NUREG–1199

Standard Format and Content of a license application for a Low-Level Radioactive Waste Disposal Facility

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

January 1991

Revision 2 to NUREG-1199

"Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility"

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NUREG–1199
Rev. 2

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Division of Low-Level Waste Management and Decommissioning
Office of Nuclear Material Safety and Safeguards
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ABSTRACT

This document has been developed as a guide to prospective applicants for licenses to dispose of low level radioactive waste pursuant to 10 CFR Part 61. The document identifies information that should be provided in the Safety Analysis Report and establishes a uniform format for presenting the information necessary to fulfill the licensing requirements for land disposal of radioactive waste called for in 10 CFR Part 61.

The uniform format will (1) help ensure that the Safety Analysis Report contains the information required by 10 CFR Part 61, (2) aid the applicant and NRC staff in ensuring that the information is complete, (3) help persons reading the Safety Analysis Report to locate information, and (4) contribute to shortening the time needed for the review process.

INTRODUCTION

A U.S. Nuclear Regulatory Commission (NRC) license is required to receive, possess, and dispose of low-level radioactive waste. The requirements for a license are contained in Title 10 of the Code of Federal Regulations, Part 61 (10 CFR 61), "Licensing Requirements for Land Disposal of Radioactive Waste." 10 CFR 61.10 through 10 CFR 61.16 specify in general terms the information to be supplied in an application for a license to construct and operate a land disposal facility for the purpose of disposing of low-level radioactive waste. The application must contain sufficient information and analyses to provide reasonable assurance that the performance objectives in Subpart C of the regulation will be met.

The application should be comprised of two parts: a Safety Analysis Report (SAR) and an Environmental Report (ER). This document provides guidance to the applicant on the type of information that should be included in the SAR in order to address the regulatory requirements of 10 CFR Part 61, particularly 10 CFR 61.11 through 10 CFR 61.16.

The ER accompanying the license application should be prepared in accordance with Subpart A of 10 CFR 51. Guidance for the preparation of the ER is contained in Regulatory Guide 4.18, "Standard Format and Content of Environmental Reports for Near-Surface Disposal of Radioactive Waste." Information included in the ER may be referenced in the SAR.

The purpose of this document, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility" (hereinafter referred to as NUREG-1199), is to explain in more detail the information that should be provided in the SAR and to establish a standard format for presenting the information. Use of the standard format will (1) help ensure that the SAR contains the information required by 10 CFR 61, (2) aid the applicant and NRC staff in ensuring that the information is complete, (3) help persons reading the SAR to locate information, and (4) contribute to shortening the time needed for the review process.

This version of NUREG-1199 applies to SARs for near-surface low-level radioactive waste disposal. Near-surface disposal encompasses the full range of technology that can be applied to low-level waste disposal near the earth's surface, that is, shallow land burial, deeper burial at depths up to 30 m, and the use of engineered structures, barriers, and other types of structures, some of which may protrude partially above the surface.

NUREG-1199 presents a format for SARs that is acceptable to the NRC staff. However, conformance is not required. The staff will accept SARs with different formats if they provide an adequate basis for the findings requisite to issuing a license. Staff review of SARs with different formats may take longer because the staff is familiar with, and its review procedures are based on, NUREG-1199.

FILING OF THE APPLICATION

The applicant initially will file one original and two copies of the SAR and ER so the staff can determine if they are acceptable for docketing. The documents will be treated initially as tendered documents until the determination is made. A copy of the tendered documents will be available in the NRC Public Document Room, 1717 H Street N.W., Washington, DC. The applicant will be notified of the results of the determination. Requirements for the filing and distribution of the application are given in 10 CFR 61.20 and the Commission's procedures for handling the application are given in 10 CFR 2.101, 2.102, and 2.103.

PROPRIETARY INFORMATION

Proprietary information must be submitted separately. It should be clearly identified and should be accompanied by the applicant's detailed reasons and justifications for requesting that the information be withheld from public disclosure, as specified by 10 CFR 2.790.

STYLE AND COMPOSITION

General Format

The applicant should present the information in the SAR as clearly as possible. Technical bases should support the applicant's claims of the adequacy of the designs or design methods.

The applicant should follow the numbering system and headings of NUREG-1199.

Appendices should be used to provide supplementary information not specifically identified in NUREG-1199.

Abbreviations

Abbreviations should be consistent throughout the SAR and consistent with generally accepted use. Any abbreviations, symbols, or special terms should be defined where they first appear.

Numerical Values

Where appropriate, estimated limits of errors or uncertainty should be given.

Graphics

Graphic presentations--such as drawings, maps, diagrams, sketches, and tables--should be used when they present information more adequately or conveniently than would just a text description. The applicant should ensure that graphic material is legible and that the physical scales are sufficiently large so that the details and notations can be read. Symbols should be clearly defined. A figure or table should be placed within the section of the SAR in which the primary discussion of its contents appears.

(2) Geotechnical and Geophysical Investigations

The scope and results of the geotechnical and geophysical investigations performed to define the occurrence and properties of the underlying materials at both the site and proposed borrow areas should be presented. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," provides general guidance and recommendations for developing investigation programs and for conducting subsurface investigations, including guidance on the spacing and depth of boring and sampling. This should be used as a general guide in developing the field investigations program for a low-level waste disposal facility. The information in the SAR should include the following:

(a) a plot plan(s) clearly showing the outline of the facility and the locations of all borings, probes, pits, trenches, seismic lines, piezometers, and geologic profiles

(b) profiles and adequate number of cross-sections of the site showing the subsoil and rock layering and illustrating in appropriate detail the relationship of the proposed facility to the subsurface materials

(c) logs of borings, probes, pits, trenches, and geophysical investigations in sufficient detail as described in Regulatory Guide 1.132 and the results of the seismic refraction and reflection surveys in detail including tabulation of the dynamic characteristics of the soil and rock materials which were encountered

Field and Laboratory Testing and Engineering Properties

The applicant should provide a detailed and quantitative discussion of the criteria used to determine that the samples were properly taken in accordance with the guidance of Regulatory Guide 1.132 and tested in sufficient number to define all the soil and rock parameters needed for characterizing the site in accordance with the general guidance of Regulatory Guide 1.138. For sites underlain by saturated cohesionless soils and/or sensitive clays, the applicant should show that all zones that could become unstable because of liquefaction or strain-softening phenomena have been sampled and tested to evaluate their liquefaction potential. Methods and procedures currently accepted in the geotechnical engineering profession for testing and determining the engineering properties of soils and rocks should be used. Test methods should be appropriately referenced, and the preparation of laboratory samples should be discussed, when appropriate because of unusual conditions or deviations from standard practice. The information should show that the static and dynamic engineering properties of soils and rocks were properly determined and that reasonable and conservative values were adopted for design. This should include an explanation of how the developed data were used in the analyses, how the test data were enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameters used in design should be presented.

Groundwater Conditions

The scope and format for the information to be submitted on the groundwater conditions at the site are initially given in Section 2.4.2 of this document. However, the following specific information is requested under this section:

(1) the location of the groundwater table and the elevation range of seasonal fluctuations in the groundwater level

(2) the presence of perched, aquifer, and artesian conditions; groundwater movement; hydraulic conductivity and infiltration characteristics of site and borrow materials; hydraulic gradients; and installation details and monitoring records for piezometers and observation wells

(3) design water level as determined by severe design-basis events such as a probable maximum flood

Borrow Materials

Information on fill borrow materials should include the following:

(1) plan showing the limits, grades, and slopes of the area proposed for borrow materials and the location of borings drilled and test pits dug to determine the quantity and type of fill material available

(2) the physical and engineering properties of soil and rock borrow materials, to be used in the construction of the facility, based on adequate explorations and testing; engineering properties should be based on laboratory tests performed on representative samples of borrow material compacted to the same range of density and moisture contents as that to be specified during construction

Stratigraphy and Design Parameters

Information on the stratigraphy and design parameters should include the following:

(1) plot plans, adequate number of cross-sections, and profiles showing subsurface soil and rock layering at the site; the cross-sections should show the location of the borings and data from borings used in developing the soil and rock layering; the stratigraphy should be developed using all the data collected, particularly zones of soft/loose conditions encountered in the explorations

(2) the recommended design parameters based on a reasonable and conservative interpretation of the test data for the soil and rock materials at the site; the recommended design parameters may be presented in a tabular form and also in a graphical form, where appropriate, to demonstrate the conservatism of the recommended values of the design parameters

2.6 Geochemical Characteristics

Water Chemistry

The applicant should provide information on the background and anticipated changes in water chemistry for groundwater and surface water systems that may be affected by site construction and waste disposal and local precipitation. Data on and descriptions of the following parameters should be included:

(1) concentrations of inorganic constituents (including important trace elements), complexing ligands, dissolved gases, organic constituents (including total organic carbon and total organic halogens, stable isotopes (or concentration ratios), and background radionclides

(2) pH, oxidation/reduction conditions determined by various methods, alkalinity, ionic strength, total disolved solids, and density

(3) temperature

(4) nature of colloidal-sized materials

(5) observations of degassing

Data that assess seasonal variations should be provided. The applicant should also provide information on sampling, preservation, storage, and analytical procedures, including details on filter sizes used during sampling and analysis of water samples and analytical detection levels. Information on quality assurance and quality control procedures used during sampling, preservation, storage, and analysis, such as split, spiked, standard, blank samples, and ion balance calculations should also be provided.

Geochemistry of Soils and Rock Units

The applicant should provide information on the classification, identification of the mineralogy, and chemical characterization of the soils and rock units. The applicant should provide information describing sampling, preservation, storage, analytical, and experimental procedures. Information on solubility, ion exchange, and sorption experiments should be provided, including the range of chemical and physical conditions used to bound the results. Information on quality assurance and quality control procedures used during sampling, preservation, storage, analysis, and experimentation should be provided.

Geochemical Modeling

The applicant should provide information on the conceptual models and documentation of codes used to model site geochemistry. Information on validation exercises, data bases (e.g., thermodynamic constraints for aqueous complexation, mineral solubility, and gas solubility reactions and binding constants or distribution coefficients for sorption models), input and output data, and interpretation of results should also be provided.

2.7 Natural Resources

The applicant should provide an analysis (or analyses) demonstrating that there will be no effect on the site that would cause the site to fail to meet the performance objectives in 10 CFR 61 if natural resources were exploited during construction, operation, and closure, after closure, or after the removal of active institutional control.

In addition, the applicant should describe the known natural resources at or near the site, the exploitation of which could result in inadvertent intrusion into the wastes after removal of active institutional control. The applicant

should consider resources such as minerals and hydrocarbons, geothermal energy sources, sand and gravel, timber, and water. The description should include information such as the types of resources, their location, and current and projected uses. (Some or all of this information may be referenced in the Environmental Report.)

2.7.1 Geologic Resources

The applicant should document the information required by the NRC staff to review SAR sections on known natural resources at the proposed disposal site. The applicant should be able to show compliance with 10 CFR 61.12(h) and 61.50(a)(4).

The applicant should demonstrate that there will be no natural resources at the proposed site which, if exploited, would result in inadvertent intrusion into the disposal site after removal of active institutional control. The applicant should further show that if known natural resources in the site area are exploited during construction, operation, and closure, or after closure, the site will not be compromised. License requirements apply to resources that may occur near or at the ground surface, in hydrologic units used for disposal or isolation, and at depths that require excavation or drilling through the disposal units.

"Known resources" are those resources designated in U.S. Geological Survey Circular 831 as "identified resources." Identified resources would include measured, indicated, and inferred resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Geologic evidence includes, but is not limited to, assays, geologic maps, geophysical and geochemical surveys, and core logs.

Information Needs

The applicant should describe natural resources occurring at or near the site. Resources include metallic and nonmetallic minerals and ores; fuels, such as peat, lignite, and coal; hydrocarbons, including gas, oil, tar sands, and asphalt; geothermal resources; industrial mineral deposits, such as sand and gravel, clays, aggregate sources, shales, and building stone; timber; agricultural lands; and waters in the form of brines. Potable, agricultural, or industrial ground or surface waters are addressed in Section 2.4. Description of these resources should include information on resource type, occurrence, location, extent, net worth, recoverability, and current and projected use. The applicant should address economic, marginally economic, or subeconomic known or identified natural resources as defined in U.S. Geological Survey Circular 831.

The identification of mineral, fuel, and hydrocarbon resources should not be limited to the site and should include areas of known resources near and surrounding the site which, if exploited, would compromise the safety of the site. The applicant should identify known resources through field observations as well as through research of published and unpublished reports and records. The SAR should include maps showing all active and abandoned wells, boreholes, and excavations at the site. Those wells, boreholes, and excavations that preceded site characterization should be distinguished from those that were part of site characterization. Borehole logs should accompany maps. Maps depicting areal geology - including lithologic units, structure, and stratigraphic relationships; current land use; and locations of all active or abandoned mines, quarries,

(6) List of invertebrate species of local importance or concern as disease vectors or pests. Detailed field surveys of all insect populations are not required (from the ER and consultation with local, State, and Federal agencies).

(7) Estimates of the relative abundance of both commercially and recreationally important game and nongame vertebrates (from the ER and consultation with local, State, and Federal agencies).

Offsite Areas

(1) Major vegetation types hydraulically or eolically downgradient (from the ER and site visit and through consultation with local, State, and Federal agencies).

(2) List of commercially or recreationally important vertebrate animals known to occur eolically and hydraulically downgradient of the facility to a distance of 5 km.

(3) List of other vertebrate species important to facility performance known to occur within 25 km or migratory distance, whichever is less, from the facility.

(4) List of invertebrate species of local importance or concern as disease vectors or pests. Detailed field surveys of insect populations are not needed (from the ER and consultation with local, State, and Federal agencies).

2.9 Preoperational Environmental Monitoring

The applicant's development of the preoperational environmental monitoring program may draw on information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site, which should be provided under other sections of the SAR.

In this section, the applicant should describe the organizational structure of the environmental monitoring program as required by 10 CFR 61.11(b)(1); the technical qualifications of the monitoring staff, including training and experience as required by 10 CFR 61.11(b)(2); and the training program for the applicant's staff as required by 10 CFR 61.11(b)(3).

This environmental monitoring and surveillance plan should consider both onsite and offsite measurements in air, water, soil, vegetation, local fauna, and local sources of food. The applicant should provide the rationale for

(1) the location of the monitoring points

(2) the media to be sampled at each location

(3) the frequency of sample collection at each location

(4) the selection of the radiological and nonradiological constituents of the samples taken from each media that are to be sampled and analyzed

(5) the instrumentation and methods selected for field sampling, surveys, and laboratory analysis

(6) the processing of the sample, including the types and frequencies of analyses (e.g., gamma spectroscopy and chemical oxygen demand) and the minimum detectable amounts and lower limits of detection for each constituent that is to be analyzed

(7) the statistical basis to be used for comparing the baseline measurements to the corresponding measurements in the operational and postclosure periods of site operation, that is, a definition of a significant difference in measurement results as required by 10 CFR 61.80(vi)

(8) the format proposed for annual reports of environmental monitoring results to be submitted to the NRC as required by 10 CFR 61.80(i)(1)

The applicant should describe the quality assurance measures and the quality control procedures for all aspects of the environmental monitoring program (e.g., testing, maintenance, and calibration of instruments; checks on sampling procedures; and laboratory analysis).

(d) the construction operations, and their sequence, that are planned for the actual placement of the waste containers and the backfill materials

(6) Closure of Individual Disposal Units

The information on closure should include the various construction features of materials to be placed in the cover above the backfilled waste. For many of the types of material to be placed in the exavation cover, the applicant should provide information that is similar to that previously identified for fill areas and quality control testing in this section for the construction of disposal units. Any unique consideration for these materials such as using specific construction methods that will prevent undesirable mixing or contamination of the different materials in the excavation cover should be discussed by the applicant. Special manufacturing, handling, or placement requirements for intruder barrier materials or geotechnical fabric should be identified and discussed.

(7) Applicable Codes, Standards, and Specifications

The applicant should provide information on design and construction codes, standards, and specifications that were applied in the design and that will be applied in the construction of the facility.

(8) Construction Materials and Quality Assurance

The applicant should provide information on the materials that will be used in the construction of the disposal facility. Among the major materials of construction that may be used are the disposal unit excavation and fill materials, concrete and grouting ingredients, reinforcing bars, and structural steel. If any material not used previously in NRC-licensed facilities is proposed, the applicant is required to provide sufficient testing and user data to establish the acceptability of the material. The applicant's quality control procedures and construction techniques directed at ensuring that there will not be degradation in material quality are also reviewed.

(9) Site Plans, Engineering Drawings, and Construction Specifications

The applicant should provide site plans and engineering drawings that clearly convey the design features. The engineering drawings should show dimensions, sections, and relative locations of the various facilities within the disposal site boundary. All plans and drawings should be drawn to a scale large enough to convey the design information adequately and should be signed by a licensed engineer. As-built condition should ultimately be documented by the applicant as a permanent record for the constructed disposal facility. Construction specifications should be compatible and consistent with the design and operation requirements. The contents and procedures specified in the specifications should conform to the applicable industry codes and standards.

3.3.2 Construction Equipment

The applicant should provide information on equipment to be used for construction and off-loading, handling, transporting, and placing waste at the disposal

facility. The information should include the equipment types, manufacturer's specifications, and the capabilities of selected equipment to safely handle the waste. Provisions for storage, maintenance, replacement, and inspection of equipment should also be provided. The applicant also should describe the quality assurance and quality control programs for purchasing, handling, replacing, and maintaining equipment to ensure that the equipment will perform reliably and will not impair the quality and proper functioning of the waste disposal facility.

3.3A Construction and Operation Considerations for Below-Ground Vaults and Earth-Mounded Concrete Bunkers

The applicant should describe the construction materials and construction methods and disposal operations for the engineered BGV or EMCB structures where low-level waste is to be placed. The major considerations and features to be described include the properties of the construction materials, particularly its quality and durability, and the major construction and operational procedures to be followed, including the measures to avoid long-term adverse impacts on adjacent filled and closed disposal vaults.

Construction Materials Quality and Durability

The information on the construction materials quality and durability characteristics should include the types of materials to be used with a description of their properties and engineering characteristics. The applicant should provide supporting data and test results on the proposed materials that are based on either proven inservice performance records, where applicable, or testing of representative samples using accepted and recognized codes and standards. The quality and durability considerations that should be discussed include the resistance of the materials to (1) freezing and thawing; (2) humidity; (3) aging; (4) fatigue; (5) sulfate, chloride, and acid attack; (6) toxic material attack; (7) abrasion; (8) temperature changes; (9) wetting and drying; (10) radiation; (11) biodegradation; (12) electrolysis; and (13) shrinkage and cracking.

NUREG/CR-5041, Section 2.3, provides guidance on the information that should be provided for the various types of material (Portland cement concrete, steel, moisture barriers, and geosynthetics) likely to be used in the construction of a BGV or EMCB. For example, the information on Portland cement concrete would include the type of cement, mixing water, coarse and fine aggregates and admixtures. The applicant should identify the engineering properties of the materials to be required in construction, such as the minimum unconfined compressive strength of concrete at 28 days of age. The applicant also should identify any deviations from the accepted and recognized codes and test standards and the basis for the deviation.

Construction Methods and Disposal Operations

The applicant should describe the major construction methods and operational procedures to be completed, including (1) site preparations for the proposed structure (surveying, clearing, draining, excavation, and foundation surface

preparation); (2) installation of the permanent drainage system (drainage blanket, perimeter drains and pipes, and collector sumps); (3) installation of monitoring wells; (4) vault construction (formwork; steel reinforcement placement; formation of joints in concrete; concrete mix proportioning, batching, mixing, and casting operations; form removal; and placement of moisture barriers); (5) waste disposal operations (placement of packages, filling voids around waste packages, closing of vault openings, placing and compacting of fill, and measures to protect facility workers); and (6) closure of individual disposal units (method for sealing access openings, method for placing materials over the completed vaults, identification of time period permitted to expire before placing sufficient cover materials over the closed units with proper drainage) including measures to avoid damage to or disturbance of adjacent completed units. Further guidance is provided in Section 2.4 of NUREG/CR-5041.

3.4 Design of Auxiliary Systems and Facilities

3.4.1 Utility Systems

The applicant should describe the utility systems of the proposed facility, how each system provides support required by the operational needs of the proposed facility, and any adverse affects that the utility system design or potential failure could have on overall facility performance in meeting 10 CFR 61 requirements.

The applicant should describe all utility systems including communication, electric, water, lighting, sanitary waste disposal, fuel delivery, and any other utility system installed at the facility. The following information should be provided for each system: (1) an accurate description of system components; (2) an identification of which functional requirements of the principal design features in Section 3.1, if any, are supported; (3) design bases, criteria, codes, and standards used for design; and (4) any potential adverse effects on principal design features or overall facility performance that might result from failure of the utility system.

3.4.2 Auxiliary Facilities

The applicant should describe the auxiliary facilities of the proposed facility, how the auxiliary facilities support the operational needs or construction requirements of the facility, and any adverse effects that the auxiliary facility design or failure could have on overall facility performance.

The applicant should describe the auxiliary buildings required to support construction or operation of the facility and should present (1) the overall layout and design of auxiliary buildings; (2) the purpose for each building; (3) design criteria, codes, and standards used in design; and (4) potential adverse effects of building design or building failure on the overall waste disposal facility performance.

The applicant also should describe the traffic systems required to support construction or operation of the facility, and should include (1) the overall traffic system design including layouts of roadways and/or railways, (2) the purpose of the traffic system components, (3) the materials used in construction, (4) traffic controls, and (5) potential adverse effects of traffic system design or component failure on overall facility performance.

The applicant should describe any auxiliary facility that is in addition to buildings and traffic systems and identify any potential adverse effects that its design or failure could have on overall facility performance.

3.4.3 Fire Protection System

The applicant should describe the fire protection system and the system's capability to safely protect the disposal facility and workers from radiation and fire hazards if an accidental fire should occur. The fire protection system includes the equipment, procedures, training, management, and emergency planning required for fire protection at the facility.

The applicant should postulate accidental fire scenarios and describe the potential consequences of the accidental fires where the postulated fires could occur in areas important to radiological safety such as the waste receipt area, the waste handling area, the waste storage area, and the disposal unit areas. Both normal operating and abnormal and/or accident conditions should be considered in the postulation and analysis of accidental fires. The fire analysis should include the locations of the fire assumed to produce the severest conditions, the construction arrangement of affected structures, the materials likely to be consumed, and the safety and health effects of the smoke and heat associated with the fire.

The applicant should describe (1) the management's plan for responding to a fire emergency; (2) the procedures, materials, and equipment that will be in place for use during a fire emergency; (3) the procedures and equipment for providing offsite alarms, if required; and (4) the training programs for facility personnel both for the prevention of fires and for responding to fire emergencies. The applicant should show how the prescribed provisions and recommendations of National Fire Protection Association Codes, NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials," and NFPA 901-1981, "Uniform Coding for Fire Protection," have been implemented in the fire protection system proposed for the waste disposal facility.

The applicant should describe the equipment to be used in preventing and responding to fires and should include building materials; fire detection equipment; sprinklers; onsite and offsite alarm systems; wet, dry, and chemical fire extinguishers; and foam extinguishing systems.

The applicant should describe the emergency response to a fire by facility personnel, the provisions for notification of the public of potential radiological hazards, and the evacuation measures for facility personnel and nearby residents, if these measures are required.

3.4.4 Erosion and Flood Control System

The applicant should provide hydrologic analyses and design details of the site flood control system to demonstrate that the requirements of 10 CFR 61.51(a) are met. Those features that will provide protection against erosion and flooding during the operational period should be fully described. The information and analyses should conclusively document that, in accordance with 10 CFR 61.51(a)(4), (a)(5), and (a)(6), surface features have been designed to direct surface drainage away from disposal units at velocities and gradients that will not result in flooding or erosion.

4 FACILITY OPERATIONS

4.1 Receipt and Inspection of Waste

The applicant should describe the procedures or contracts in place that will ensure that arriving shipments comply with applicable Federal regulations and waste acceptance criteria that might be incorporated into the disposal facility license as conditions. These regulations and acceptance criteria should govern the acceptability of waste packages for routine handling operations and for long-term disposal.

Specifically, information on the following procedures should be provided:

(1) Procedures for visual examination of the shipping documents, including any required compliance certificates and the waste manifest required by 10 CFR 20.311.

(2) Procedures for visual examination of the waste package to ascertain if there are any irregularities in markings, labels, or probable waste contents and if the package is correctly described on the waste manifest as to its size, type, and waste contents; visual procedures in place to ensure that the "routine determinations" required by 10 CFR 71.87 are met.

(3) Procedures to ensure verification surveys of the non-fixed (removable) radioactive contamination on the external surfaces of packages as required by 10 CFR 71.87 and 49 CFR 173.443 and procedures to verify that the external radiation levels around waste packages and transporting vehicles are within the limits of 10 CFR 71.47 and 49 CFR 173.441.

(4) Procedures and information on testing and test equipment to be used to verify the accuracy of the waste class reported on the waste manifest. These procedures should include a proposed frequency for performing waste classification testing.

(5) Procedures and information on testing and test equipment to be used to analytically verify that waste characteristics and waste form requirements are met and that the waste contains no hazardous constituents as determined by U.S. Environmental Protection Agency regulations 49 CFR 261. These procedures should include a proposed frequency for performing waste form testing.

(6) Other procedures required to ensure that all waste acceptance criteria are met.

4.2 Waste Handling and Interim Storage

The applicant should provide information on the waste handling and interim waste storage operations to be performed at the disposal facility following acceptance and receipt of the waste packages. The applicant should describe the operations in sufficient detail to demonstrate that the waste will be handled

safely and stored in a manner that will prevent contact of water with the stored waste. Waste handling information to be provided should include the procedures and equipment that will be used to move the waste from the area of receipt to the permanent location of the disposal unit or, alternatively, to a location of interim storage. The applicant's description of the waste handling operations should include the procedures and equipment to be used in properly identifying and segregating the Class A, Class B, and Class C wastes for disposal. Interim waste storage information to be provided should include the buildings, restricted areas, procedures, and equipment that will be used to store waste after receipt for a short period of time before permanent disposal.

The information on waste handling should include procedures to protect facility workers during handling (training to ensure safe radiological control, decontamination provisions, use of protective clothing, etc.) and a description of the handling operations (off-loading procedures, anticipated rigging for the various types and sizes of containers, unloading equipment, etc.). The description of handling procedures should cover contingency plans for damaged waste packages and proposed procedures for repackaging.

The information on interim storage should include (1) a description of the conditions that would warrant temporary storage of the waste packages, (2) the maximum time that storage would be permitted, and (3) the applicant's procedures for maintaining a storage log and inventory with appropriate radiological monitoring provisions to ensure that above-ground storage limits were not exceeded. The applicant should describe the storage locations and facilities and the measures to be used to to protect the waste from precipitation and adverse weather conditions, including surface water runoff that might come in contact with temporarily stored waste.

4.3 Waste Disposal Operations

The applicant should present information on all the waste disposal operations and procedures beyond waste handling and interim storage (if storage is required) from the actual emplacement of the waste into the individual disposal units up to closure and stabilization operations in the individual units. The applicant should discuss site closure operations pertaining to, for example, final site grading across several disposal units to ensure the proper handling of surface water runoff and long-term settlement/subsidence in other sections of the SAR.

The major operations for waste disposal that should be described by the applicant in this section include waste emplacement in the individual units while maintaining the integrity of waste packages, minimizing void spaces between waste packages by controlling placement and stacking arrangements, filling the void spaces between packages to minimize future settlements, covering the emplaced wastes to ensure that surface radiation doses will meet regulatory limits, locating the individual units including permanent mapping and marking of unit boundaries and contents, closure and stabilization of individual disposal units, and allowance for a buffer zone around and beneath the disposal facility.

Waste Emplacement

The information on waste emplacement should include the operations and procedures for actually placing unstable Class A wastes and stable Class A, Class B,

protected with properly designed and durable filter materials to prevent clogging of drains in the long term. The final grading of the site cover should accommodate without any adverse effects the long-term settlement and/or subsidence expected at the site.

(2) The proposed monitoring of the settlement of the disposal unit excavation cover and infiltration into the disposal unit excavations during the site-closure phase and the initial 5 years during the observation and surveillance period. This monitoring program should be similar in scope to that provided for the pre-site-closure phase. The scope or the extent of monitoring may be ultimately modified on the basis of the observations recorded and the evaluation of the preclosure monitoring data to fulfill long-term monitoring requirements.

(3) The evaluation of the long-term stability (static and dynamic stability) of all permanent slopes at the site and the long-term settlement and/or subsidence at the site, as it applies to the geotechnical aspects of site closure phase. Sections 6.3.2 and 6.3.3 provide information on long-term stability and settlement evaluations.

The information on the geotechnical aspects of site closure should be adequate for the staff to judge the applicant's conclusions on the performance requirement of reasonable assurance that the disposal site will not experience instability of slopes, excessive settlement and/or subsidence, and infiltration of water into the backfilled disposal unit excavations and will not require active maintenance during the institutional control period.

5.1A Site Closure and Stabilization Considerations for Below-Ground Vaults and Earth-Mounded Concrete Bunkers

The applicant should provide information on site closure and stabilization at facilities where below-ground vaults (BGVs) or earth-mounded concrete bunkers (EMCBs) are to be constructed. This information should include (1) the provisions of a structural performance monitoring program that will verify important structural design assumptions and confirm structural performance and stability after site closure, (2) the design and construction features of the filter and drainage systems that are to be installed around and below the disposal vaults to safely control conservatively estimated flow quantities, and (3) the design and construction features of the waste cover system that will demonstrate that the cover will provide protection against radiation and protection for inadvertent intruders and will minimize infiltration and ensure long-term stability without the need for active maintenance.

NUREG/CR-5041, Sections 2.6, 2.7, and 2.8, provides guidance on the information to be provided on structural performance monitoring, filter and drainage systems, and the waste cover system.

Structural Performance Monitoring

The information on structural performance monitoring should include a description of the types and locations of instruments to be installed and the scope of the monitoring program. This information should include the specific parameters to be monitored (loads, stresses, deformations, strains, water levels, and flow

quantities in the drainage collector sumps), typical installation details and installation procedures for each type of instrument including plans for replacing inoperative instruments, the frequency and duration of proposed monitoring, the procedures for evaluating the recorded data and observations including identification of the experience and qualification requirements for pertinent personnel, the limiting values of measured structural parameters and the bases for establishing these values, and the procedures to be followed for remedial action if the limiting values are approached.

Filter and Drainage Systems

The information on filter and drainage systems to be installed around and below concrete disposal vaults should include a description of (1) the features to be installed; (2) the type and size of drainage pipes, filter and drainage materials; and (3) other features along with the results of design computations supporting the established drainage rates and capacities. The information on filters should describe (1) how the materials selected fulfill the filter criteria (prevent internal erosion and piping and provide required perviousness); (2) the provisions for ensuring proper controls on gradation, placement, and compaction, and (3) how the properties of the selected materials were considered in addressing long-term performance and compatibility in the anticipated disposal environment. The applicant would also need to describe the type of fill material and the method of placement for fill around the waste packages within the vaults.

Additional information on features of the drainage system to be provided by the applicant should include (1) the capability of the drainage features to resist corrosion, encrustation, and clogging and measures that would be taken to restore clogged or ineffective drains; (2) internal drainage provisions (slope of concrete vault floor, size and shape of drain openings, and method for acceptance testing); (3) the location and configuration of collector sumps with procedures for determining inflow quantities and the chemical constituents in the collected flows; and (4) the procedures for ensuring proper controls on gradation, placement, and compaction of drainage materials.

Waste Cover System

The information on the waste cover system to be constructed over the completed engineered BGV or EMCB structure should include details on (1) the vault roof (materials, provisions for supporting the roof and minimizing void spaces over the waste and beneath the roof slab, measures for sloping to promote drainage and for sealing and controlling cracks to prevent infiltration, and reliance as an intruder barrier, if assumed, with supporting basis); (2) low-permeability cover materials (e.g., geomembranes, bentonite panels, and clay soils) including appropriate industrial standards and pertinent engineering characteristics (e.g., maximum coefficient of permeability to be permitted); (3) placement methods (e.g. for soils, the lift thicknesses, specified degree of compaction, and controls for placement moisture content); and (4) the acceptance testing methods and frequency.

The applicant should provide information on the outermost cover material (topsoil and vegetation or rock protection) to resist erosional forces along with

- the effects of the assumptions inherent in the method of analysis that was used on the resulting margins of safety

(b) Dynamic Stability

For the dynamic stability analyses, the following features should be described and assessed:

- The appropriateness of the typical cross-section of the slope analyzed and the soil parameters used in the analysis.

- The appropriateness of the method of dynamic stability analysis used. This may be decided on a case-by-case basis depending on the level of earthquake shaking, the types of soils in the slope, and the consequences of a seismically induced failure of the slope. The selection of the method of dynamic stability analysis should be adequately justified.

- Failure surfaces (slip circle, sliding plane, etc.) corresponding to the lowest factor of safety obtained in the analyses for the anticipated conditions of loading (e.g., long-term, seismic, and flooding).

- The effect of the assumptions inherent in the method of analysis that was used on the resulting margins of safety. The factors of safety calculated should be identified and will be evaluated on a case-by-case basis by the staff depending on the conservatisms in the data base, design assumption, and method of analysis that was used.

(c) Liquefaction Potential

If the slope or foundation materials at the site of the facility are saturated, loose, cohesionless soils, then the applicant should analyze the liquefaction potential of these materials for long-term stability considerations. The information should include the following:

- The method of analysis selected and the basis for its selection. The need for a detailed liquefaction analysis should be determined on a case-by-case basis and should consider the level of earthquake shaking, site stratigraphy, critical soil parameters (relative density, standard penetration test (SPT), percent fines, etc.), and the consequences of a liquefaction-induced failure.

- For the method of analysis used, the appropriateness of the soil parameters used in the liquefaction potential analysis should be adequately justified.

- The appropriateness of the computed factor of safety and its physical significance in the context of the method of analysis used should be explained.

6.3.3 Settlement and Subsidence

The applicant should address the long-term settlement and/or subsidence aspects of the proposed facility design in accordance with the performance objectives and technical requirements of 10 CFR 61. The settlement and/or subsidence of the individual disposal unit excavation cover and the disposal site should be evaluated to determine if the settlement and/or subsidence would adversely affect the facility's meeting the performance objectives in Subpart C of 10 CFR 61. Information on settlement and/or subsidence should include (1) the results of site characterization, details of disposal unit excavation and waste emplacement and backfilling during the operations phase, and details of disposal unit excavation cover design and construction; (2) modeling for the settlement analysis; (3) the uncertainties in the settlement analysis; and (4) commitments for remedial actions if settlement would adversely affect the facility's meeting its performance objectives. If any information that should be presented in this section of the SAR is presented in other sections, it does not have to be repeated here, but the appropriate sections should be referenced.

Site Data

(1) Site Characteristics

Information required to identify the areas potentially susceptible to settlement and the engineering properties of various materials needed for the evaluation of settlement should be presented in this section. The information on site characteristics, either by reference to appropriate sections of Sections 2.3, 2.4, 2.5, and 2.6 or by presentation of additional data in this section, should include the following:

(a) Plot plan(s) clearly showing the outline of the facility and the locations of all site explorations with the location of the areas selected for settlement investigation.

(b) Profiles and cross-sections of the areas selected for settlement evaluation, illustrating in appropriate detail the relationship of the proposed facility structures and components to the subsurface materials.

(c) Logs of borings, probes, pits, and trenches considered in developing the stratigraphy used in the settlement analysis.

(d) The description and test results for the engineering properties of materials underlying the site. Guidance is provided in Regulatory Guide 1.138 for soil testing. The properties of these materials must be supported by field and laboratory test records. The applicant should demonstrate that the parameters required for the settlement analyses were properly determined and that reasonable and conservative values were used in the analyses. The applicant should explain how the developed data were used in the analyses, how the test data are enveloped in design, and why the design envelope is conservative. A table indicating the values of the parameters used in the settlement analyses should be provided.

9.0 QUALITY ASSURANCE*

To ensure that the performance objectives of 10 CFR Part 61 will be accomplished and can be demonstrated, it is suggested that the applicant establish a quality assurance (QA) program as an expansion of the quality control program required by 10 CFR 61.12(j). The QA program may be used to provide a multidisciplinary system of management controls backed by quality verification and overview activities that demonstrate completeness and appropriateness of achieved quality. An effectively planned and executed quality assurance program should include the participation of all organizations. The policies and procedures for implementing the program should describe integrated technical and administrative activities that will ensure successful accomplishment of the performance objectives of 10 CFR Part 61 and the design bases stated in the application. In this section of the application, the applicant should describe the QA program that will be established and executed in determining the characteristics of natural disposal, during design, construction and operation of the facility. The QA program should include a description of controls and verifications to be exercised during the development and use of computer codes. The applicant should describe how the QA program will be established at the earliest practical time consistent with the schedule for performing the activity to which it applies.

The applicant should provide the description of the QA program in sufficient detail to permit the NRC to determine the adequacy of the planned implementation. Insufficient detail is likely to result in formal requests for additional information by the NRC and answers by the applicant.

The applicant should provide the description of the QA program in the application for each major participating organization. The applicant may provide the descriptions of the QA programs separately or integrally for all organizations, keeping in mind that the NRC must be able to assess the adequacy of the planned implementation.

The criteria that should be addressed in the applicant's and major participant's QA programs are listed and described below. It is recommended that the descriptions of the QA programs address each criterion in the order in which they appear in this section. Should the applicant conclude that one or more criterion will not apply, the justification should be clearly stated to permit the NRC to evaluate the conclusions reached.

9.1 Quality Assurance During Design, Construction, and Operation

9.1.1 Organization

The applicant should clearly describe the authority and responsibilities of organizations performing "quality achieving" and "quality assuring" functions. "Quality achievement" is defined as satisfactory performance of a work activity, such as drilling, designing, constructing and testing, in accordance with

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*Quality assurance is not currently specified as a regulatory requirement in 10 CFR Part 61. The NRC staff is in the process of correcting this omission through proposed rulemaking.

the performance objectives have been correctly performed. The description should make clear the assignment of responsibility for establishing and executing the quality assurance program. The organizational responsibilities should reflect an integration of the technical, administrative and quality achieving and quality assuring functions such that the quality assurance program elements are threaded throughout the entire organizational structure and are an integral part of day-to-day operations.

The applicant should provide organizational charts and functional responsibility descriptions that denote the lines of responsibility and areas of authority within each of the major organizations in the project. These charts and descriptions should present the structure of the QA organizations as well as other functional organizations performing activities affecting quality of the design and construction of the facility. In addition, a single project organization chart should be provided showing how the major organizations or companies working directly for the applicant on the project interrelate with one another. The chart should reflect the control exercised by the applicant to ensure that the quality of work is performed by the lowest tier supplier or subcontractor is adequate to support accomplishment of the performance objectives.

The applicant should describe the measures that ensure that persons and organizations performing "quality assuring" functions have sufficient authority and organizational freedom to (1) identify quality problems; (2) initiate, recommend or provide solutions; and (3) verify implementation of solutions. The applicant should describe the measures that ensure that persons and organizations assigned the responsibility for checking, auditing, inspecting or otherwise verifying correct performance of an activity report to a management level in order to provide required authority and organizational freedom, including sufficient independence from pressures of cost and schedule.

Irrespective of the organizational structure, the applicant should describe how the individual or individuals with primary responsibility for ensuring effective implementation of the QA program at any location where activities subject to the control of the QA program are being performed will have direct access to such levels of management as may be necessary to carry out this responsibility. The applicant should indicate from whom the persons performing quality assuring functions receive technical direction for performing quality assuring tasks and administrative control (salary review, hire and/or fire, position assignment). The applicant should identify those positions or organizations that have written delegated responsibility and authority to stop work or control further processing, delivery, installation or use of nonconforming items until proper disposition of the deficient item has been approved.

The applicant should describe how requirements will be imposed on contractors and subcontractors to ensure that individuals or groups within their organizations performing quality assuring functions have sufficient authority and organizational freedom to effectively implement their respective QA programs.

The applicant should describe the extent to which it will delegate to other contractors the work of establishing and executing the QA program or any part thereof. The QA functions that are implemented within the applicant's QA organization and those that are delegated to other organizations should be

(c) If any persons or organized group of persons, directly or indirectly, own, control, or hold the power to vote 10 percent or more of the outstanding voting securities of the applicant, a detailed explanation of each such relationship should be provided.

(2) Description of Applicant's Operations

The applicant should describe the service to be provided and the acquisition, construction, operations, and extension of the facility including the proposed dates for the beginning and completion of construction and operations, as well as the provisions for long-term care.

(3) Applicant's Financing Plan

The applicant is encouraged to propose a detailed financing plan for the proposed facility that will enable the staff to determine how the facility will be financed. This should include, but not be limited to the following:

(a) If a State or compact authority has agreed to finance, guarantee, or underwrite any portions of the construction, operation, closure, or long-term care of the facility, the applicant should provide notarized copies of any such contracts with these parties. It should provide an explanation of the amount, length, and type of financial commitment in regard to this arrangement.

(b) The applicant should provide a statement explaining the extent to which it will rely on short-term financing in connection with the proposed construction, and statements tending to substantiate the fact that such short-term loans will be made available.

(c) The applicant should provide a detailed description of its outstanding and proposed securities and liabilities, showing amount (face value and number), interest or dividend rate, dates of issue and maturity, voting privileges, and principal terms and conditions applicable to each.

(d) The applicant should provide copies of the company's independently audited, financial reports for the past 3 years. As minimum, this must include balance sheets, and income statements (both in consolidated form if available), accumulated retained earnings statement, and a statement of changes in financial position (sources and uses of funds statement).

(e) The applicant should provide a statement of anticipated cash flow, including provisions during the construction period and the first three full years of operation for paying interest and dividends and for retiring debt issues.

(f) The applicant should provide a statement showing, over the life of each issue, the annual amount of securities it expects to retire through a sinking fund or other extinguishment of indebtedness.

(g) The applicant should provide comparative pro forma balance sheets and income statements for the construction period and each of the first three full years of operation giving the effect of the construction and financing of the project.

(h) The applicant should submit pro forma statements for each of the first three full years of operation showing (i) annual revenues subdivided by type of service to be provided and (ii) annual operating expenses including property and labor costs, depreciation, depletion, taxes, rate of return on net investment, including working capital. If the applicant is a public authority, it should provide similar data and amortization interest schedules for the life of each bond issue related to the facility.

(i) The applicant should provide a statement of the proposed rates to be charged for the services to be rendered at the facility, including all charges for closure and long-term care.

(j) The applicant should provide a statement explaining the type and amount of property and liability insurance that will be obtained for the facility, along with copies of such policies and any attached riders.

(k) The applicant should provide any additional data and information on sources on which it proposes to rely, showing the adequacy and availability of resources for financing the project.

(4) Other Applicable Information

(a) If the applicant has a parent or holding company, it should provide copies of any fiduciary guarantees provided by the parent or holding company with regard to this project.

(b) If the applicant is required to submit Form 10K or Form 10Q to the U.S. Securities and Exchange Commission, it should provide copies of these reports for the last 5 years.

(c) If the applicant's company is evaluated by a bond rating service such as Moody's Investors Service, Inc., or Standard and Poor's Corporation, it should provide copies of these ratings for the last 3 years.

(d) The applicant should provide a brief description of any litigation in which it is involved that might have a negative economic effect on the operations at the facility.

10.2 Funding Assurances

The applicant should demonstrate that the requirements of 10 CFR 61.62(a) through (g) have been met. Additionally, the party offering a guarantee must demonstrate that it has the legal authority to provide this kind of financial assurance in the State where the proposed low-level waste disposal site is located.

The applicant also should provide an estimate of the cost of disposal site closure and stabilization in accordance with its plan for site closure and stabilization. The applicant should identify the source(s) for the funds necessary to pay the cost of decommissioning and closing the proposed facility. The applicant should provide a detailed breakdown, including an explanation of assumptions used in the cost calculations.

Specific Acceptable Financial Assurances

The applicant should follow the guidance given below on the types of financial assurances the staff has found acceptable.

(1) Sureties or Performance Bonds

A bond is a contract that an applicant (sometimes called the principal) can enter into with a qualified surety company (sometimes called the surety).

Under this contract, the surety company guarantees to the NRC (sometimes called the obligee) that specified activities will be performed. The applicant should pay the surety for this guarantee, since the surety company will be liable for these obligations if the applicant fails to perform the activities.

The surety bond should provide guarantee that funds will be available for closure of the facility by the applicant in accordance with the Commission-approved plan for site closure and stabilization. The bond must continue to provide coverage during the postclosure observation and maintenance period before a license is terminated.

Should the applicant default, a surety company may fulfill its obligations under such a bond by securing the performance of activities in accordance with the plan for site closure and stabilization. This bond limits the liability of the surety company to the face amount of the bond, called the penal sum. As cost estimates increase, this penal sum may be increased on agreement of the applicant and the surety company. The bond may provide, by an optional rider, that the penal sum can be increased up to 20 percent in any year without a new agreement between the parties.

An acceptable bond for the purposes of this chapter should meet the following criteria:

(a) An applicant wishing to use a surety bond should establish a standby trust fund at the same time if it does not wish to have the State as the named beneficiary. Both the bond and standby trust agreement should be submitted as evidence of financial assurance.

(b) The surety bond should contain terms so that any funds drawn under it would be placed directly into the standby trust fund by the institution making the payment. (In this regard, the Commission is following the approach of the U.S. Environmental Protection Agency (EPA), which imposed this requirement pursuant to the Resource Conservation and Recovery Act after it found that without such a mechanism, any funds drawn under a surety bond that would be payable

to the EPA would have to be paid into the U.S. Treasury and could not be used specifically to pay for closure and postclosure care of a hazardous waste facility (U.S.C 3303(b).)

(c) An applicant wishing to use a bond should first enter into a contract with a qualified surety. The NRC staff considers qualified sureties to be those listed by the U.S. Department of the Treasury in Circular 570, which is published annually on approximately July 1, and then updated in the Federal Register. The circular also lists the maximum amount that each surety can guarantee in one bond; this amount is called the underwriting limitation. (A surety company can only issue a surety bond exceeding that amount which it brings another company into the surety agreement to help share the risk. Several sureties acting together, however, may not exceed the total of their individual underwriting limitations.) Finally, Circular 570 lists those States where each qualified surety is licensed to enter into a surety bond; a surety bond used to meet the NRC financial assurance requirements should be signed in one of those States.

(d) In order to be considered adequate, the penal sum of the surety bond should be in an amount at least equal to the cost estimates in the plan for site closure and stabilization, plus the cost estimates for long-term care. An applicant wishing to use this instrument should verify that the amount and the terms and conditions are satisfactory to the NRC during the licensing review. The wording for surety bonds should be similar to that recommended in Appendices 10.A and 10.B.

(2) Letters of Credit

A letter of credit is a binding arrangement by which the credit of one party, such as a bank, is extended on behalf of a second party, called the account party, to a third party, the beneficiary. The first party, the issuer, allows the beneficiary to draw funds on the presentation of documents in accordance with the terms of the letter of credit.

The applicant is the account party, the financial institution is the issuer, and the NRC is the named beneficiary. The letter of credit allowed for NRC applicants for financial assurance is different in two major ways from standard commercial versions,

- The NRC version can only be cancelled with 120 days' notice before the current expiration date.

- The NRC version must be extended automatically for at least 1 year if it is not cancelled. Therefore, although many financial institutions may be qualified, it is not certain how many will be willing to provide a letter of credit for this purpose.

The issuer offers this assurance in exchange for a fee paid by the applicant. The applicant also undertakes to repay, with interest, any funds drawn through the letter of credit. Although the NRC suggests that the wording of the letter of credit be similar to the language shown in Appendix 10.C, the terms of the credit arrangement between the applicant and the issuer will depend on individual circumstances and negotiations.

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The Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, NUREG-1199, discusses the information to be provided in the Safety Analysis Report and establishes a uniform format for presenting the information required to meet the licensing requirements for land disposal of radioactive waste as required by 10 CFR 61.

The use of the Standard Format will (1) help ensure that the Safety Analysis Report (SAR) contains the information required by 10CFR 61, (2) aid the applicant in ensuring that the information is complete, (3) help persons reading the SAR to locate information, and (4) contribute to shortening the time required for the review process.

The Standard Format and Content (NUREG-1199) ensures that the information required to perform the review is provided, and in a usable format while the Standard Review Plan, NUREG-1200, defines the technical review process.

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