunting, will not be allowed on the repository site at any time before closure. Exceptions would be allowed only after a documented safety analysis was performed that showed applicable regulations and performance requirements could be met.

5.9.1.1 Native American Cultural Activities

In 1987, the DOE initiated the Native American Interaction Program to consult and interact with Native American tribes and organizations regarding the Yucca Mountain site and the possible construction and operation of a repository. Three tribal groups—the Southern Paiute, the Western Shoshone, and the Owens Valley Paiute and Shoshone—have cultural and historic ties to the Yucca Mountain area. Additional ethnographic efforts have identified and subdivided the three tribal groups into 17 tribes and organizations, which have since been included in the Native American

Interaction Program. The Native American Interaction Program concentrates on the protection of cultural resources at Yucca Mountain and promotes a government-to-government relationship with the tribes and Native American organizations (DOE 2002, Section 3.1.6.2).

Cultural resources are protected under 36 CFR Part 800, as required by Sections 106 and 110 of the National Historic Preservation Act (16 U.S.C. 470 et seq.). The DOE is committed to maintaining the Native American Interaction Program throughout construction and operation of the repository. A number of tribes and Native American organizations have formed the Consolidated Group of Tribes and Organizations, which consists of officially appointed tribal representatives who are responsible for presenting their respective tribal concerns and perspectives to the DOE (DOE 2002, Section 3.1.6.2). Native Americans may make a request for utilization of portions of the repository site or the GROA for ceremonial or other cultural heritage purposes. The DOE will evaluate such requests under the auspices of the Native American Interaction Program. The DOE will ensure that Native American cultural uses of portions of the repository site or, if approved, the GROA, will not endanger the health and safety of participants, workers, or the public and that such uses will not adversely affect structures, systems, or components (SSCs) that are important to safety (ITS) or the natural and engineered barriers important to waste isolation (ITWI).

5.9.1.2 Independent Performance Monitoring

Groups other than the NRC and the DOE may make requests to execute performance monitoring. The DOE will develop procedures to evaluate such requests and to ensure that independent performance monitoring or confirmation activities inside the GROA do not adversely affect ITS SSCs or the natural and engineered barriers that are ITWI.

5.9.1.3 Protection of Flora and Fauna

No plant species within the repository site depicted in Figure 5.8-2 are listed as threatened or endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). No plants within this area are proposed or candidates for such listing. Additionally, no plant species classified as sensitive by the Bureau of Land Management are known to occur in this area. Several species of cacti and yucca, which are protected by the State of Nevada from commercial collection, are scattered throughout the region, including the repository area (DOE 2002, Section 3.1.5.1.3).

One animal species found at Yucca Mountain, the desert tortoise (*Gopherus agassizii*), is listed as threatened under the Endangered Species Act of 1973. Yucca Mountain is at the northern edge of the range of the desert tortoise, and the number of tortoises at Yucca Mountain is low or very low in comparison to other portions of the species' range. Aspects of the ecology of the desert tortoise population at Yucca Mountain have been studied extensively (DOE 2002, Section 3.1.5.1.3). The U.S. Fish and Wildlife Service has provided a final biological opinion based on review of the construction, operations and monitoring, and closure of the repository and agrees with measures proposed to minimize the effects of construction, operations and monitoring, and closure of the repository on the desert tortoise (DOE 2002, Appendix O). The DOE is already implementing these measures.

The activities associated with the protection of flora and fauna inside the GROA do not involve construction or similar ground disturbing activities, nor do they involve permanent addition to the

GROA surface of materials different from its existing environment. Hence, the activities do not have an adverse effect on ITS SSCs or on natural or engineered barriers that are ITWI.

5.9.1.4 Activities in the Proximity of the Geologic Repository Operations Area

Some facilities supporting repository operations are located in proximity to, but outside of, the GROA. These facilities include administrative buildings, craft shops, warehouse facilities, fire and rescue facilities, the Visitors Center (to be sited later), utility and security facilities, a vehicle maintenance building, and a motor pool. In addition, there will be one helicopter pad (for plant operations and for fire and rescue). Figure 1.2.1-2 shows the location of these facilities. The Visitors Center, when sited, will provide a central location to assemble, brief, and prepare visitors for site tours, which may include the GROA, and to educate scientists and engineers on repository operations. Generally, tours of the repository will be conducted by request or appointment. Such tours will require qualified personnel as escorts.

The rail equipment maintenance yard will be designed for the maintenance, repair, staging, storage, and operations (in Nevada) of railroad equipment. This facility will be located outside the GROA. Another facility, the cask maintenance facility, will be designed for the maintenance, repair, storage, and staging of the spent nuclear fuel and high-level radioactive waste transportation casks. This facility will be located outside the GROA. Neither facility will contain unshielded waste forms. The DOE will inform the NRC of any proposed land-use changes.

Facilities in proximity to, but outside of, the GROA will not contain unshielded waste forms. Therefore, no preclosure event sequences are possible in these facilities, and no preclosure safety analysis is required. Based upon the defense-in-depth approach to fire protection of the GROA surface facilities, fire rated construction separating the GROA surface facilities systems and equipment provides sufficient separation to preclude a fire from compromising the ability of the GROA surface facilities to perform their intended design functions. In addition, the design and operation of the fire protection features minimizes the potential for a fire to pose a threat for an onsite or offsite release of hazardous material (BSC 2007, Sections 3.2 and Section 8). The helicopter pad is located at least 0.5 mi from the surface GROA handling facilities. This distance is established from the basis of the aircraft hazard analysis portion of the preclosure safety analysis.

5.9.1.5 Resource Exploitation

Historically, no mineral or geothermal resource exploitation has occurred within the GROA. The occurrence and economic potential of natural resources within the geologic setting of the repository area have been evaluated and assessed. The results of these evaluations indicate there is little potential for economic exploitation of metallic mineral, industrial rock and mineral, hydrocarbon, or geothermal energy resources in the GROA. Therefore, no geothermal, mineral, or metal resource exploitation is expected in or near the GROA, and such actions will be prohibited at the repository. Thus, there will be no adverse impact to safe repository operation from resource exploitation. There are no plans to extract water resources from the GROA. Water appropriation requests have been made for the extraction of water resources from five well sites outside the GROA at UE-25 J-12, UE-25 J-13, and the three wells in the C-Wells complex for the purposes of construction, operation, and closure of the repository as described in Section 5.8.4. For repository operations water distributions will be made to areas within the GROA from these C-Wells.

Section 5.8 discusses certain free-use permits issued by the Bureau of Land Management to the DOE. These permits allow the extraction of aggregates, such as sand and gravel, utilized mainly for road construction and concrete production. However, these surface, free-use borrow pits do not lie within the GROA. The pits are near Fortymile Wash, which is more than 1 mi east of the GROA. Additional borrow pits, not within the GROA but in proximity to it, will likely be developed for construction activities.

5.9.2 Procedures for Potential Activities that Potentially Affect Structures, Systems, and Components

[NUREG-1804, Section 2.5.9.3: AC 2]

The activities at the site may include those previously discussed. Such activities within the GROA will be authorized only after the performance of analyses demonstrating that these activities will have no adverse effect on SSCs or features that are ITS or ITWI. The individuals and groups engaged in these activities will be granted access to the GROA in accordance with access authorization procedures. A procedure for authorizing such requests will be developed prior to the handling of waste. The procedures will include evaluation of the purpose of the activity, detailed activity descriptions for evaluation, radiation safety of workers and visitors, and disposition of records and identification of parties to be notified upon completion of the activities.

5.9.3 General References

BSC (Bechtel SAIC Company) 2007. *Site Fire Hazard Analysis*. 000-M0A-FP00-00200-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070814.0003.

DOE (U.S. Department of Energy) 2002. *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada.* DOE/EIS-0250. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020524.0314 through MOL.20020524.0320.

Endangered Species Act of 1973. 16 U.S.C. 1531 et seq.

National Historic Preservation Act. 16 U.S.C. 470 et seq.

CONTENTS

Page

INTENTIONALLY LEFT BLANK

TABLES

Page

INTENTIONALLY LEFT BLANK

5.10 LICENSE SPECIFICATIONS

This section proposes probable subjects of license specifications and provides the basis for the selection of these items as required by 10 CFR 63.21(c)(18). In accordance with 10 CFR 63.42, the U.S. Nuclear Regulatory Commission (NRC) must include as part of the repository license to receive and possess spent nuclear fuel (SNF) and high-level radioactive waste (HLW) conditions of license, including license specifications, that it deems necessary to protect the health and safety of the public, the common defense and security, or environmental values.

10 CFR 63.43 requires that the license specifications incorporated in the license to receive and possess SNF and HLW consist of restrictions derived from analyses and evaluations included in the license application, together with any additional conditions the NRC finds appropriate. 10 CFR 63.43 lists various categories of subjects that may be included in the license specifications. These categories include:

- Restrictions as to the physical and chemical form and radioisotopic content of radioactive waste
- Restrictions as to size, shape, and materials and methods of construction of radioactive waste packaging
- Restrictions as to the amount of waste permitted per unit volume of storage space, considering the physical characteristics of both the waste and the host rock
- Requirements relating to test, calibration, or inspection to ensure that the foregoing restrictions are observed
- Controls to be applied to restrict access, and to avoid disturbance to the site and to areas outside the site where conditions may affect compliance with 10 CFR 63.111 and 10 CFR 63.113
- Administrative controls, which are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting, necessary to ensure that activities at the facility are conducted in a safe manner and in conformity with the other license specifications.

NUREG-1804, Section 2.5.10.1(1), specifies the additional category of "characteristics of drifts, drip shields, backfill, ventilation systems, and other structures, systems, and components." NUREG-1804 notes, however, that the potential categories of license specifications presented in 10 CFR 63.43 and NUREG-1804 are not intended to be comprehensive. NUREG-1804 states that the scope of the items proposed for license specifications should be based on information presented in a license application, rather than a predetermined list, and should include items in the specified categories as appropriate.

Consistent with the provisions of 10 CFR 63.43, the proposed subjects of license specifications presented in this section are derived from the analyses and evaluations included in this license

application with special attention given to those items that might significantly influence the final design of the geologic repository operations area (GROA).

Although not explicitly required by the regulations, the U.S. Department of Energy (DOE) plans to submit draft license specifications, implementing the proposed subjects identified in this section, for NRC consideration in conjunction with the license application update requesting a license to receive and possess SNF and HLW.

The following table lists the information provided in this section, the corresponding regulatory requirement, and applicable acceptance criteria from NUREG-1804.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference
5.10.1	Structure of Proposed License Specifications	63.21(c)(18) 63.43	Section 2.5.10.3 Acceptance Criterion 1 Acceptance Criterion 2
5.10.2	Probable Subjects of License Specifications	63.21(c)(18) 63.43	Section 2.5.10.3 Acceptance Criterion 1
5.10.3	Plans for Implementing License Specifications	63.21(c)(18) 63.43	Section 2.5.10.3 Acceptance Criterion 2
5.10.4	Draft License Specification Development	—	—

5.10.1 Structure of Proposed License Specifications

[NUREG-1804, Section 2.5.10.3: AC 1, AC 2]

The NRC has not issued specific guidance on the structure or format of the repository license specifications. However, the discussion of license specifications in 10 CFR Part 63 is sufficiently similar to the discussion of technical specifications in other NRC regulations (e.g., 10 CFR 50.36 and 10 CFR 72.44) that NRC guidance relative to the format and structure of these documents is useful in establishing the proposed structure of the repository license specifications.

The current NRC guidance for technical specifications incorporated in the operating licenses for commercial power reactors is contained in NUREG-series reports for the various reactor vendors. NUREG-1430 (NRC 2004), for example, contains the current standard technical specifications for commercial power plants that use Babcock and Wilcox–designed reactors and nuclear steam supply systems. Similar guidance for technical specifications for SNF storage casks is contained in NUREG-1745 (Withee and Jackson 2001).

The draft license specifications the DOE intends to submit will be structured consistent with the above guidance documents to the extent applicable to a geologic repository in order to take maximum advantage of previous NRC and industry efforts and experience in implementing and

complying with such specifications. Specifically, the proposed probable subjects of license specifications will be grouped into three sections:

- Limiting conditions for operation
- Design features
- Administrative controls.

Similar to the standard technical specifications for SNF storage casks, the proposed structure of the repository license specifications omits the section entitled "Safety Limits" contained in the NRC standard technical specifications for commercial power plants. As discussed in 10 CFR 50.36(d)(1), safety limits for commercial power reactors are intended to specify limits on important process variables that are found to be necessary to reasonably protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. Safety limits typically consist of limits on the maximum reactor coolant system pressure and limits related to the fuel cladding temperature. Repository operation does not involve high energy systems such as a reactor coolant system or fuel temperatures approaching those that might result in the type of damage possible in an operating reactor. Therefore, the proposed subjects of probable license specifications do not include a separate section entitled "Safety Limits."

The NRC standard technical specifications for SNF storage casks contain a section entitled "Approved Contents" that specifies the types of SNF that are approved for storage in a specific storage cask design. A geologic repository must be able to accept a wide variety of types of SNF (i.e., commercial, DOE, or naval), as well as various forms of HLW. Restrictions on acceptable waste forms to be emplaced in the geologic repository are more appropriately addressed in the design features section, along with appropriate provisions in the administrative controls section of the license specifications. Therefore, the DOE does not propose a separate section entitled "Approved Contents."

The NRC standard technical specifications for other types of facilities also contain a section entitled "Use and Application," which is an administrative section establishing standard definitions, format, and rules for usage. The repository license specifications will contain a similar section.

Proposed license specifications bases (Section 5.10.2.4.1) will document the technical basis for license specifications and explain the relationship of each specification to repository safety. The proposed license specifications bases will be separate from the license specifications and are not intended to be incorporated in the repository license.

5.10.2 Probable Subjects of License Specifications

[NUREG-1804, Section 2.5.10.3: AC 1]

The purpose of license specifications is to impose those conditions or limitations upon repository operation necessary (1) to reduce, consistent with the preclosure safety analysis (PCSA), the probability of an off-normal situation or event that might present a threat to the public health and safety, and (2) to provide assurance that the postclosure performance of the geologic repository will be consistent with the performance assessment. This purpose is accomplished by identifying those features that are of controlling importance to safety and waste isolation, and establishing on them certain conditions of operation which cannot be changed without prior NRC approval.

Proposed subjects of license specifications are selected considering the unique structure and function of the geologic repository and the GROA and the importance of programs; structures, systems, and components (SSCs); or features in preventing or mitigating event sequences or in providing adequate waste isolation. These proposed subjects are derived from the analyses and evaluations of the PCSA and postclosure performance assessment with special attention to those subjects that may significantly affect the final design of the repository.

These proposed subjects of license specifications address the period of operation subsequent to the receipt of the license to receive and possess SNF and HLW and prior to permanent closure of the geologic repository. The proposed subjects do not address specific restrictions or inspections that may be required at the time of repository closure. In accordance with 10 CFR 63.51, the DOE will be required to request a license amendment prior to closure of the geologic repository. It is expected that any necessary additional license conditions or specifications would be included in the ensuing license amendment. No license specifications are expected for the period following closure and termination of surface activities (i.e., following application for an amendment by the DOE to terminate the license pursuant to 10 CFR 63.52).

The probable subjects of license specifications proposed in this section do not include parameters or features that are explicitly required by regulations. For example, the Performance Confirmation Program described in Chapter 4 is required by 10 CFR 63, Subpart F (Sections 63.131 to 63.134). Since the Performance Confirmation Program is a direct regulatory requirement with explicit requirements relative to the scope of the program and required evaluations and reporting criteria, parameters subject to the Performance Confirmation Program are not included as probable subjects of license specifications.

The proposed subjects of license specifications focus on the safety functions of SSCs and process variables and their operational and programmatic parameters that restrict operation of the GROA facilities to the analyzed bases described in the PCSA. The proposed subjects of license specifications also focus on compliance with those aspects of operations and waste emplacement important to establish that the initial conditions of geologic repository closure will be within the analyzed bases of the total system performance assessment (TSPA). Other elements of the management system, including controls on procurement, construction, operations, quality assurance, and performance confirmation, taken together with the license specifications support safe operation of the facility.

Section 1.9 describes SSCs that have been identified as important to safety (ITS) as well as barriers that have been identified as important to waste isolation (ITWI) and features that are important to the performance of these barriers. This information serves as the principal basis for identifying potential subjects of the license specifications. In some cases, the PCSA and the TSPA may impose different but compatible requirements on the same SSC. The PCSA provides information for deriving variables, conditions, procedural safety controls, and SSCs that are determined to be the subject of probable license specifications. To the extent that the TSPA analytical bases affect variables, design features, or operational restrictions during the preclosure period, they are also evaluated as probable subjects of the license specifications. Both sets of requirements must be satisfied to restrict repository operation within the analyzed bases and satisfy the performance objectives contained in 10 CFR 63.111 and 10 CFR 63.113.

5.10.2.1 Criteria for Selection of Probable Subjects

The current NRC standard technical specifications for commercial power plants and independent SNF storage installations reflect years of experience and the combined efforts of NRC staff, industry owners groups, vendors, and the Nuclear Management and Resources Council. The result of this extensive body of work is reflected in the NRC policy statement on improved technical specifications for commercial power plants (58 FR 39132). As discussed in the NRC policy statement, the intent of the current standard technical specifications is to produce an improvement in the safety of nuclear power plants through the use of more operator-oriented technical specifications, improved technical specification bases, reduced-action statement-induced plant-transients, and more efficient use of NRC and industry resources.

To the extent practicable, the probable subjects for license specifications discussed below reflect the lessons learned from NRC development of improved standard technical specifications for commercial power reactors, while concurrently addressing the unique aspects of the repository design and the specific requirements of 10 CFR Part 63. To that end, the DOE used a set of criteria, appropriate to the geologic repository and supporting GROA, to identify probable subjects for each major section of the license specifications. These criteria are intended to ensure that the proposed subjects are derived from the safety analyses presented in this SAR. The selection criteria are also intended to implement the lessons learned from the improved NRC technical specification development process discussed above by focusing on potential subjects of license specifications that are of most significance to safe operation of the GROA and postclosure performance of the geologic repository. The proposed structure of the license specifications also incorporates the concept of a separate Technical Requirements Manual as discussed in Section 5.10.2.4.2. Similar to many NRC-licensed commercial power facilities, the Technical Requirements Manual will be a licensee-controlled document that will not require a license amendment or prior NRC approval to effect changes, provided that certain criteria are met.

The criteria used to identify probable subjects for each major section of the license specifications are presented in the following sections.

5.10.2.2 Limiting Conditions for Operation

Limiting conditions for operation are specific restrictions on GROA operation that either establish a minimum complement of ITS SSCs, or establish limits on process parameters or SSC configurations that must be confirmed during various modes of operation in order to maintain the capabilities of ITS or ITWI items to perform their intended functions. When a limiting condition for operation is not met, affected operations must be halted or remedial action permitted by the specific limiting condition for operation must be followed until the conditions for resuming unrestricted operation can be restored.

Consistent with the format established in the NRC standard technical specifications for commercial power plants and independent SNF storage installations, the limiting conditions for operation will include:

- A statement of the specific limit or restriction
- The applicability of the limiting condition for operation (i.e., the modes of operation and specific repository facilities to which the limitation applies)
- Actions to be taken if the restriction is not met and specific limitations on the time allowed to complete these actions
- Required surveillance testing or inspections to confirm that the restriction is met along with the required frequency of such tests or inspections.

Limiting conditions for operation typically address active processes or systems which the operators monitor and control. The nature of limiting conditions for operation results in compliance being primarily the responsibility of the repository operations staff. Limiting conditions for operation are used by the operations staff to control processes, establish surveillance requirements, and provide instruction with respect to actions to be taken should a variable or condition exceed the established bounds.

Limiting conditions for operation are selected to support PCSA requirements and to support activities which could impact postclosure performance. Probable subjects for limiting conditions for operation are selected using the following criteria to ensure that the proposed restrictions are derived from the analyses in the SAR:

- The subject involves active ITS systems that are relied upon to be in operation or capable of operation in order to prevent or mitigate a Category 1 or Category 2 event sequence. Active systems include SSCs that perform an active function via electrical or mechanical means such as fans and motors. Such systems do not include SSCs whose ITS function is passive in nature (e.g., structural members that resist loads, walls that provide radiation shielding). Specifically, ITS systems are considered for inclusion in this category if the SSCs are those: (1) subject to automatic initiation or under direct manual control by operations staff, (2) whose performance can change over time, (3) whose functioning is verifiable by observation or periodic testing and (4) relied upon to:
  - Reduce the frequency of an event sequence from Category 1 to Category 2
  - Reduce the frequency of an event sequence to beyond Category 2
  - Significantly reduce the aggregated dose of Category 1 event sequences
  - Significantly mitigate the dose consequences of a Category 1 or Category 2 event sequence
  - Prevent criticality.

- The subject involves process variables or configuration of ITS or ITWI SSCs that are subject to control or measurement by operations staff and must be established or maintained within a specific range of values in order to:
  - Reduce the frequency of an event sequence from Category 1 to Category 2
  - Reduce the frequency of an event sequence to beyond Category 2
  - Significantly reduce the aggregated dose of Category 1 event sequences
  - Significantly mitigate the dose consequences of a Category 1 or Category 2 event sequence
  - Prevent criticality
  - Ensure initial conditions that might have a significant impact on the analyses of postclosure performance of the geologic repository are maintained.

Probable subjects of limiting conditions for operations, along with justification for their selection, are shown in Table 5.10-1. Table 5.10-1 includes probable subjects of license specifications in categories described in 10 CFR 63.43(b)(4) and Section 2.5.10.1(1)(e) of NUREG-1804.

Section 1.9 identifies other ITS SSCs that do not meet the criteria for limiting conditions for operation. Controls identified as necessary to confirm continued functionality of these ITS SSCs will be specified in the Technical Requirements Manual described in Section 5.10.2.4.2.

5.10.2.3 Design Features

The design features section of the license specifications lists selected repository design features that, if altered or modified, would have a significant effect on safe operation, waste isolation, or both, and are not addressed in other sections of the license specifications. The purpose of including specific design features or limits in the design features of the license specifications is to preclude the DOE from altering these features without prior NRC approval, regardless of whether or not a potential change satisfies the criteria of 10 CFR 63.44(b).

Unlike limiting conditions for operation, design features generally address features of SSCs that are passive in nature (e.g., dimensions, geometric arrangement, materials of construction), which are primarily of concern to repository organizations other than the operations staff.

The criteria used for selecting potential subjects to be included in the design features section of the license specifications are:

- Fundamental features of the repository design that, if changed, would impact multiple aspects of the safety analyses, would have significant effect on safety, or are key to compliance with applicable regulations

- Features of the design that are relied upon to preclude criticality events during receipt, handling, packaging, storage, emplacement, and retrieval (e.g., SSC configurations which provide needed separation or radioisotopic limits applied to waste forms).

Probable subjects of design features, along with justification for their selection, are shown in Table 5.10-2. Table 5.10-2 includes probable subjects of license specifications in categories described in 10 CFR 63.43(b)(1) and (2), as well as Sections 2.5.10.1(1)(a), (b), and (e) of NUREG-1804.

Section 1.9 identifies other ITS SSCs that are not addressed by these design features. Controls identified as necessary to maintain the features and functions of these ITS SSCs will be controlled using the Technical Requirements Manual described in Section 5.10.2.4.2.

5.10.2.4 Administrative Controls

Administrative controls are provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary for safe operation and long-term waste isolation. These controls are needed to help ensure that the waste forms and waste packages will be received, stored, packaged, handled, and ultimately emplaced within the geologic repository in a manner which preserves the integrity of the waste package and reduces the potential for release of radiation and occupational exposure for the preclosure and postclosure periods.

The criteria used for selection of probable subjects of administrative controls are:

- Controls defined in the NRC standard technical specifications for other types of licensees to the extent that such standard items are applicable to a geologic repository or to GROA SSCs.

- Programs or manuals unique to the operation of a geologic repository or to GROA SSCs that provide for operations consistent with assumptions of the PCSA or TSPA. Programs or manuals are required when the complexity of required administrative controls are such that implementation requires integration among several individual operations, procedures, or organizational units.

Proposed subjects of administrative controls include items such as organization and management, procedures, recordkeeping, review and audit, and reporting, as well as other programs or controls required to support ITS or ITWI SSCs, or to support procedural safety controls identified in the PCSA or the TSPA.

Probable subjects of administrative controls, along with justification for their selection, are shown in Table 5.10-3. Table 5.10-3 includes probable subjects of license specifications in categories described in 10 CFR 63.43(b)(1), (2), (3), (4), (5), and (6), as well as Sections 2.5.10.1(1)(a), (b), (c), (d), (f), and (g) of NUREG-1804.

5.10.2.4.1 License Specification Bases

One of the probable subjects included as a proposed administrative control in Table 5.10-3 is a License Specifications Bases Control Program. The license specification bases will document the technical basis for each limiting condition for operation or design feature, and the relationship of each specification to repository safety.

The bases for each limiting condition for operation and design feature will include:

- A statement of the safety function of the SSC or waste isolation process and feature
- The relationship of the license specification to SSCs or processes and features that are classified as ITS or ITWI in Section 1.9
- The identification of the event sequences or TSPA assumptions or inputs that are associated with the license specifications and an explanation of the importance of maintaining the SSC within limits imposed by the applicable license specification
- References to the applicable sections of the license application that support the bases and that provide clarifying details for each license specification
- The bases of required testing or inspection frequencies specified and the relationship, if any, to the PCSA
- The bases of time limits associated with completion of specified actions and the relationship, if any, to the PCSA.

The license specification bases are not a part of the license specifications and are not expected to be appended to or otherwise incorporated into the repository license. The License Specification Bases Control Program will specify the means for processing changes to the license specifications bases. Changes may be made to bases without prior NRC approval provided the changes do not require either a change in the conditions of the license, a change in the license specifications themselves, or otherwise require prior NRC approval pursuant to 10 CFR 63.44.

5.10.2.4.2 Technical Requirements Manual

Tables 5.10-2 and 5.10-3 also include a proposed administrative control requiring that the DOE develop and maintain a Technical Requirements Manual and associated bases. The Technical Requirements Manual will provide a central location for compilation and control of operational and design restrictions that do not meet the criteria discussed above for inclusion in the license specifications themselves. Technical requirement manuals are utilized by many 10 CFR Part 50

licensees; however, neither 10 CFR Part 50 nor 10 CFR Part 63 specifically addresses this document.

In general, the Technical Requirements Manual will include items where restrictions or controls are warranted based on the design and analysis described in the license application, but where the item does not meet the criteria for inclusion in the license specifications. The format of the Technical Requirements Manual will be similar to the license specifications and the requirements may be expressed in the format of limiting conditions for operations, design features, or administrative controls, as appropriate.

At a minimum, the Technical Requirements Manual will contain information necessary to support and implement other programs listed in the administrative controls section of the license specifications that are unique to the geologic repository. These programs include:

- Waste form and waste package qualification program
- Canister and transportation cask acceptance program
- Waste package loading, handling, and emplacement program
- Subsurface committed materials control program (Section 1.3.6.1.3).

Specific information to be included in the Technical Requirements Manual relative to these programs is described in Table 5.10-3.

Like the license specifications bases discussed in Section 5.10.2.4.1, the Technical Requirements Manual is not intended to be appended to or otherwise incorporated into the repository license. The license specifications will specify the means for processing changes to the Technical Requirements Manual and the DOE may make changes to the Technical Requirements Manual without prior NRC approval and without amending the license, provided the changes do not require either a change in the conditions of the license, a change in the license specifications themselves, or a change that otherwise requires prior NRC approval pursuant to 10 CFR 63.44.

5.10.3 Plans for Implementing License Specifications

[NUREG-1804, Section 2.5.10.3: AC 2]

Operating crews will be trained on the requirements and purpose of the license specifications and will be required to maintain strict adherence to the limiting conditions for operation. Compliance with the limiting conditions for operation and other sections of the license specifications will be implemented by various procedures and programs as discussed below.

5.10.3.1 Procedures

The license specifications will be supported by, and operations conducted in accordance with, approved procedures and instructions following the format and requirements provided in the Conduct of Operations Plan (Section 5.6). Topics for which procedures are required will be identified in the administrative controls section of the license specifications. The required procedures will include those necessary to implement the programs identified in the administrative controls section of the license specifications (Table 5.10-3). These procedures will be developed prior to the receipt of a license to receive and possess SNF and HLW.

Management systems (Section 5) that control activities such as procurement, maintenance, and configuration management of both technical documents and procedures will similarly be integrated into repository procedures. The proper execution of these procedures and management systems, using prescribed operating and maintenance principles, will be used to implement the license specifications.

5.10.3.2 Testing

As discussed in Section 5.10.2.2, limiting conditions for operation will include specific surveillance testing requirements or other inspections required to verify that process variables are maintained within proper ranges or to support determinations of SSC capability to function in a manner that bounds the nuclear safety design bases for PCSA and postclosure. The required frequencies of surveillance testing will be based on the reliability basis of the safety analyses, as appropriate, and experience from applicable industry practice modified to reflect the unique aspects of repository operations. Surveillance requirements specified in the limiting conditions for operation will be integrated into the repository operating procedures as discussed above.

As noted in Table 5.10-3, the proposed subjects of the administrative controls section of the license specifications will include a requirement that the repository maintenance program include a Reliability Centered Maintenance process (Section 5.6.4). The Reliability Centered Maintenance process may identify additional testing, inspection, and maintenance requirements for SSCs that are not addressed by the specific surveillance testing requirements in the limiting conditions for operation. For ITS SSCs that are not subject to specific limiting conditions for operation, the Reliability Centered Maintenance process will identify periodic testing and maintenance requirements derived from the PCSA, as well as from ongoing operating experience, as appropriate.

5.10.3.3 Configuration Management System

Compliance with limitations on the repository design included in the design features section of the license specifications will be controlled through integration in the configuration management processes.

As discussed in Section 5, the objectives of configuration management are to provide a disciplined approach to ensure design modifications and operation within the design bases of SSCs by:

- Identifying and controlling preparation and review of documentation associated with SSCs
- Controlling changes to SSCs
- Maintaining the physical configuration of the repository consistent with the approved design.

The configuration management system will include necessary reviews to ensure compliance with 10 CFR 63.44. Proposed changes to engineering, science, and programmatic documents that form the basis of the SAR and supporting documents that could impact the repository design, analysis, or operation will be screened as part of this process. These reviews will include new and revised

drawings, calculations, specifications, science products, procedures, and programmatic plans. Changes that are not consistent with the provisions of the license specifications are prohibited by 10 CFR 63.44(b)(1)(i) without prior NRC approval.

5.10.4 Draft License Specification Development

Prior to NRC issuance of a license to receive and possess SNF and HLW, a proposed draft set of license specifications will be submitted to the NRC. These draft license specifications will be provided in an appropriate format, considering the format and approach both from the discussion of SNF storage casks and from the applicable portions of the improved standard license specifications, such as those contained in NUREG-1430 (NRC 2004). The final license specifications issued by the NRC are expected to be incorporated as an appendix to the license to receive and possess SNF and HLW.

The draft license specifications will not address the operations necessary to: (1) close the geologic repository; (2) perform statutory retrieval of any or all of the emplaced SNF and HLW, should that be determined to be appropriate; or (3) decontaminate and dismantle GROA facilities. Revised safety analyses and any appropriate proposed license specifications will be developed and submitted for NRC approval prior to initiating these operations.

5.10.5 General References

58 FR 39132. Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors.

NRC (U.S. Nuclear Regulatory Commission) 2004. *Standard Technical Specifications Babcock and Wilcox Plants, Specifications*. NUREG-1430, Rev. 3. Volume 1. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20040901.0094.

Regulatory Guide 1.33, Rev. 2. 1978. *Quality Assurance Program Requirements (Operation)*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238399.

Withee, C. and Jackson, C. 2001. *Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance*. NUREG-1745. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20040901.0093.

Table 5.10-1. Probable Subjects of License Specifications to be Incorporated as Limiting Conditions for Operation

Probable Limiting Conditions for Operation	Bases for Selection
Surface ITS Confinement HVAC Systems—This limiting condition for operation will establish operability and testing requirements for ITS HVAC systems that serve an ITS confinement function for radioactive materials. Separate limiting conditions for operation will be proposed for each surface facility with ITS HVAC systems.	These exhaust HVAC systems are designed to mitigate radioactive releases associated with postulated drops or mishandling events. In accordance with the selection criteria discussed in Section 5.10.2.2, this system constitutes an active system whose operability is relied upon to mitigate the radiological dose consequences of potential Category 2 event sequences.
ITS Power (feeders up to and including ITS loads, ITS direct current power, ITS uninterruptible power supply power, and ITS diesel generators A and B)—This limiting condition for operation will establish operability and testing requirements for the ITS diesel generators and associated portions of the ITS power system.	The ITS power system provides power to the ITS HVAC systems. In accordance with the selection criteria discussed in Section 5.10.2.2, this system constitutes an active system whose operability is relied upon to mitigate the radiological dose consequences of potential Category 2 event sequences.
Portions of the Surface ITS (nonconfinement) HVAC System that Support the Cooling of ITS Electrical and Controls Equipment—This limiting condition for operation will establish operability and testing requirements for the ITS HVAC systems that provide cooling for ITS electrical equipment and battery rooms.	These ITS supply and exhaust HVAC systems are required to support operation of the ITS power system. In accordance with the selection criteria discussed in Section 5.10.2.2, this system constitutes an active system whose operability is relied upon to mitigate the radiological dose consequences of potential Category 2 event sequences.
ITS Fire Detection and Suppression System—This limiting condition for operation will establish requirements for operability and testing of ITS portions of the fire protection system in areas where potential breaches of waste canisters are postulated. These areas include the Canister Receipt and Closure Facility, and Wet Handling Facility.	These systems are intended to prevent criticality by reducing the frequency of spurious actuation of the fire suppression systems which might introduce a moderator in areas where potential breaches of waste canisters are postulated. In accordance with the selection criteria discussed in Section 5.10.2.2, this system constitutes an active system whose operability is relied upon to prevent criticality.
TAD Canister Dewatering and Drying—This limiting condition for operation will establish the criteria for ensuring that TAD canisters are adequately drained and moisture removed by forced helium dehydration and vacuum drying prior to final closure.	Moisture removal is necessary to preclude the formation of hydrogen via radiolytic decomposition, minimize internal corrosion, preclude criticality, and preclude steam overpressurization. In accordance with the selection criteria discussed in Section 5.10.2.2, this operation involves process variables that are subject to control or measurement by repository operations staff and must be established and maintained within a specific range of values in order to ensure that initial conditions that might have a significant impact on the analyses of postclosure performance of the geologic repository are maintained.
Wet Handling Facility Pool Boron Concentration—This limiting condition for operation will specify requirements for maintaining a minimum concentration of soluble boron in the Wet Handling Facility pool.	In accordance with the selection criteria discussed in Section 5.10.2.2, this process variable is subject to control or measurement by repository operations staff and must be established and maintained within a specific range of values in order to prevent criticality.

Table 5.10-1. Probable Subjects of License Specifications to be Incorporated as Limiting Conditions for Operation (Continued)

Probable Limiting Conditions for Operation	Bases for Selection
ITS Radiation Detectors and Interlocks—This limiting condition for operation will establish operability and testing requirements for ITS radiation detectors and interlocks that function to preclude opening of shield doors in the presence of high radiation levels. These radiation detectors include those interlocked with the shield doors separating the waste package loadout areas in the IHF and CRCF.	Radiation detectors interlocked with ITS shield doors prevent inadvertent door opening if high radiation conditions (due to the presence of a loaded, sealed waste package) are present.

NOTE: HVAC = heating, ventilation, and air-conditioning; TAD = transportation, aging, and disposal.

Table 5.10-2. Probable Subjects of License Specifications to be Incorporated as Design Features

Probable Design Features	Bases for Selection
Repository Location—This design feature will specify the geographic location of the geologic repository, GROA, and associated site boundaries.	Specifying the geographic location and boundaries will ensure that the location of the surface GROA is consistent with the bases for the PCSA and TSPA.
Geologic Constraints—This design feature will establish constraints on the location of the emplacement drifts relative to geologic features (e.g., depth above groundwater, minimum overburden).	Specifying the geologic constraints will ensure that the location of the emplacement drifts is consistent with the TSPA. The constraints on the location of emplacement areas are described in Section 1.3.2.2.1.
Aging Pads—This design feature will describe the location, size, and capacity of the aging pads.	The location, size, and capacity of the aging pads are fundamental features of the GROA design that are expected to be key factors in NRC review of the GROA design. As described in Section 1.6, the potential for aircraft impact to SNF stored on the aging pads has been determined to be a beyond Category 2 event. This determination is based, in part, on the size and location of the aging pads.
Waste Forms—This design feature will establish limits on key parameters associated with the waste forms to be handled in the GROA and emplaced in the geologic repository. These parameters will include: • Maximum repository capacity (70,000 MTHM) and basis for calculation • Commercial SNF maximum burnup, enrichment, and time out of reactor • Envelope of potentially acceptable waste forms.	The physical, chemical, and radiochemical characteristics of the waste forms are key factors in both the PCSA and postclosure performance assessment. This design feature will define the scope of waste forms that may be emplaced subject to confirmatory analyses. Additional requirements relative to acceptance of waste forms are included in proposed administrative controls (Table 5.10-3).
Waste Packages—This design feature will specify limits on key features of the waste packages such as: • Outer corrosion barrier material • Acceptable waste package configurations • Inner vessel materials and design/construction codes of record.	The waste packages are a key feature of the Engineered Barrier System considered in the postclosure performance assessment. The waste packages prevent or limit the contact of water with the waste form and thereby prevent or limit the release of radionuclides to the environment. This design feature will identify the waste package configurations that may be emplaced in the repository, subject to additional confirmatory analyses. Additional requirements relative to final qualification of waste package designs are included in proposed administrative controls (Table 5.10-3). The design of the waste packages is described in Section 1.5.2. The function of the waste packages to contribute to the capability of the Engineered Barrier System in the postclosure performance assessment is described in Section 2.1.2.2.

Table 5.10-2. Probable Subjects of License Specifications to be Incorporated as Design Features (Continued)

Probable Design Features	Bases for Selection
Drip Shields—This design feature will specify the materials of construction and key features of the drip shields such as interlocking design.	The drip shields are a key feature of the Engineered Barrier System considered in the postclosure repository performance assessment. The drip shields are intended to prevent or substantially reduce seepage water from contacting the waste packages and to protect the waste packages from rockfall due to potential drift degradation. The design of the drip shields is described in Section 1.3.4.7. The function of the drip shields as part of the Engineered Barrier System in the postclosure performance assessment is described in Section 2.1.2.2.

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls

Probable Administrative Controls	Bases for Selection
Administrative Controls that are Defined in the NRC Standard Technical Specifications for Other Types of NRC Licensees and that are Applicable to a Geologic Repository	
Responsibilities—The administrative controls section of the license specifications will include a definition of responsibilities for key onsite management personnel who direct repository operations. At a minimum, these personnel will include the Site Operations Manager, Operations Manager, Waste Handling Manager, and Shift Manager. These specifications will also address delegation of authority for repository operations.	Typical administrative control included in standard technical specifications for commercial power plants. This specification supports safe operation by ensuring that management responsibility for repository operations is clearly defined.
Organization—The administrative controls will require that the onsite and offsite organizations be established for repository operation and offsite management, respectively. The onsite and offsite organizations will include the positions for activities affecting safety of the repository including definition of lines of authority, responsibility, and communication throughout highest management levels, intermediate levels, and operating organization positions. The license specification will require that relationships be documented and updated, as appropriate, in organization charts, functional descriptions of departmental responsibilities and relationships, and job descriptions for key personnel positions, or in equivalent forms of documentation.	Typical administrative control included in standard technical specifications for commercial power plants. This specification supports safe operation by ensuring that lines of authority and responsibilities are clearly defined.
Repository Staff Qualifications—The administrative controls will require that key repository staff positions meet or exceed the minimum qualifications described in Section 5.3.2 and that the Operations Manager and operation staff be trained and certified in accordance with the training and certification program required by 10 CFR 63.152.	Typical administrative control included in standard technical specifications for commercial power plants. This specification supports safe operation by ensuring that key repository personnel have appropriate experience and qualification to perform their assigned responsibilities and that personnel who operate ITS systems and components are trained and certified personnel who are adequately trained for these operations or are personnel who are under the direct visual supervision of an individual with training and certification in such operation.

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls (Continued)

Probable Administrative Controls	Bases for Selection
Procedures—Administrative controls will require that the DOE establish, implement, and maintain written procedures covering activities that are important to safe operation of the repository. Procedures will include those necessary to implement specific programs required by the license specifications as well as other procedural safety controls identified in the SAR. Typical categories of procedures will include: • Administrative controls (including limitations on staff overtime) • Routine operations • Alarms and annunciators • Emergency operations • Configuration management • Control of surveillances and tests • Control of special processes • Maintenance • Radiation protection, including ALARA practices • Special nuclear material accountability • Quality assurance, inspection, and audits • Physical security and safeguards • Records management • Reporting • Procurement of ITS SSCs.	Typical administrative controls included in standard technical specifications for commercial power plants. This specification supports safe operation by requiring that activities affecting safe operation of the repository be performed in accordance with written procedures. For commercial power plants, the types of procedures covered by this administrative control are typically specified by reference to Appendix A of Regulatory Guide 1.33, *Quality Assurance Program Requirements (Operation)*. This appendix contains a listing of typical procedures for light water reactors. Since many of the procedures in this listing are unique to power reactors and not applicable to a geologic repository, this administrative control will include a listing of specific types of procedures applicable to repository operations. The SAR identifies specific procedural safety controls. These procedural safety controls are activities performed by personnel to ensure operations are within analyzed conditions of the PCSA and TSPA. Procedural safety controls are discussed in Section 1.9.3. This administrative control will require that these procedural safety controls be implemented via procedures.
High Radiation Areas—This administrative control will, (if needed) propose alternative methods to control access to high radiation areas for NRC approval in accordance with 10 CFR 20.1601(c).	Typical administrative control included in standard technical specifications for commercial power plants. 10 CFR 20.1601 specifies the control mechanisms that must be used to restrict personnel access to high radiation areas. 10 CFR 20.1601(c) provides that licensees may use alternative methods if approved by the NRC. An item in the administrative controls section is the method typically used to document such alternative control methods.

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls (Continued)

Probable Administrative Controls	Bases for Selection
License Specifications Bases Control Program—This administrative control will require that the DOE establish and implement a program to control the license specifications bases described in Section 5.10.2.4.1 and changes thereto.	Typical administrative control included in standard technical specifications for commercial power plants. As discussed in Section 5.10.2.4.1, the license specifications bases will be a licensee controlled document and not a part of the license specifications. However, the license specifications bases will contain information related to the intended purpose of the limiting conditions for operations and bases for specified time intervals allowed for completion of required actions and the specified frequencies of surveillance testing and inspections. This administrative control will ensure that changes to the license specifications bases are adequately controlled.
Programs/Manuals Unique to the Operation of a Geologic Repository and GROA Required to Ensure Operations Consistent with the Assumptions of the PCSA or Postclosure Analyses	
Waste Form and Waste Package Qualification Program—This administrative control will require that the DOE establish and implement a program to govern the required analyses and evaluations prior to emplacement of specific waste forms and waste packages. Criteria for approval of waste forms and waste packages along with a listing of waste forms and waste packages that have been found acceptable for use at the repository will be maintained in the Technical Requirements Manual.	Waste forms and key design parameters of waste forms are specified as proposed subjects of design features in Table 5.10-2. The repository is designed to accommodate a wide range of waste forms. Waste is shipped to the repository in accordance with waste acceptance criteria established for the repository for the different waste forms and containers. Waste acceptance criteria include such criticality safety requirements as waste form, physical, chemical, and nuclear characteristics (e.g., geometries, fissile material content, burnup). This qualification program will delineate the waste receipt inspection and verification at the repository to confirm that the incoming waste form meets the waste acceptance criteria for criticality safety to further minimize the likelihood that an unanalyzed event sequence occurs. Sections 1.8, 1.14, 2.3.7, and 2.2.1.4.1 demonstrate the methodology and analyses required to confirm that waste forms are enveloped by the PCSA and postclosure performance assessment. This administrative control will require that similar analyses be completed prior to receiving individual waste forms or waste package designs that are not explicitly analyzed in the license application.
Canister and Transportation Cask Acceptance Program—This administrative control will require that the DOE establish and implement a program governing the evaluation and acceptance of SNF and HLW shipping and storage canisters and appurtenances, or transportation casks approved by the NRC under regulations other than 10 CFR Part 63 prior to receipt at the repository. These analyses will demonstrate compliance with Yucca Mountain specific criteria. Acceptance criteria and a listing of components that have been found acceptable for use at the repository will be maintained in the Technical Requirements Manual.	The NRC approves spent fuel storage systems and radioactive material transportation packages under the provisions of 10 CFR Part 71 and 72. These deterministic regulations define a set of generic design, test, and performance specifications. This administrative control will require that such items be evaluated to confirm that their design is enveloped by the PCSA and postclosure performance assessment prior to receipt.

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls (Continued)

Probable Administrative Controls	Bases for Selection
Reliability Centered Maintenance—This administrative control will require that the repository maintenance program include a Reliability Centered Maintenance process. As described in Section 5.6.4, this is a systematic process by which equipment important to the repository's function is properly identified and specific maintenance activities are assigned and performed at the proper frequency to ensure reliability goals are achieved and/or maintained.	Reliability Centered Maintenance is required in order to maintain the performance and reliability of ITS/ITWI SSCs assumed by the PCSA or the postclosure performance assessment. Reliability Centered Maintenance may include requirements which are addressed by various separate programs included in the standard technical specifications for commercial power plants (NUREG-1430 (NRC 2004)), where these requirements are consistent with their treatment in the PCSA (e.g., Diesel Fuel Oil Testing, Battery Monitoring and Maintenance, and Ventilation Filter Testing).
Waste Package Loading, Handling, and Emplacement Program—This administrative control will require that the DOE establish and implement a program to control the loading, handling, and emplacement of waste packages. Specific limitations that must be observed will be specified in the Technical Requirements Manual. These limitations will include: • TAD canister loading limitations (e.g., 22.0 kW thermal limit and compliance with loading restrictions on enrichment, burnup, and cooling) • Waste package closure and inspection requirements • Limitations on waste handling including lift height restrictions • Waste package thermal loading limits (Section 1.3.1.2.5): – Maximum waste package limit of 18.0 kW – Maximum line load limit of 2.0 kW/m – Midpillar temperature of 99°C (as calculated by thermal energy density methodology) • Waste package emplacement requirements (e.g., spacing, and standoff distance from faults) • Postemplacement inspections.	The waste package loading, handling, and emplacement program will include provisions to ensure that the waste packages are loaded, handled, and emplaced in accordance with assumptions in the PSCA and TSPA. This program will include waste package loading controls to ensure that a accidental criticality is avoided. By adherence to the waste package loading procedure, the operator ensures that the waste form is placed in the appropriate waste package configuration to minimize the likelihood of criticality due to lack of neutron absorber, inappropriate geometric configuration, or excessive fissile material. These loading controls will include TAD canister loading limitations, inspection requirements, and thermal loading limits. This administrative control is similar to the "ISFSI Operations Program" included in the standard technical specifications for 10 CFR Part 72 Cask Certificates of Compliance (Withee and Jackson 2001).

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls (Continued)

Probable Administrative Controls	Bases for Selection
Subsurface Committed Materials Control Program—This administrative control will require that the DOE establish and implement a program to control the types and quantities of materials that are installed during construction, used during operations of the geologic repository, and that remain underground after the removal of uncommitted materials prior to repository closure. Currently approved material types and quantities will be documented in the Technical Requirements Manual (described below). This program will include analysis methodology and acceptance criteria for approving new materials or increased quantities prior to revising the committed materials listing in the Technical Requirements Manual.	Materials added to the subsurface facilities as part of the Engineered Barrier System or as the result of subsurface construction can impact the results of the performance assessment for the repository. The subsurface committed materials control program will ensure that the types and quantities of such materials are consistent with the performance assessment or are properly evaluated and determined to be acceptable prior to repository closure. Committed material controls are discussed in Section 1.3.6.
Access Control Program—This administrative control will require that the DOE establish and implement a program to control access to areas outside the GROA to avoid disturbance to the site that might affect compliance with 10 CFR 63.111 (the site boundary, as shown in Figure 5.8-2, is considered as the boundary of the preclosure controlled area under the definition of 10 CFR 20.1003). The administrative control will also require that this program be revised prior to closure of the repository to provide controls to restrict access and to prevent disturbance of the GROA and the site that might affect compliance with 10 CFR 63.113.	Access controls are required by 10 CFR 63.121. Inclusion of this administrative control is consistent with 10 CFR 63.43(b)(5) as a typical category of license specifications.
Fire Protection Program—This administrative control will require that the DOE establish and implement a repository Fire Protection Program. This program will include: • Combustible material control • Ignition source control • Firefighting services • Control of fire barriers • Control of combustible vegetation in the vicinity of ITS structures.	The Fire Protection Program will establish requirements consistent with the PCSA that will mitigate the potential for fire that could affect a waste form. The Fire Protection Program is described in Section 1.4.3.5.

Table 5.10-3. Probable Subjects of License Specifications to be Incorporated as Administrative Controls (Continued)

Probable Administrative Controls	Bases for Selection
Technical Requirements Manual—This administrative control will require that the DOE establish and maintain a Technical Requirements Manual and associated bases. This administrative control will also identify the approval process for changes to the Technical Requirements Manual and associated bases. At a minimum, the Technical Requirements Manual will include: • Acceptance criteria and designation of SNF and HLW shipping and storage canisters, appurtenances, or transportation casks approved for receipt at the repository in accordance with the canister and transportation cask acceptance program • Acceptance criteria and designation of waste forms and waste packages approved for emplacement in accordance with the waste form and waste package qualification program • Compilation of constraints on the design, loading, handling, and emplacement of waste packages. These constraints will be implemented in accordance with the waste package loading, handling, and emplacement program • Designation of material types and quantities approved as committed materials in accordance with the subsurface committed materials control program • Programmatic controls which assure continued functionality of ITS SSCs not represented with limiting conditions of operations or included as design features.	The Technical Requirements Manual is discussed in Section 5.10.2.4.2. The Technical Requirements Manual will provide a central location for compilation and control of operational and design restrictions that may be needed to support implementation of the license specifications. In addition to the review/approval authority defined in the license specifications, changes to the Technical Requirements Manual and associated bases will be subject to the provisions of 10 CFR 63.44.

NOTE: ALARA = as low as is reasonably achievable; TAD = transportation, aging, and disposal.

CONTENTS

Page

INTENTIONALLY LEFT BLANK

5.11 OPERATIONAL RADIATION PROTECTION PROGRAM

[NUREG-1804, Section 2.1.1.8.3: AC 1, AC 3]

This section of the license application addresses a portion of the requirements of 10 CFR 63.21(c)(6) and 10 CFR 63.111(a)(1). The remainder of the 10 CFR 63.21(c)(6) requirements are addressed in Section 1.4.2.

The U.S. Department of Energy (DOE) will establish an Operational Radiation Protection Program that meets the requirements of 10 CFR Part 20. The program will be implemented through procedures and work controls that ensure that radiation protection measures are employed commensurate with the scope and extent of licensed activities for the protection of workers, the public, and the environment as required by 10 CFR 63.21(c)(6). Program elements will be documented in an Operational Radiation Protection Program Plan.

The program described in this section is based, in part, on the format of NUREG-1567 (NRC 2000, Section 11.4.4). The Operational Radiation Protection Program will be available for review by the U.S. Nuclear Regulatory Commission (NRC) prior to submittal of the updated license application for a license to receive and possess spent nuclear fuel (SNF) and high-level radioactive waste (HLW).

This section provides information that addresses specific regulatory acceptance criteria in Section 2.1.1.8.3 of NUREG-1804. The information also addresses requirements contained in 10 CFR Part 63. The following table lists the information provided in this section, the corresponding regulatory requirements, and the applicable acceptance criteria for NUREG-1804. Acceptance Criterion 2 from Section 2.1.1.8.3 of NUREG-1804 is addressed in Section 1.10. Acceptance Criterion 1 is addressed in this section and in Section 1.10.

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference (and Changes to NUREG-1804 from HLWRS ISGs)
5.11	Operational Radiation Protection Program	63.21(c)(6) 63.111(a)(1)	Section 2.1.1.8.3: Acceptance Criterion 1 Acceptance Criterion 3
5.11.1	Organization	63.21(c)(6) 63.111(a)(1)	Section 2.1.1.8.3: Acceptance Criterion 1 Acceptance Criterion 3

SAR Section	Information Category	10 CFR Part 63 Reference	NUREG-1804 Reference (and Changes to NUREG-1804 from HLWRS ISGs)
5.11.2	Equipment, Instrumentation, and Facilities	63.21(c)(6) 63.111(a)(1)	Not applicable
5.11.3	Policies and Procedures	63.21(c)(6) 63.111(a)(1) 63.111(a)(2) 63.9(e)(1) 63.112(e)(4)	Section 2.1.1.6.3: Acceptance Criterion 1(2)(d) Section 2.1.1.8.3: Acceptance Criterion 1 Acceptance Criterion 3 Section 2.5.3.3.3: Acceptance Criterion 3 HLWRS-ISG-03 Section 2.1.1.8.3: Acceptance Criterion 4

Sources of radiation and radioactive material that will be addressed in the program include SNF and HLW waste forms, as well as sealed sources of radioactive material and site-generated, low-level radioactive waste. Elevated exposure fields within the restricted area are identified in Figures 1.10-1 through 1.10-17. Based on Section 1.4.5.1.1.4, mixed waste is not generated in routine operations. Should such waste be generated, it will be managed in accordance with federal and state requirements. The DOE will implement a program to address the radiological risks posed by repository testing and startup activities, transportation cask receipt and return operations, waste handling and processing, movement and emplacement of waste packages into underground facilities, waste package remediation, and other support operations necessary for safe handling of radioactive material at the repository.

The components of the program, its policies, supporting programs, and implementing procedures will ensure that radiation doses from these sources to workers and the public meet regulatory limits and will be as low as is reasonably achievable (ALARA). When implemented, the program will establish that:

- Radioactive material is controlled.
- Potential for radioactive contamination of personnel, equipment, and areas is minimized.
- The onsite generation of low-level radioactive waste and effluents is minimized.
- Facilities, equipment, training, and qualified staff will be available to provide adequate radiation protection and safe radiological operations consistent with ALARA principles.
- Individual and collective occupational and public doses are maintained below regulatory limits and are consistent with ALARA principles described in Section 1.10.

This section provides an overview of how the applicable radiation protection elements related to regulatory requirements and guidance documents will be implemented. Management will adopt and promulgate policies, procedures, and guidance which will clearly express management's

commitment to ALARA and integrate that commitment into facility operations. Among other things, those policies, procedures, and, guidance will: (1) direct supervisors to integrate appropriate radiation protection controls into work activities and direct managers to verify that supervisors have followed those directions; (2) establish sufficient and appropriate worker initial and periodic training on how to implement ALARA principles, direct supervisors and managers to periodically determine whether workers are adhering to ALARA principles, and direct managers and supervisors to take any corrective actions which may be necessary in this regard; (3) be disseminated periodically to all personnel to make them aware of management's commitment to ALARA; and (4) implement an operations program, as described in detail below, which will control radiation exposures in ways that maintain individual and collective doses ALARA.

Sealed radioactive sources used in support of testing and Performance Confirmation Programs are controlled using a program that meets the requirements of 10 CFR Part 835. A 10 CFR Part 835-compliant program will be in effect, if applicable, for radiological activities until subsumed by the Operational Radiation Protection Program developed to meet the requirements of 10 CFR Part 20, as appropriate. The 10 CFR Part 835 program applies to radiological activities only, not to design considerations.

5.11.1 Organization

[NUREG-1804, Section 2.1.1.8.3: AC 1, AC 3]

The program will identify radiation protection staffing requirements based on the guidance contained in ANSI/ANS-3.1-1993, *American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants*. The radiation protection organization will be staffed with qualified radiation safety professionals who will be responsible for developing and implementing an effective radiation protection program. The Radiation Protection Manager and the radiation protection organization will operate independently of the operations and maintenance organizations. The Radiation Protection Manager will have direct access to the Site Operations Manager and other facility management to address issues relating to radiation protection program implementation. Section 5.3.2.1.7 addresses the qualifications of the Radiation Protection Manager. The radiation protection organization will interface with the other facility organizations to facilitate integration of radiation protection program requirements consistent with ALARA principles into their programs.

Trained and qualified radiation protection supervisors, technicians, and staff will implement radiological work controls, including performing surveys, posting and implementing restricted area access controls, and providing job coverage based on the radiological risk of the work. Qualification of radiation protection technicians will incorporate certification training and examination, on-the-job training, and evaluation by knowledgeable radiation protection staff. Periodic retraining will be performed to ensure that radiation protection technicians are aware of changes and improvements to the program, related industry events, and other appropriate topics.

The program will identify minimum radiation protection staffing needed to support safe operations during all shifts. Staffing levels may vary, based upon planned facility operating status and other applicable needs and considerations. Staffing will include radiological response personnel to support emergency response functions. This will be described in the Emergency Plan (Section 5.7).

In accordance with 10 CFR 20.1101(c), the program will require that a review and assessment be conducted at least annually to evaluate the adequacy of the program content and its implementation. The assessment will document program deficiencies and recommend corrective actions or improvements.

5.11.2 Equipment, Instrumentation, and Facilities

5.11.2.1 Radiation Protection Equipment

The Operational Radiation Protection Program will describe radiation protection equipment necessary to successfully implement the program. Portable air-sampling and survey equipment, including air-sampling filter media, will be provided to supplement fixed radiation monitoring instruments and to survey ambient job conditions. This equipment may be supplemented by personal air samplers, where appropriate. Air-sampling equipment, support equipment, and other monitoring devices (e.g., environmental dosimeters) necessary to support the environmental radiological monitoring program will be maintained.

Respiratory protection equipment, associated cleaning and maintenance equipment, and fit-test equipment will be available for use, as appropriate. This equipment will be maintained separately from respiratory protection equipment used in nonradiological areas.

Equipment needed to minimize worker contamination or spread of contamination will also be available, including protective anticontamination clothing, step-off pads, and decontamination supplies and equipment. Protective clothing will be staged for use at contaminated area ingress and egress points, along with collection containers for used equipment and supplies. Adequate supplies of radiological signs, labels, bags, drums, rope, and stanchions will be maintained to identify, mark, and control access to restricted areas.

5.11.2.2 Radiation Protection Instrumentation

The Operational Radiation Protection Program will identify the types of instruments necessary to support safe radiological operations and emergency response actions. Radiation protection instruments will be:

- Appropriate for the types, levels, and energies of radiation encountered
- Appropriate for existing and expected environmental conditions
- Periodically calibrated to traceable standards and maintained on an established frequency
- Routinely tested for operability.

Determinations for the minimum quantity of equipment needed will include considerations for out-of-service instruments, such as those requiring maintenance or calibration. Radioactive sources used to perform calibrations of radiation detection instruments will be traceable to the National Institute of Standards and Technology.

Portable radiation survey instruments will be used to: conduct radiation and contamination surveys; monitor and sample airborne radioactivity; monitor area radiation levels; and monitor personnel during normal operations, anticipated operational occurrences, and off-normal or emergency

situations. Fixed radiation detection instruments, such as portal monitors, will be used for direct monitoring of personnel for contamination, as appropriate.

Instruments and equipment used for quantitative radiation measurements will be calibrated and performance-checked in accordance with procedures consistent with guidance contained in Regulatory Guide 8.6; ANSI N323A-1997, *American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*; ANSI N323B-2003, *American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instrumentation for Near Background Operation*; and manufacturer recommendations. Radiation detection instruments will be used to perform laboratory analyses on samples such as bioassay samples, swipes, liquid samples, air samples, and soil samples to detect the presence of radioactive materials. Laboratory instrument capability will be provided to analyze samples for compliance with the survey requirements of 10 CFR 20.1501 and 10 CFR 20.1502. Radiological analyses not performed at the site will be provided by a qualified laboratory, consistent with radiation protection requirements.

As required by 10 CFR 20.1501(b), the program will identify steps to ensure the accuracy and precision of each type of radiation survey, and laboratory instrument. Qualified individuals will calibrate, check the performance of, and maintain radiation protection instruments in accordance with the Quality Assurance Program, as described in Section 5.1. Instruments that are not qualified for use will be tagged or marked so that they are not used inadvertently.

The process and area radiation monitoring equipment that are a part of the repository are described in Section 1.4.2.

5.11.2.3 Radiation Protection Facilities

The radiation protection organization will have sufficient facilities to adequately implement the various aspects of the program. The radiation protection facilities will support monitoring of radiological work, monitoring of facility radiological conditions, radiological access control, and generation of radiological work controls or permits. Facilities will be available for conducting prejob reviews, operational radiation protection training, ALARA reviews, and postjob assessments. Space will be available in the repository waste handling facilities for locally controlling access to radiological work areas.

Radiation protection areas within facilities will include contamination control supplies, contaminated equipment storage, and radioactive material storage areas. Access control stations, protective clothing and change facilities, and respiratory protection equipment facilities will also be provided. Facilities will be available to decontaminate personnel and equipment; to store, calibrate, and maintain portable radiation protection instruments; to execute internal and external dosimetry programs; and to accommodate radiation protection record needs. The radiation protection laboratory facilities will house assay instrumentation for onsite sample analysis. These facilities will accommodate the equipment, instruments, and qualified personnel necessary for onsite processing of anticipated radiological samples.

5.11.3 Policies and Procedures

[NUREG-1804, Section 2.1.1.6.3 AC 1(2)(d); Section 2.1.1.8.3: AC 1, AC 3; Section 2.5.3.3.3: AC 3; HLWRS-ISG-03, Section 2.1.1.8.3: AC 4]

Operational radiation protection requirements will be governed by and implemented through written policies and procedures. The program-implementing procedures may be developed and adopted in a phased manner, commensurate with the extent of the radiological hazard at the facility. The required policies and procedures of the program will be fully implemented prior to the receipt of waste. The policies and procedures will ensure that radiation doses to workers and the public meet 10 CFR Part 20 and 10 CFR Part 63 dose limits, consistent with ALARA principles, during facility operations and Category 1 event sequences. The Emergency Plan will establish the basis for procedures and practices for responding to and recovering from radiological emergencies that may occur during operations at the repository and will include evacuation plans or other self-protection procedures.

5.11.3.1 Radiation Surveys

The operational radiation protection procedures will describe methods, frequencies, and plans for conducting radiation surveys to comply with the survey requirements of 10 CFR 20.1501, 10 CFR 20.1502, and 10 CFR 20.1703. Radiation survey documents will incorporate the units of measurement specified in 10 CFR 20.2101. Radiation surveys will be performed by personnel trained and qualified in the survey process and in the operation, application, and limitations of the radiation detection instruments. Radiation survey frequency will be based on the potential radiological hazards associated with any specific area, the potential for change in radiological conditions because of facility operations, and the potential for individual exposure to radiation within that area. Radiation surveys will consist of dose rate measurement, radioactive contamination measurement, or airborne radioactivity measurement, as appropriate for the area or item being surveyed. The characterization of the radiological conditions that these surveys provide will be used in the planning and execution of radiological work processes and in the planning process to implement ALARA principles. These surveys will also be used to determine or verify proper postings, barriers, and work controls and to document, monitor, and track changing radiological conditions. Surveys outside restricted areas and preclosure controlled areas will also be performed to confirm the absence of radioactive contamination and to confirm that dose rates are not elevated from background or predicted levels.

Radiation surveys characterizing the magnitude and extent of radiation dose rates will be performed for radiological work activities in facility general and specific areas and on material and equipment. The characterization of dose rates will normally include general area measurements, measurements at worker locations, measurements at contact, and measurements at 30 cm from surfaces.

Radioactive contamination surveys will be performed in areas and on material and equipment to identify radioactive contamination to prevent it from being spread or transferred outside of restricted areas and to minimize doses to workers or the public. Contamination surveys will be performed on personnel to detect personnel who may be contaminated, to prevent personnel from spreading contamination to clean areas, and to confirm that contamination controls are effective. The results of contamination surveys will be used as an input in determining dose impact to the

individual, to investigate the cause of the contamination event, and to implement necessary corrective actions.

Surveys for airborne radioactivity will be performed in areas where there is a potential exposure of personnel to airborne radioactivity. The characterization of airborne radioactivity levels that these surveys provide will be used in evaluations for respirator use, modifications of engineering controls, and in the planning and execution of work processes.

5.11.3.1.1 Radioactive Material Shipment Surveys

Radiological surveys of external package surfaces for incoming transportation casks and shipments containing a package or packages of radioactive material in excess of a Type A quantity will be performed in accordance with 10 CFR 20.1906. Waste shipments will be received at the Cask Receipt Security Station. The accessible transportation cask surfaces and the transport vehicle will be surveyed for radiation levels and removable contamination. Upon determination of acceptable radiological receipt conditions, routine processing of the shipment will proceed. If unacceptable radiological receipt conditions are identified, actions will be taken, including moving the shipment to a holding area within railcar or truck staging areas, until necessary remedies can be determined. These remedies may include temporary isolation of the shipment or contaminated areas; investigation of the cause of the unacceptable conditions; required notification of the appropriate agencies, officials, shipper, and transport company; and decontamination of the shipment, where applicable.

Radiological release surveys will be performed prior to release of the unloaded transport vehicle for unrestricted use. These surveys will confirm that the radiation and contamination levels of the unloaded transport vehicles are within applicable regulatory limits. Each transportation cask will receive a radiological survey that will document radiation and contamination levels on the exterior surfaces. If necessary, remediation steps will be taken.

5.11.3.1.2 Radiological Postings

The geologic repository operations area (GROA) will be conspicuously posted for radiological protection purposes, in accordance with 10 CFR 20.1901 through 10 CFR 20.1903. Results of area surveys will be used to establish and maintain proper radiological postings. The potential for changing radiological conditions will be evaluated when establishing or modifying radiological postings.

5.11.3.2 Access and Dose Control

5.11.3.2.1 Radiological Access Control

A restricted area will be established to assist in minimizing exposure of personnel to radiation. The restricted area of the GROA will change as phased construction progresses (Figures 1.1-3 and 1.1-2). The program will describe the radiological access control system, which will verify that the radiological entry requirements for personnel have been met prior to allowing access. At a minimum, verification of training, accumulated dose, and radiation work permit status will be performed prior to granting access. Additional access control stations may be employed to facilitate

application of graded radiological controls, to enhance worker access and processing needs, or to address other facility needs within the owner-controlled area. This use of the restricted area to control access to the active waste handling areas of the GROA does not prevent the use of other restricted areas within the GROA or site.

The access control features for high radiation and very high radiation areas will meet the criteria of 10 CFR 20.1601 and 10 CFR 20.1602. High and very high radiation levels will exist in the areas where waste is received, processed, and emplaced, especially in areas containing uncanistered SNF assemblies, partially loaded or fully loaded waste packages, or exposed loaded SNF or HLW canisters. These facility areas will be shielded, and, when high radiation levels exist, access via a shielded door will be prevented by interlock or other positive controls. Control measures are designated important to safety for shield doors or other access doors that preclude worker exposures to high radiation areas where the failure of the door or the inadvertent opening of the door has the potential to cause worker doses in excess of the regulatory dose limits. The operability of these interlocks will be verified during initial startup testing and periodically during operations to ensure they are functioning properly. Access controls to such areas will be consistent with the guidance in Regulatory Guide 8.38 and will be incorporated into the radiological access control process to ensure that controls regarding high radiation and very high radiation areas are effectively implemented.

5.11.3.2.2 Onsite Dose Control

To ensure that the occupational dose limits of 10 CFR 20.1201 through 10 CFR 20.1208 are met, including requirements for summation of internal and external doses, the program will identify occupational dose monitoring practices. The program will establish conditions necessary to authorize planned special exposures in accordance with 10 CFR 20.1201(b) and 10 CFR 20.1206 and will follow the guidance contained in Regulatory Guide 8.35. The program will also identify the methodology to ensure that the dose limits prescribed in 10 CFR 20.1301 for members of the public are not exceeded and that compliance is demonstrated.

Radiation work controls will be implemented to ensure doses to personnel are maintained below regulatory dose limits and are consistent with the principles of ALARA during:

- Normal operations
- Maintenance
- Surveillance
- Test activities
- Radiological emergency response, including responses to Category 1 event sequences, if any.

These controls will consist of policies, procedures, and administrative controls, such as radiological work permits, development and testing of contingency procedures for off-normal occurrences (Section 1.10.4.1.5), and administrative dose levels. Work in restricted areas will be planned and

approved in advance. Planning will include a defined scope of work, the specific job tasks to be accomplished, the personnel needed to accomplish the work, the expected dose for the work, specific work procedures or instructions, radiological safety measures, special training or practice, and radiological monitoring requirements for the work. The work planning process will include a review of relevant operational experience with comparable facilities, a determination of the occupational doses associated with those alternatives, and an application of ALARA principles to determine the appropriate operational alternative to implement. The work planning process will also include dry runs, where they have been determined to be a useful tool for identifying the need to consider alternative procedures to minimize exposures, and determinations of the need to adopt alternative procedures to minimize exposures. See Section 1.10 for additional discussions on ALARA principles.

Job-specific radiological work requirements will be stipulated through a radiological work permit process or incorporated into the work-control process. Workers will be responsible for understanding the radiological work control requirements for each job and the methods to be used to minimize radiation doses prior to commencing work. Radiation protection personnel will be available to discuss these requirements and facilitate worker understanding prior to commencing work in the restricted areas.

5.11.3.2.3 Radioactive Material and Contamination Control

A radioactive material control program will be implemented to ensure that radioactive material, such as low-level radioactive waste bags and containers and contaminated equipment or tools, is identified; contained; labeled and marked, as appropriate; and otherwise controlled. The radioactive material control program is supported by the housekeeping activities described in Section 5.6.4.3.2. The radioactive material control program is separate from the Material Control and Accounting Program for SNF and HLW (GI Section 4). The radioactive material control program will implement controls to minimize the amount of material and equipment brought into restricted areas. Material and equipment will be surveyed to identify the presence of radiation or radioactive contamination prior to its removal from restricted areas. Radioactive and contaminated material and equipment will be designated as such until successfully decontaminated or appropriately disposed of. Containers of radioactive material will be labeled and marked, in accordance with 10 CFR 20.1904 and 10 CFR 20.1905. Radioactive material will be stored only in designated locations intended for such storage.

Outdoor storage of radioactive material will require consideration of environmental conditions when determining appropriate packaging, containment, segregation, and posting. The radioactive material control program will ensure that material and equipment are not released outside restricted areas unless they meet the acceptable surface contamination levels listed in Table 1 of Regulatory Guide 1.86.

The radioactive material control program will also describe radioactive source control, including radioactive source labeling, control, storage, use, inventory, and leak testing. These sources will be controlled and secured from unauthorized access, removal, and use.

The program will identify contamination limits for personnel, equipment, and areas. Radiological surveys will be used to identify personnel, equipment, and areas that exceed these contamination

limits. Personnel who have detectable levels of contamination will be promptly decontaminated under the direction of radiation protection personnel, and, if appropriate, dose calculations will be performed. Measures will be taken to ensure contamination is controlled while transporting contaminated personnel to an onsite decontamination facility. Contaminated personnel will be evaluated for potential internal dose, where appropriate. Equipment that is found to exceed contamination limits will be identified, contained, and controlled. Areas found to exceed contamination limits will be cordoned off, and access to those areas will be controlled. Contamination events will be tracked to ensure causes are identified and corrected.

5.11.3.2.4 Low-Level Radioactive Waste Management

Site-generated, low-level radioactive waste will be controlled and disposed of in a DOE low-level radioactive waste disposal site, in an Agreement State site, or in an NRC-licensed site subject to the completion of the appropriate review pursuant to the National Environmental Policy Act of 1969. Disposal in an Agreement State site or in an NRC-licensed site would be in accordance with applicable portions of 10 CFR Part 20. See Section 1.10.3.3.3 for additional discussion of low-level radioactive waste.

Consistent with the implementation of ALARA principles, facility plans for decontaminating or dismantling facilities will include procedures and processes that minimize the generation of low-level radioactive waste. See Section 1.12 for additional discussion on decontamination and dismantlement plans.

5.11.3.3 External Dose Monitoring

This program will include monitoring of personnel for external radiation dose. The monitoring will meet the requirements of 10 CFR 20.1501(c) and 10 CFR 20.1502. The monitoring criteria and methods to calculate occupational radiation doses will be based upon Regulatory Guide 8.34. Direct-reading and indirect-reading pocket dosimeters will be selected and utilized in accordance with Paragraph C (introductory paragraph) and Paragraph C.1 of Regulatory Guide 8.4 and ANSI N322-1997. An active personnel dose and dose rate warning program will be based upon ANSI N42.20-2003, *American National Standard Performance Criteria for Active Personnel Radiation Monitors*, as an alternative to Regulatory Guide 8.28.

Personnel who have successfully completed appropriate radiation protection training and who have completed the required radiation dose record forms may be issued dosimeters for access to restricted areas. Dosimeters of record that require processing to determine radiation dose will be obtained from a dosimetry processor accredited by the National Voluntary Laboratory Accreditation Program. These dosimeters will be capable of and accredited for measuring the types of radiation that individuals will encounter in their work activities at the repository.

In addition, personnel who require access to posted high radiation areas will wear dosimeters or similar devices equipped with alarms. A dose-tracking system will verify that the individual meets the radiation protection entry requirements prior to issuing the alarming dosimeter. The dosimeter will have visual indication of the accumulated dose, and it will be set to alert the individual if the accumulated dose or dose rate while on a job exceeds predetermined control levels.

The dose data from dosimeters will be collected and maintained by the dose-tracking system. These data will be used to ensure that personnel do not exceed regulatory occupational dose limits, as specified in 10 CFR 20.1201 through 10 CFR 20.1208. The dose-tracking system will maintain the required radiation dose records, generate required dose reports, and support long-term, dose-record retention. The dose results of dosimeters for personnel will be entered into this system and will become the permanent dose record. Any dose results from dosimeters may be maintained on the system until the permanent dose record is established. The dosimeter data will be used by radiation protection personnel for monitoring worker dose, planning radiation work, establishing dose limits for personnel, and tracking dose goal performance consistent with implementation of ALARA principles.

5.11.3.4 Internal Dose Monitoring

The program will include monitoring of personnel for internal radiation dose. Internal dose will be monitored, controlled, and determined in accordance with the requirements provided in 10 CFR 20.1502 and 10 CFR 20.1204 and with the guidance contained in Regulatory Guide 8.34 and Regulatory Guide 8.9. Internal dose monitoring procedures will describe the methods used to calculate internal dose from the results of internal radionuclide deposition, as determined by bioassay sample analysis or whole body counting. When whole body counting or bioassay sampling is not available, air sample results may be used to calculate individual derived air concentration-hour exposure and to assign internal dose based on evaluation of the derived air concentration-hour exposure. Internal dose results will be entered into the dose-tracking system and will be tracked accordingly. Internal dose records will become part of the permanent dose record.

5.11.3.5 Air Sampling and Analysis

The program will include airborne radioactivity sampling in accordance with the survey and measurement requirements provided in 10 CFR 20.1204, 10 CFR 20.1501, 10 CFR 20.1502, and 10 CFR 20.1701 through 10 CFR 20.1703 and the guidance contained in Regulatory Guide 8.25, including the control of risks associated with respirator use.

A portion of the airborne radioactivity sampling will be implemented through fixed-process instrumentation located within areas or rooms potentially containing airborne radioactivity or high contamination levels. The program will establish the criteria to be followed in determining when portable airborne radioactivity sampling will be performed. Generally, airborne radioactivity sampling will be performed in areas with potential for airborne radioactivity, in contamination and high contamination areas where workers are present, on jobs that may cause a release of airborne radioactivity, and on jobs that involve highly contaminated equipment or systems.

Analyses will be performed on collected air samples to determine radionuclide concentrations. The results will be evaluated to ensure proper posting of areas, in accordance with 10 CFR 20.1902. The results may also be used to perform prospective evaluations for respiratory protection equipment requirements for work in airborne radioactivity areas.

5.11.3.6 Respiratory Protection

The program will include respiratory protection in accordance with the applicable regulations in 10 CFR 20.1701 through 10 CFR 20.1705 and the guidance contained in Regulatory Guide 8.15. However, prior to the use of respiratory protection equipment, process or engineering controls will be employed to the extent practicable to control the concentration of airborne radioactivity. The use of respirators will be limited to situations in which respirator use has been shown to keep the total effective dose equivalent consistent with the implementation of ALARA principles. If other methods of protection against airborne radioactivity, such as the use of process or engineering controls, are not practical, additional monitoring and limiting intakes will be accomplished through use of access controls, limited exposure times, and use of respiratory protection devices.

Respiratory protection equipment for radiation protection use will be selected in accordance with applicable portions of 10 CFR 20.1703 and 10 CFR 20.1704. Requirements for the use of respiratory protection equipment will be communicated through administrative controls, such as radiological work permits or work instructions and postings. Personnel will be issued respiratory protection equipment only if they satisfy requirements for medical examination, applicable training, and respirator fit testing.

5.11.3.7 Radiation Protection Training

The program will identify individuals who are likely to receive an occupational dose in excess of 100 mrem/yr in accordance with 10 CFR 19.12. This determination will include consideration of assigned activities during normal and off-normal situations involving exposure to radiation or radioactive material that can be expected to occur during the life of the facility. The extent of the instruction provided to these individuals will be commensurate with radiological health protection needs and will be consistent with guidance in Regulatory Guide 8.8, Section C.2; Regulatory Guide 8.27; Regulatory Guide 8.29; and ASTM E 1168-95, *Standard Guide for Radiological Protection Training for Nuclear Facility Workers*. Prior to being exposed to radiation or radioactive material, these individuals will be:

- Informed of the storage, movement, or use of radiation or radioactive material in their work areas
- Instructed in the health protection issues associated with exposure to radiation or radioactive material, in precautions or procedures to minimize exposure, and in the purposes and function of protective devices used in the workplace
- Instructed in and required to implement the applicable provisions of NRC regulations and licenses for protection from exposure to radiation or radioactive material
- Instructed in their responsibility to promptly report to management any avoidable exposure to radiation or radioactive material or any condition that may lead to or cause a violation of NRC regulations or licenses
- Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material

- Advised of the radiation dose reports that workers may request pursuant to 10 CFR 19.13
- Informed of potential off-normal occurrences and the associated contingency procedures
- Trained on normal operations and off-normal occurrences and contingency procedures.

Personnel who require access to restricted areas will be given information on the potential health risks associated with exposure to radiation and radioactive material, on ALARA methods to minimize radiation dose, and on the use of personal protective equipment. This information will be commensurate with the potential radiological hazard and the radiation conditions of the area and will be communicated prior to personnel being allowed entry into the restricted area. Based on the type of work to be performed and on the potential dose, an individual may be given special training, monitoring requirements, instructions, or work planning information.

Sufficient training or information will be provided to individuals who are not provided access to restricted areas, including visitors, so that they recognize designated radiological areas and postings and know why they are not allowed to enter these areas. These individuals will be provided information regarding the associated radiological hazards, if any, that could be encountered outside of restricted areas, such as those associated with Category 1 event sequences or with onsite movement of radioactive material. A description of this training is provided in Section 5.3.3.2.1. In addition to the training indicated above, retraining will be provided as necessary.

5.11.3.8 Notices to Workers

Current copies of NRC Form 3, Notice to Employees, and other documents specified in 10 CFR 19.11 will be prominently posted in sufficient places for individuals engaged in licensed activities to view them, in accordance with 10 CFR 19.11. In compliance with 10 CFR 63.9(e)(1), NRC Form 3 will be posted no later than 30 days after docketing of the license application and remain posted for the term of the license and for 30 days following license termination.

5.11.3.9 Pregnant Worker, Embryo, and Fetus Protection

The program will include development and implementation of a declared-pregnant woman protection policy and program that implement the requirements of 10 CFR 20.1208 and that follow the guidance contained in Regulatory Guide 8.13, Section C, and Regulatory Guide 8.36. The declared-pregnant woman protection program will ensure that workers, including supervisors and managers, understand the rights of women to voluntarily declare, in writing, their pregnancy or intent to become pregnant, as well as their right not to declare. At a minimum, female workers who are occupationally exposed to radiation will be given additional information regarding the health risk of radiation exposure to the developing embryo and fetus. Administrative controls regarding radiation work assignments will ensure that the embryo and fetus of a declared-pregnant worker does not receive a total effective dose equivalent greater than the limit specified in 10 CFR 20.1208.

5.11.3.10 Radiation Protection Records and Reports

5.11.3.10.1 Records

The program will include radiation protection record generation and maintenance practices in accordance with the applicable requirements of 10 CFR 20.2101 through 10 CFR 20.2110. The program will also incorporate guidance from Regulatory Guide 8.7 and ANSI/HPS N13.6-1999, *Practice for Occupational Radiation Exposure Records Systems*, into the records program. Electronic media and software programs will be an integral part of health physics records and reports. These media will be developed with the ability to generate and maintain required regulatory records that are legible, accurate, and complete. Each record will be required to be legible throughout its retention period. Safeguards against tampering will be included in the record maintenance and retention system.

Records generated in accordance with the provisions of the Operational Radiation Protection Program will be retained until the NRC terminates the license. Records generated during formal program reviews or audits will be retained for a minimum of 3 years after completion. Records generated with information described in the Privacy Act of 1974 (5 U.S.C. 552 et seq.) will be protected from public disclosure.

5.11.3.10.2 Reports

The program will include reporting and notification practices, in accordance with 10 CFR 20.2201 through 10 CFR 20.2206 and 10 CFR 19.13. These reports and notifications will include occupational dose reports, radioactive material theft or loss notifications, incident notifications, and reports of doses or releases exceeding regulatory limits. Each individual for whom occupational dose monitoring is required during the calendar year will be provided with an annual written report of occupational radiation dose. Monitored individuals will be provided with a written summary of occupational dose upon request. Occupational dose reports provided to the NRC will also be provided to the exposed individuals.

5.11.3.11 Environmental Radiological Monitoring

The Operational Radiation Protection Program will include development and implementation of the environmental radiological monitoring program. The objectives of environmental radiological monitoring will be to ensure that radiation doses to members of the public in the general environment are below the applicable preclosure performance objectives and are consistent with ALARA principles and that releases of radioactive material to the environment are minimized and monitored. These objectives will be achieved by minimizing sources of direct radiation to members of the public and by minimizing releases of radioactive material in effluents through effective application of design principles, engineering controls, and operational controls for activities involving radioactive material.

Environmental radiological monitoring will include the following:

- Environmental radiological monitoring program
- Effluent monitoring

- Offsite dose calculation
- Meteorological monitoring.

5.11.3.11.1 Environmental Radiological Monitoring Program

The Operational Radiation Protection Program will include development of the environmental radiological monitoring program to demonstrate compliance with applicable requirements of 10 CFR 63.111(a)(2), 10 CFR 20.1101(d), 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 20.1501, and 10 CFR 20.2001 and to ensure protection of the public and the environment. The environmental radiological monitoring program will be developed consistent with applicable guidance contained in Regulatory Guide 1.21. The environmental radiological monitoring program will be intended to ensure that the facility is functioning as intended, that releases of radioactive material to the environment are limited, and that exposure of the public to direct radiation is minimized. The environmental radiological monitoring program will provide for effective measurement of direct radiation and radionuclide concentrations emitted in effluents by facility operations. Through effluent measurements and modeling of exposure pathways, the environmental radiological monitoring program will confirm effluent controls by measuring concentrations of radioactive material and levels of radiation in the general environment.

The environmental radiological monitoring program will be implemented in phases to coincide with repository operational phases. The phases will consist of preoperations, operations, and postoperations. The preoperational phase will commence prior to receipt of waste. The operational phase will commence upon first receipt of SNF or HLW. After completion of operations, the postoperational phase will begin, to support site decommissioning and closure. Each of these phases will consist of environmental sampling and monitoring activities necessary to support that phase. The data collected during the preoperational phase will establish the baseline data for the program.

The environmental radiological monitoring program will identify environmental sample media, appropriate sample analysis methodology, and methods of measuring direct radiation. Samples will be appropriate for the exposure pathway of interest. Sampling and monitoring media, sampling locations, collection methods, sampling frequencies and duration, chain-of-custody requirements, and analytical methods will support the specific objectives of each phase of the environmental radiological monitoring program. Additionally, a land-use census will be conducted to identify sampling locations in appropriate meteorological sectors. The census may be conducted periodically to ensure that changes in the use of areas in the general environment are identified and factored into the environmental radiological monitoring program.

5.11.3.11.2 Effluent Monitoring

The program will include effluent monitoring and sampling in accordance with 10 CFR 63.21(c)(6) to demonstrate compliance with release and constraint limits to ensure protection of the public and the environment. The concentration of radioactive material in surface facility effluents will be monitored. Additionally, administrative limits and operational controls will be established and will include effluent monitor set-point calculations, as well as surveillance requirements and their bases. Subsurface effluents (emplacement drift exhaust air) will be sampled as part of the repository ventilation system. The description of effluent monitors and samplers and their integration into facility design appears in Section 1.4.2.

The concentrations of radioactive material released from surface structures and the subsurface in effluents outside restricted areas will be monitored or sampled. The results will be used in accordance with the methods and parameters in the offsite dose calculation described in Section 1.8.3 to ensure that radiation doses comply with regulatory limits.

5.11.3.11.3 Offsite Dose Calculation

The program will include an offsite dose calculation, which will contain the basis for the dose assessment methodology. The offsite dose calculation will demonstrate compliance with the performance objectives in 10 CFR 63.111(a)(2), the requirements of 10 CFR 20.1302, and the constraints of 10 CFR 20.1101(d) regarding air emissions of radioactive material to the environment. The offsite dose calculation will include the capability of evaluating the potential radiological consequences of actual and potential radioactive effluent releases during normal facility operations and during off-normal conditions. The dose assessment process will involve mathematical modeling based on the results of environmental sampling, direct radiation monitoring, radiological effluent monitoring and sampling, and meteorological monitoring. The offsite dose calculation will be reviewed and modified periodically, as appropriate, to reflect changes in applicable regulations or improvements in the computational methodology. The offsite dose calculation is described in Section 1.8.3.

5.11.3.11.4 Meteorological Monitoring

The program will include development and implementation of meteorological monitoring. The meteorological monitoring system is described in Section 1.4.2. The meteorological monitoring system will monitor and record the meteorological data necessary to support normal operations and emergency response functions. The meteorological monitoring system will specify the acquisition and storage requirements for meteorological data. The meteorological monitoring system is integral to the environmental radiological monitoring program, providing real-time meteorological data necessary to evaluate the radiological consequences of actual and potential radioactive effluent releases during normal facility operations and during emergency conditions. The meteorological monitoring system data will be used in the assessment of the transport, diffusion, and deposition of radioactive material in effluents released to the atmosphere, as well as to evaluate potential exposure pathways and sampling locations for the environmental radiological monitoring program.

5.11.4 General References

ANSI/ANS-3.1-1993. 1999. *American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants.* La Grange Park, Illinois: American Nuclear Society. TIC: 235767.

ANSI/HPS N13.6-1999. 2000. *Practice for Occupational Radiation Exposure Records Systems.* McLean, Virginia: Health Physics Society. TIC: 254452.

ANSI N42.20-2003. 2004. *American National Standard Performance Criteria for Active Personnel Radiation Monitors*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 260010.

ANSI N322-1997. *American National Standard Inspection, Test, Construction, and Performance Requirements for Direct Reading Electrostatic/Electroscope Type Dosimeters*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 260009.

ANSI N323A-1997. *American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 246397.

ANSI N323B-2003. 2004. *American National Standard for Radiation Protection Instrumentation Test and Calibration, Portable Survey Instrumentation for Near Background Operation*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255346.

ASTM E 1168-95. *Standard Guide for Radiological Protection Training for Nuclear Facility Workers*. West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 241268.

National Environmental Policy Act of 1969. 42 U.S.C. 4321 et seq.

NRC (U.S. Nuclear Regulatory Commission) 2000. *Standard Review Plan for Spent Fuel Dry Storage Facilities.* NUREG-1567. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 247929.

Privacy Act of 1974. 5 U.S.C. 552 et seq.

Regulatory Guide 1.21, Rev. 1. 1974. *Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 223043.

Regulatory Guide 1.86. 1974. *Termination of Operating Licenses for Nuclear Reactors*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 218739.

Regulatory Guide 8.4. 1973. *Direct-Reading and Indirect-Reading Pocket Dosimeters.* Washington, D.C.: U.S. Atomic Energy Commission. TIC: 3699.

Regulatory Guide 8.6. 1973. *Standard Test Procedure for Geiger-Müller Counters.* Washington, D.C.: U.S. Atomic Energy Commission. TIC: 246018.

Regulatory Guide 8.7, Rev. 2. 2005. *Instructions for Recording and Reporting Occupational Radiation Dose Data*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20080104.0001.

Regulatory Guide 8.8, Rev. 3. 1978. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as is Reasonably Achievable*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238609.

Regulatory Guide 8.9, Rev. 1. 1993. *Acceptable Concept, Models, Equations, and Assumptions for a Bioassay Program.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 2977.

Regulatory Guide 8.13, Rev. 3. 1999. *Instructions Concerning Prenatal Radiation Exposure*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20050406.0220.

Regulatory Guide 8.15, Rev. 1. 1999. *Acceptable Programs for Respiratory Protection.* Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20050516.0264.

Regulatory Guide 8.25, Rev. 1. 1992. *Air Sampling in the Workplace.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238394.

Regulatory Guide 8.27. 1981. *Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238517.

Regulatory Guide 8.28. 1981. *Audible-Alarm Dosimeters.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 246019.

Regulatory Guide 8.29, Rev. 1. 1996. *Instruction Concerning Risks from Occupational Radiation Exposure.* Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20010724.0313.

Regulatory Guide 8.34. 1992. *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 8912.

Regulatory Guide 8.35. 1992. *Planned Special Exposures.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 6117.

Regulatory Guide 8.36. 1992. *Radiation Dose to the Embryo/Fetus.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 8911.

Regulatory Guide 8.38, Rev. 1. 2006. *Control of Access to High and Very High Radiation Areas in Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20071030.0095.