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STANDARD FORMAT AND CONTENT FOR THE SAFETY ANALYSIS REPORT FOR ONSITE STORAGE OF SPENT FUEL STORAGE CASKS

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INTRODUCTION

Section 72.24, "Contents of Application: Technical Information," of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," requires that a safety analysis report (SAR) be included with an application for a license under Part 72.

Regulatory Guides 3.44, "Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Water-Basin Type)," and 3.48, "Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage)," supply guidance for preparing an SAR if the installation is not located at the site of a licensed reactor.

This regulatory guide supplies guidance for preparing the SAR if the ISFSI is collocated with a civilian nuclear power reactor and the spent fuel will be stored in casks. Much of the information requested in this guide may be contained in docketed material previously submitted to the NRC by the applicant (as a power reactor licensee) or by a spent fuel storage cask vendor. For instance, such information may be contained in the Final Safety Analysis Report (FSAR) for the collocated reactor or in a topical safety analysis report (TSAR) submitted by a cask vendor. Presentation of the information requested in this guide may be simplified or shortened by reference to the appropriate sections of the reactor FSAR or the storage cask TSAR. As long as the TSAR has been approved by the NRC staff for referencing and the site-specific conditions are within the scope of the cask TSAR analyses, there is no need for additional NRC review. Information presented in this SAR must show that the safety evaluations are applicable under the ISFSI license application. In other cases (e.g., health physics program, training program, emergency plan, safeguards plans), submittal of information may be simplified by showing how the existing plans and programs used for the reactor will be revised to cover the ISFSI. Consultation with the NRC staff is encouraged when preparing the SAR for the onsite storage of spent fuel in casks.

This guide sets forth a format that is acceptable to the NRC staff for the SAR required for the license application to store spent fuel in accordance with 10 CFR Part 72. Conformance with this Standard Format is not mandatory. License applications with differing SAR formats will be acceptable to the staff if they provide an adequate basis for the findings required for the issuance of a license. However, because it may be more difficult to locate needed information in a nonstandard format, the staff review time may be longer.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Part 72, which provides the regulatory basis for this guide. The information collection requirements in 10 CFR Part 72 have been cleared under OMB Clearance No. 3150-0132.

1. Purpose, Applicability, and Use of This Standard Format

This Standard Format has been prepared to identify for applicants the type of information needed in the SAR and to facilitate an orderly review. The SAR

serves as the principal technical communication between the applicant and the NRC. It establishes the nature of the spent fuel storage system and the plans for its use.

The SAR should describe the onsite spent fuel storage system (excluding the reactor pool storage capability). This system should include the cask storage site, the facilities for loading and unloading the cask, and the onsite transport of the cask. Since the reactor pool will probably be used for the loading and unloading of the cask, only those areas directly affected by these operations need be discussed. This discussion would normally be centered on methods of reducing impacts on the reactor system and interfaces between systems.

In the SAR, the applicant should analyze the storage system in terms of additional potential hazards that could result from the spent fuel storage system and the means employed to protect against these hazards, including the associated margins of safety. This includes evaluating

a. Radiation shielding,
b. Confinement and control of radioactive materials,
c. Vulnerability of storage casks to accidents,
d. Projected quantities and concentration of radioactive materials in effluents,
e. Treatment of effluents containing radioactive materials,
f. Reliability of components and systems that are important to safety,
g. The radiological impact associated with normal operations, off-normal conditions, and accidents, and
h. Operation of the ISFSI, including interfaces between existing systems and the new spent fuel storage systems.

The SAR should demonstrate the degree of skill, care, and effort used by the applicant in planning all aspects of the project. The applicant may provide a complete, in-depth analysis of some subjects in supplemental reports or topical reports and incorporate them into the SAR by reference.

Discussions and analyses of operations should be presented in the SAR, including consideration of functions and tasks of personnel performing operation and maintenance activities. The following topics should be covered:

a. Startup testing and startup,
b. Normal operations and procedures,
c. Accident management and emergency plans and procedures,
d. Organizational structure and interfaces,
e. Personnel qualifications,
f. Training for operating and maintenance personnel,
g. Human factors and human reliability,
h. Reactor systems interfaces,
i. Management and administrative policies, procedures, and controls,
j. Proposed license conditions, including technical specifications, and
k. Decommissioning plan.

2. Supplemental Information

Because of the diversity of storage cask designs, the age and condition (e.g., cladding integrity) of the fuel to be stored, and other storage conditions, the applicant may wish to include appendices to the various sections of the SAR to provide detailed supplemental information not explicitly identified in this Standard Format. The following are examples:

a. Supplementary information regarding assumed analytical models, calculational methods, or design alternatives used by the applicant or its agents with particular emphasis on rationale and detailed examples used to develop the bases for criticality safety,

b. Technical information in support of new or novel design features, and

c. Reports available to the applicant such as cask TSARs that have been submitted by cask vendors for evaluation and determined by NRC to be acceptable for referencing in license applications.

3. Proprietary Information

Proprietary information should be submitted separately. When submitted, it should be clearly identified and accompanied with the applicant's detailed reasons and justifications for requesting its being withheld from public disclosure, as specified by § 2.790, "Public Inspections, Exemptions, Requests for Withholding," of 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings."

4. Style and Composition

The applicant should strive for clear, concise presentation of the information provided in the SAR. Information requested in more than one section may be cross-referenced and need not be repeated.

The SAR should follow the numbering systems of this Standard Format at least down to the level of subsections.

References, including author, date, and page number, should be cited within the text if this is important to the meaning of the statement. References used should appear either as footnotes to the page where referenced or at the end of each chapter.

A table of contents and an index of key items should be included in each volume of the SAR.

Where numerical values are stated, the number of significant figures given should reflect the accuracy and precision to which the number is known. Where appropriate, estimated limits of errors or uncertainty should be given.

Abbreviations should be consistent throughout the SAR and should be consistent with generally accepted usage. Any abbreviations, symbols, or special terms not in general use or unique to the proposed storage system should be defined when they first appear in the SAR.

Graphic presentations such as drawings, maps, diagrams, sketches, and tables should be employed where the information may be presented more adequately or conveniently by such means. Due concern should be taken to ensure that all information so presented is legible, that symbols are defined, and that drawings are not reduced to the extent that visual aids are necessary to interpret pertinent items of information. These graphic presentations should be located with the section in which they are primarily referenced.

5. Physical Specifications

a. Paper size

(1) Text pages: 8½ x 11 inches.

(2) Drawings and graphics: 8½ x 11 inches preferred; however, a larger size is acceptable provided the finished copy when folded does not exceed 8½ x 11 inches.

b. Paper stock and ink. Suitable quality in substance, paper color, and ink density for handling and reproduction by microfilming or image-copying equipment.

c. Page margins. A margin of no less than 1 inch should be maintained on the top, bottom, and binding side of all pages submitted.

d. Printing

(1) Composition: Text pages should be single spaced.

(2) Type face and style: Should be suitable for microfilming or image-copying equipment.

(3) Reproduction: May be mechanically or photographically reproduced. All pages of text should be printed on both sides with image printed head to head.

e. Binding. Pages should be punched for standard 3-hole loose-leaf binders.

f. Page numbering. Pages should be numbered with the two digits corresponding to the chapter and first-level section numbers followed by a hyphen and a sequential number within the section, i.e., the third page in Section 5.2 of Chapter 5 should be numbered 5.2-3. Do not number the entire report sequentially (Note that because of the small number of pages in many sections, this Standard Format is numbered sequentially throughout.)

6. Procedures for Updating or Revising Pages

Data and text should be updated or revised by replacing pages. "Pen and ink" or "cut and paste" changes should not be used.

The changed or revised portion of each page should be highlighted by a "change indicator" mark consisting of a bold vertical line drawn in the margin opposite the binding margin. The line should be of the same length as the portion actually changed.

All pages submitted to update, revise, or add pages to the report should show the date of change and a change or amendment number in the lower right-hand corner. A guide page listing the pages to be inserted and the pages to be removed should accompany the revised pages.

1. INTRODUCTION AND GENERAL DESCRIPTION OF STORAGE SYSTEM

Provide introductory information, preferably in narrative style, on the purpose for and the general description of the storage system. The information in this chapter should enable the reader to obtain a basic understanding of the storage system and the protection afforded the general public and the operating personnel without having to refer to the subsequent chapters. Review of the detailed chapters that follow can then be accomplished with better perspective and with recognition of the relative safety importance of each individual item to the overall design, construction, and operation of the spent fuel storage system. The language in this guide assumes that only one type of cask will be used for storage. If more than one type of cask is to be used, the design information for each type of cask should be provided in Chapter 3 and analyzed in Chapters 4, 5, 7, 8, and 10.

1.1 Introduction

Present briefly the principal features of the storage system. Include the type of cask to be used; a general description of the storage requirements; the anticipated amount of spent fuel to be stored; the type, form, quantities, and potential sources of the spent fuel to be stored; and estimated schedules for construction and operation of the storage system.

1.2 General Description of Location

Include a summary description of the proposed location of the storage system. The description should include identification and description of the collocated nuclear reactor, arrangement of major structures and equipment, and general layout of the storage site. Describe where the storage system will be located with respect to other structures. Any additional features likely to be of special interest because of their relationship to safety should be identified.

1.3 General Storage System Description

A description of the storage cask, arrangement of the casks in storage, and spent fuel storage operations should be presented. This description should include such things as the loading and unloading systems, the means for onsite transport of the loaded cask, cask storage array, and other storage system facilities. Provide sufficient detail in the discussion and accompanying charts and tables to provide an understanding of the systems involved.

1.4 Identification of Agents and Contractors

Identify the prime agents or contractors for the design, construction, and operation of the storage system, including cask vendors. All principal consultants an outside service organizations, including those providing quality assurance services and cask manufacturers, should be identified. The division of responsibility among the designer, architect-engineer, vendor, fabricators, and applicant should be delineated. This information should be updated if agents, contractors, and cask vendors are added or changed.

1.5 Material Incorporated by Reference

This section should provide a tabulation of safety analysis reports, environmental reports, or topical safety analysis reports (TSARs) that are incorporated by reference as part of the SAR. In this context, a TSAR is defined as a report that has been prepared by architect-engineers, vendors, or other organizations and filed with the NRC for evaluation under the Topical Report Review Program. For each safety analysis report, environmental report, or TSAR, this tabulation should include the title, the report number, the date submitted to the NRC, date accepted by NRC for referencing, and the sections in which this report is referenced. Sections of the TSAR that have been withheld from public disclosure pursuant to § 2.790(b) of 10 CFR Part 2 as proprietary documents should also be referenced. This section should include a listing of any documents submitted to the NRC in other applications that are incorporated in whole or in part by reference in this application (e.g., FSAR for a reactor license). If any information submitted in connection with other applications is incorporated by reference in this SAR, summaries or explanations of such information should be included in appropriate sections.

2. SITE CHARACTERISTICS

Provide information on the location of the storage systems and a brief description of the geographical, demographical, meteorological, hydrological, seismological, and geological characteristics of the storage site and surrounding vicinity. The objective is to identify site characteristics that are important for the design of the spent fuel storage system.

Since the storage system will be located at the site of a licensed reactor, much of the required siting information should be available in previous submittals to the NRC. Any material in this chapter that is covered in the environmental report (ER) or final safety analysis report (FSAR) for the collocated reactors may be covered by clear and specific reference to the subject matter. It is important that the applicant confer with the NRC staff prior to preparing the SAR to determine the applicability of such information.

2.1 Geography and Demography of Site Selected

2.1.1 Site Location

The location of the site for the placement of the storage system should be described in relationship to other onsite buildings. The State and county in which the storage system is to be located should be identified, as well as the location of the storage system relative to prominent natural and man-made features such as rivers, lakes, and the local road network. Additional maps should be provided to present detail near the spent fuel storage site to establish orientation of proposed or existing buildings, roads, railroads, streams, ponds, and transmission lines. This section may be referenced in subsequent chapters to minimize repetition.

2.1.2 Site Description

A map of the storage system site should be included and should be of suitable scale to clearly define the boundary of the site and the distance from significant features of the storage system to the site boundary. The area to be considered as the controlled area should be clearly delineated if its boundaries are not the same as those of the existing facilities. The distance from the proposed storage location to the controlled area boundary should be clearly presented.

The applicant should include a description of legal responsibilities with respect to the properties described for the proposed location of the storage casks.

The topography of the site and vicinity should be described by suitable contour maps that indicate the character of surface drainage patterns. Vegetative cover and surface soil characteristics should be described sufficiently to indicate potential erosion and fire hazards.

For any activity conducted within the area controlled by the applicant but not related to the operation of the storage system, identify the activities involved, the boundaries within which the applicant will control such activities, and any potential interaction of such activities and the operation of the storage system.

2.1.3 Population Distribution and Trends

Population information based on the most recent census data should be presented to show the population distribution as a function of distance and direction from the storage site. Projected future population changes should be specified through the proposed life of the storage system.

2.1.4 Uses of Nearby Land and Waters

Uses of nearby land and waters within a minimum of an 8-kilometer (5-mile) radius should be described. A brief description of farming, dairy, industrial, residential, and recreational activities should be presented.

2.2 Nearby Industrial, Transportation, and Military Facilities

Identify nearby industrial, transportation, and military installations that are within 8 kilometers (5 miles) of the storage site. As appropriate for each, provide a description of products or materials produced, stored, or transported and the maximum quantities for each with emphasis on those items that could present a hazard to the safe operation of the storage system.

Summarize items that may present a hazard to the storage site from nearby activities. The following are typical considerations to be evaluated:

1. The effects of explosion of chemicals, flammable gases, or munitions;

2. The effects of explosions of large natural gas pipelines that pass close to the storage site;

3. The effects of detonation of the maximum amount of explosives permitted to be stored at mines or stone quarries near the site; and

4. The effects of

   a. Brush or forest fires,
   b. Fires from transportation accidents, and
   c. Fires from adjacent industries.

If tall structures such as discharge stacks are located near the proposed storage site, evaluate the potential for damage to the storage casks in the event that these structures collapse.

2.3 Meteorology

This section should provide a brief meteorological description of the storage site and its surrounding area. Meteorological conditions for the storage site should be the same as for the collocated nuclear power plant. Meteorological conditions that influence the design and operation of the spent fuel storage site should be identified.

2.3.1 Regional Climatology

Describe the climate of the region, pointing out characteristics attributable to the terrain. Indicate annual extremes and seasonal weather conditions,

including temperature, precipitation, relative humidity, and prevalent wind direction. Provide summary data on

1. The frequency and duration of maximum and minimum temperatures;

2. The frequency and duration of heavy rain, snow, and ice storms;

3. The frequency and intensity of thunderstorms and lightning strikes;

4. The frequency and intensity of strong winds, tropical storms, tornadoes; and

5. The frequency and intensity of other meteorological conditions (e.g., blowing dust) that could affect the passive cooling system of the cask.

These data should be reported in sufficient detail to indicate impacts on the cask and storage site design and operation. All information should be fully documented and the historical record on which the information was based should be identified. Sources of such information could include the National Climatic Center, National Weather Service stations, collocated nuclear facilities, government facilities (e.g., military installations), and private organizations such as universities that have maintained quality-controlled data collection programs. The validity of the information provided, with respect to representation of conditions at or near the site, may be substantiated by appropriate references.

2.3.2 Local Meteorology

2.3.2.1 Data Sources. Provide onsite data summaries and nearby weather summaries, identifying the methods and frequencies of collection. Data may be obtained from the onsite meteorological measurements program of the collocated nuclear power plant. Provide joint frequency distributions of wind speeds, wind direction, and atmospheric stability.

2.3.2.2 Topography. Provide a map showing the detailed topographic features (as modified by the placement of the storage site) within an 8-kilometer (5-mile) radius of the storage site.

2.3.3 Onsite Meteorological Measurement Program

The program conducted to develop local data and the programs to be used during operations to estimate offsite concentrations of airborne effluents from the spent fuel storage operation, if any, should be described. The information should include measurements made, locations and elevations of measurements, descriptions of the instruments used, instrument performance specifications, calibration and maintenance procedures, and data analysis procedures.

2.3.4 Diffusion Estimates

2.3.4.1 Basis. Provide estimates of atmospheric diffusion at the controlled area boundary for appropriate time periods for routine releases and

after an accident. Consideration of any influence that local topography may have should be included. Show the decrease in relative concentration as a function of distance.

2.3.4.2 Calculations. Describe the diffusion equations and the parameters used in the diffusion estimates.

2.4 Hydrology

The SAR should contain a discussion of surface and subsurface hydrology related to cask design bases and cask performance criteria. The discussion should relate this information to cask handling, storage, and the storage system operating sequence and should characterize site hydrologic features, e.g., rivers, streams, lakes, dams, aquifers, ground water and its use. Topographic maps should be provided as necessary for clarity. Documents submitted for the collocated reactor may be referenced.

2.5 Geology and Seismology

The geologic and seismic characteristics of the area and the storage site, the nature of the investigations performed, results of investigations, conclusions, and identification of information sources should be provided. Supplement the written description with tables and legible graphics, as appropriate.

The information required to satisfy this section is contained in the FSAR for the collocated nuclear power plant. The appropriate sections should be reviewed and referenced. A brief summary of conclusions should be provided in this SAR.

2.5.1 Basic Geologic and Seismic Information

The basic geologic and seismic information for the storage site should be presented. Information from professional papers, dissertations, maps, published reports, the FSAR for the collocated nuclear power plant, private communications, or other sources should be referenced. Material in this section may be included, as appropriate, in Section 2.5.3 and cross-referenced.

The following information should be included in this section:

1. Storage site geomorphology;

2. Geologic history of the storage site and surrounding region;

3. Specific structural features of significance to the storage site;

4. Large-scale geologic map;

5. Plot plan showing cask storage locations and all borings, trenches, and excavations;

6. Geologic profiles showing relationship of storage cask foundations to subsurface materials, including ground water;

7. Plan and profile drawings showing the extent of excavations and backfill planned at the storage site;

8. Local geological features that could affect the storage cask placement such as zones of alteration, deformation zones, previous earthquakes, zones of structural weakness, and unstable rock formations;

9. Site ground-water conditions;

10. Geophysical surveys to evaluate the stratigraphic structure and bedrock;

11. Static and dynamic engineering soil and rock properties of materials underlying the storage site; and

12. Analysis techniques used and the factors of safety for foundation materials.

2.5.2 Vibratory Ground Motion

Information should be presented to describe how the data were selected for determining the design basis for vibratory ground motion. Specific information and determinations should be included to the extent necessary to clearly establish the design basis for vibratory ground motion. Information presented in other sections of this SAR may be cross-referenced and need not be repeated. The following information should be included in the discussion:

1. Engineering properties of materials for seismic wave propagation and soil-structure interaction analyses,
2. Earthquake history,
3. Earthquake probabilities, and
4. Procedures to determine the design earthquake.

2.5.3 Surface Faulting

Information that describes surface faulting at the site should be presented if the method or approach of 10 CFR Part 100, "Reactor Site Criteria," is used. A summary of the following specific information and determinations should also be included. Since most of this information is included in the FSAR for the collocated nuclear power plant, the information should be referenced.

1. Evidence of fault offset, and
2. Identification of capable faults.

2.5.4 Stability of Subsurface Materials

Information should be presented concerning the stability of rock and soil underneath the storage structure foundations during the vibratory motion associated with earthquake design. Evaluate the following types of information to determine if the storage geologic features could affect the storage cask location foundations:

1. Geologic features,
2. Properties of underlying materials,

3. Plot plan,
4. Soil and rock characteristics,
5. Excavations and backfill,
6. Ground-water conditions,
7. Response of soil and rock to dynamic loading,
8. Liquefaction potential,
9. Earthquake design basis,
10. Static analyses,
11. Techniques to improve subsurface conditions, and
12. Criteria and design methods.

2.5.5 Slope Stability

Information and appropriate substantiation should be presented concerning the stability of all slopes, both natural and man-made (both cut and fill), the failure of which could adversely affect the storage site. The information should include a description of slope characteristics, analyses used to determine slope stability, logs of core borings, and compaction specifications.

3. PRINCIPAL CASK DESIGN CRITERIA

Principal design criteria for the type of cask or casks selected by the applicant should be established in this chapter. The design bases for the design criteria should be discussed. The guide language is based on selection of one type of cask. In the case in which an applicant selects more than one type of cask, each type should be analyzed in each of the following sections. In many cases, the cask selected for spent fuel storage will have been analyzed in a topical safety analysis report (TSAR) submitted by the cask vendor. Clear and specific reference to a TSAR, accepted by NRC for referencing, in the appropriate sections may facilitate preparation of this safety analysis report (SAR).

3.1 Purposes of Cask

Describe the cask, its functions, storage capacity, and the types of fuel to be stored.

3.1.1 Spent Fuel To Be Stored

A detailed description of the physical, thermal, and radiological characteristics of the spent fuel that will be stored in the cask should be provided. Compare these characteristics to the design criteria for the cask. Include spent fuel characteristics such as specific power, initial enrichment, burnup, decay time, heat generation rates, and physical condition of the spent fuel (e.g., cladding integrity). Indicate whether credit is being taken for fuel cladding as a barrier. The method of storage (such as assemblies, consolidated fuel rods, canning) should also be described.

3.1.2 General Operating Functions

Provide information related to the overall functioning of the cask in the storage system operation. Information should include onsite handling, transport, and utility services required for system operation.

3.2 Design Criteria for Environmental Conditions and Natural Phenomena

The design criteria for the cask components that are identified as important to safety should be emphasized. Design bases should include such subjects as meteorology, flooding, seismic activity, ambient temperature range, and peak solar insolation. Clear and specific reference to the appropriate section in a cask TSAR may be adequate.

3.2.1 Tornado and Wind Loadings

3.2.1.1 Applicable Design Parameters. The design parameters applicable to the design tornado such as translational velocity, rotational velocity, and the design pressure differential and its associated time interval should be specified. Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," contains guidance that may be helpful.

3.2.1.2 Determination of Forces on Structures. Describe the methods used to convert the tornado and wind loadings into forces on the cask, including the

distribution across the cask and the combination of applied loads. If factored loads are used, the basis for selection of the load factor used for tornado loading should be furnished.

3.2.1.3 Tornado Missiles. The dimensions, mass, energy, velocity, and other parameters should be selected for a potential tornado-driven missile.* An analysis should be presented to show the potential effect of such a missile on structures, systems, and components important to safety.

3.2.2 Water Level (Flood) Design

If the cask is not to be located on a floodfree site, discuss the design loads from forces developed by the probable maximum flood (PMF), including hydrostatic effects and dynamic phenomena such as momentum and drag.

3.2.3 Seismic Design

The design criteria and parameters to be used in the seismic analysis of the cask and cask storage pads should be presented in this section. If the cask is located on a soil-supported structure (e.g., storage pad), include the depth of the soil over bedrock. This section should also discuss the seismic analysis method and the method used to determine overturning moment for the cask. Clear and specific reference to appropriate sections of a cask TSAR or the reactor FSAR may be adequate.

3.2.4 Snow and Ice Loadings

Describe design and operating load criteria used to ensure that maximum snow and ice loads can be accommodated by the cask. Include an analysis to show that thermal and stress transients will not adversely affect the cask.

3.2.5 Combined Load Criteria

Describe, for combined loads, the criteria selected to provide mechanical and structural integrity. The loads and loading combinations to which the cask is subjected, including the load factors selected for each load component where a factored load approach is used, should be defined. The design approach used with the loading combination and any load factors should be specified. Describe the loads acting on the cask such as dead loads and live loads as well as the design basis accident loads and loads resulting from natural phenomena such as earthquakes, floods, tornadoes, tornado missiles, hurricanes, and snow and ice effects. The design loading combinations used to examine the effects on localized areas such as penetrations, structural discontinuities, and local areas of high thermal gradients should be provided together with time-dependent loading such as the thermal effects, effects of creep and shrinkage, and other related effects. Explanation should be provided of the use of an ultimate strength approach with a load factor of 1.0.

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*Section 3.5.1.4 (paragraph 4 of Section III) of NUREG-0800,"Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, contains information that may be helpful in developing these data. A copy of Section 3.5.1.4 is available for inspection and copying for a fee at the NRC Public Document Room, 1717 H Street NW., Washington, DC, under Task CE 301-4.

3.3 Safety Protection Systems

3.3.1 General

Special considerations in the design of the spent fuel storage system resulting from site conditions, operating conditions, or other requirements should be identified.

3.3.2 Protection by Multiple Confinement Barriers and Systems

3.3.2.1 Confinement Barriers and Systems. Discuss each method of confinement that will be used to ensure that there will be no uncontrolled release of radioactivity to the environment.

If the release limits selected are consistent with present practice, a referenced statement to that effect will suffice; if the limits extend beyond present practice, an evaluation and an explanation based on developmental work and analysis should be provided. Those criteria may be expressed as explicit numbers or as general conditions.

3.3.2.2 Cask Cooling. Describe the criteria selected for providing suitable cooling of the cask by showing capacity standards for normal and off-normal conditions.

3.3.3 Protection by Equipment and Instrumentation Selection

3.3.3.1 Equipment. Itemize design criteria for key cask equipment items that have been specifically selected to provide protection.

3.3.3.2 Instrumentation. Discuss the design criteria for instrumentation selected with particular emphasis on features to provide testability and maintenance.

3.3.4 Nuclear Criticality Safety

Supply pertinent criteria relating to the appropriate safety margins provided to ensure that a subcritical situation exists under credible handling and storage conditions.

3.3.4.1 Control Methods for Prevention of Criticality. Present the methods to be used to ensure that subcritical situations are maintained in storage under the worst credible conditions.

3.3.4.2 Error Contingency Criteria. To support the above information, define the error contingency criteria selected.

3.3.4.3 Verification Analyses. Present the criteria for establishing and verifying models and computer programs used in analyses. Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities," provides information concerning validation of criticality calculations.

3.3.5 Radiological Protection

A portion of the radiological protection design criteria was discussed in Section 3.3.2. Present any additional radiological protection design criteria.

Provide an estimate of collective doses (in man-rem) per year, including the collective doses associated with cask operation, maintenance, repair, and decommissioning. When special provisions such as time and distance are to be included, determine the design dose rate in occupancy areas. Show that further reduction of collective doses is not practicable.

3.3.6 Fire and Explosion Protection

The design criteria selected to ensure that safety functions will successfully withstand credible fire and explosion conditions should be provided.

3.3.7 Materials Handling and Storage

Describe the design criteria for spent fuel storage. Specifically cover cooling requirements, criticality, and contamination control. Discuss criteria for detecting and handling breached fuel rods.

3.4 Summary of Storage Cask Design Criteria

Provide a summary of the design criteria used during the design of the storage cask. This summary should identify an envelope of criteria and may be presented in tabular form.

4. STORAGE SYSTEM

Provide descriptive information on the structures, systems, and components of the storage installation and their locations on the site. Use drawings and maps as appropriate. Describe and evaluate each part of the storage system with emphasis on those features that are important to safety. Show that storage casks that are being considered can be handled, loaded, stored, and unloaded either under the existing reactor operating license or by facilities to be included under the Part 72 license. Describe and evaluate special design features employed to withstand environmental and accident forces. Relate the design bases and use of industrial codes to the design criteria presented in Chapter 3, "Principal Cask Design Criteria." Identify structures, systems, and components that are covered by the quality assurance program.

4.1 Location and Layout

Identify the location of the cask storage site, the cask loading and unloading facilities, and the transport route for the spent fuel storage casks on a map or drawing to scale. Also include other onsite facilities, roadways, railroad lines, and utility and water service locations related to the spent fuel storage installation.

4.2 Storage Site

Provide the design bases for the storage site including (1) the analysis and design procedures for tornado, earthquake, fire, and explosion effects, (2) the general analysis and design procedures for normal, off-normal, and special loadings and load combinations, and (3) allowable foundation loads and deflections and deformation stresses for storage pads and structures.

4.2.1 Structures

Describe the design bases and engineering specifications of supporting storage structures. This description should include cask storage pads. Discuss applicable nationally recognized codes and standards, the materials of construction, and the fabrication and inspection to be used.

4.2.2 Storage Site Layout

Provide engineering drawings, plans, and elevations showing the layout of the functional features of the storage site. Include spatial and equipment identification data directly on the layouts with suitable designations in tabular listings. Provide engineering drawings, plans, and elevations showing the total array of the storage casks. Include sectional drawings as required to relate all features of the storage site.

4.2.3 Storage Cask Description

Provide a summary description of the cask or types of casks to be used for spent fuel storage. A reference to an appropriate topical safety analysis report (TSAR), which has been approved by NRC for referencing, will suffice with a discussion showing how the TSAR review is applicable. If a TSAR has not been submitted for review or if the storage cask has not been identified, a more detailed description and evaluation of the cask should be provided.

4.2.3.1 Function. Describe the function of the storage cask, and discuss the performance objectives.

4.2.3.2 Description. Using equipment sketches and engineering drawings, identify the various components of the cask. Include a discussion of the features used to ensure that operating personnel are protected from radiation and that criticality will not occur. Describe the internal components of the cask such as the basket assembly. Provide design provisions for interfaces with other equipment. This information may be included in a TSAR for a particular cask and may be referenced if approved by NRC.

4.2.3.3 Design Bases and Safety Assurance. Present the design codes used and specifications necessary to show that a sufficient margin of safety exists under normal and accident conditions. Include detailed analyses showing that the design criteria as defined in Chapter 3, "Principal Cask Design Criteria," are fulfilled.

4.2.4 Instrumentation System Description

Identify those aspects of the storage system relied on to ensure that adequate reliability is provided and that provisions have been included in the design for safe storage conditions or curtailment of storage system operations in the event of off-normal and accident conditions. Relate these to the design criteria presented in Chapter 3, "Principal Cask Design Criteria." Describe the various monitoring systems that provide indications of off-normal operations. By means of instrumentation flowsheets, discuss the instrumentation and control features associated with the storage system.

Discuss how instrumentation systems will monitor variables and systems important to safety over anticipated ranges for normal operation, off-normal operation, and accident conditions. Describe redundancy of safety features that may be necessary to ensure adequate safety of spent fuel storage. The variables and systems that may need surveillance and control include (1) confinement leakage indications, (2) cask liquid levels, (3) cask pressures, and (4) area radiation and airborne radioactivity levels.

Discuss the provisions for testability of the instrumentation and maintenance of radiation control systems. Describe how the instrumentation and radiation control systems are designed to fail-safe or to indicate faulty conditions such as disconnection, loss of energy or motive power, or adverse environmental conditions.

4.3 Transport System

A transport system will be needed to move the loaded casks from the nuclear power plant's spent fuel loading facilities to the storage site. This movement should be totally conducted on site to allow the transport system to be licensed under 10 CFR Part 72 and avoid licensing related to 10 CFR Part 71. The transport system should include a transport vehicle (e.g., truck and lowboy trailer), means for loading and unloading at both the spent fuel loading facility and at the storage site, and a transfer path between the two areas.

4.3.1 Function

Describe the function of the transport system and of the components. Provide a narrative description of how the system will operate. Discuss the performance objectives.

4.3.2 Components

Describe the transport system components in detail. Use individual equipment sketches, engineering drawings, and plans. Where applicable, identify nationally recognized codes and standards, and itemize in tabular form features that will be covered by the quality assurance program discussed in Chapter 11, "Quality Assurance."

For the transfer path, indicate on a site map the location of the path. Describe the construction of the pathway. Indicate any additional uses for the path that are not related to the movement of spent fuel storage casks.

4.3.3 Design Bases and Safety Assurance

Present the design bases and codes used and specifications necessary to show that a sufficient margin of safety is provided under normal, off-normal, and accident conditions. Backup provisions and interfaces with the collocated reactor spent fuel pool and the storage site should be included. Include a discussion of the features used to ensure that operating personnel are adequately protected from radiation and radioactive contamination.

4.4 Operating Systems

This section should include a discussion, description, and analysis of the total operation. Anticipated operator functions and tasks for normal, off-normal, and emergency conditions should be included. The discussion should include the proposed job performance aids, communications, special equipment, and tools required to perform these functions and tasks. The means to be used for ensuring that the system and its interfaces are safely operated and maintained should be identified; include analyses of all functions and tasks. Such information should be provided in paragraphs 4.4.1, 4.4.2, 4.4.3, and 4.4.4. Other systems that are important to safety should be analyzed in paragraph 4.4.5.

Some of the information requested in this section, such as technical specifications related to heavy loads and crane capacity, may be included in the FSAR or other documents related to the collocated reactor operating license. Include these references as supporting information.

4.4.1 Loading and Unloading System

The system that will be used to load the fuel into the storage cask, seal the cask, and prepare the cask for transport to the storage site should be described. This section should also include a description of the procedures and equipment used to unload the cask. References to the collacted reactor FSAR could facilitate presentations.

4.4.1.1 Function. Describe the function of the loading and unloading systems, and discuss the performance objectives of the system.

4.4.1.2 Major Components and Operating Characteristics. Describe the design and operating features of the system. Use individual equipment sketches, engineering drawings, layouts of equipment location, and limits imposed on the design to achieve safety. Identify which components are shared with the nuclear power plant operations. Describe the equipment that will be used to prepare the cask for loading or unloading operations such as cask evacuation and backfill, cask cooldown, and crud control during unloading.

4.4.1.3 Safety Considerations and Controls. The design features that ensure safe handling of the spent fuel should be described. Present the design bases, codes, and specifications that ensure a sufficient margin of safety under normal, off-normal, and accident conditions. Provide details on backup provisions and interfaces with other systems or components. Discuss specific components that are required to be operable during loading and unloading operations to ensure that exposures to operating personnel are reduced to as low as is reasonably achievable (e.g., for control of crud and other radioactive material).

4.4.2 Decontamination System

This is the system that may be used to decontaminate the cask after it has been loaded and removed from the nuclear power plant's spent fuel pool.

4.4.2.1 Function. Describe the function of the decontamination system for equipment and personnel. Discuss the operating features of the system and the decontamination techniques that may be used for decontamination and the limitations of each technique.

4.4.2.2 Major Components and Operating Characteristics. Describe the components of the cask decontamination system and how this system interacts with other service and utility systems. Discuss the operating capabilities of the system.

4.4.3 Storage Cask Repair and Maintenance

Indicate the location of the storage cask repair and maintenance area. Provide an engineering drawing of the shop layout with major items of equipment identified. Describe modes of operation with emphasis on contamination control and occupational radiation exposure reduction.

4.4.4 Utility Supplies and Systems

Identify the utility services needed for operation of the storage system (e.g., air, water, electricity). The utility supply and distribution systems should be described and shown on drawings and plans.

4.4.5 Other Systems

Identify other systems that may be used in support of the storage system. Continue additional systems sequentially (e.g., 4.4.5.1, 4.4.5.2, ...). For each system, provide the following information:

1. Functional Description. Describe the portion of the system to be used, its function, and how the function will be accomplished.

2. Major Components. If more than one component is included in a particular system, explain the interrelationsnip of the individual components and the means by which these are combined within the system.

3. Design Description. Discuss the design, design capacity (including materials of construction where appropriate), operating limits, and standards and codes used. Describe the layout of equipment from the standpoint of minimizing personnel exposures to radiation during operations and maintenance.

4.5 Classification of Structures, Systems, and Components

Provide a classification of the structures, systems, and components selected in the design according to their importance to the safety function they perform, the seismic design considerations, and the relationship of the quality requirements of an item with respect to its function and performance. Describe the criteria for selecting these categories. Structures, systems, and components that should be included in this classification system are the storage cask and radiation monitoring systems.

4.6 Decommissioning Plan

Submit a proposed decommissioning plan that includes information on proposed practices and methods for decontamination of the facility and site, disposal of residual radioactive material after the spent fuel has been removed, and financial arrangements made to provide reasonable assurance that decommissioning will be carried out in a timely manner. A description of design and operational features that may facilitate decommissioning should be included.

5. STORAGE SYSTEM OPERATIONS

In this chapter, provide a detailed description of operations and a general plan for the overall operation of the storage system. Identify potentially hazardous operations. Sufficient detail should be provided to indicate how the applicant intends to conduct operations and still maintain the independence of the spent fuel storage system. An analysis of the ISFSI operation, including consideration of human factors, should be provided.

5.1 Operation Description

5.1.1 Narrative Description

Describe the means that will be used to determine the condition of the spent fuel and storage cask prior to loading, e.g., monitoring of external radiation, monitoring interior and external temperatures, cask seal leakage, periodic examination for cask structural deterioration, and accountability and security of contents. This description should also include the means for evaluating the storage cask integrity during storage and prior to movement for unloading.

An analysis of the ISFSI operations, including consideration of human error, should be provided for normal, off-normal, and accident conditions. The number and types of personnel, their functions and tasks, equipment, job performance aids, and workload should be considered. The handling of fuel with breached cladding would be considered an off-normal event. The consequences of this event should be discussed in Chapter 8, "Accident Analyses." However, the sequence of operations to handle this event should be discussed in this chapter. This discussion should include cask sampling, flushing, and confinement of radioactive material.

5.1.2 Flowsheets

In support of the description above, supply flowsheets showing the sequence of operations and their controls. Provide a description of the operations. Sufficient details should be given to derive source terms for radiation exposure determinations to be developed in Chapter 7, "Radiation Protection." Include equipment descriptions with dimensions, design and operating characteristics, materials of construction, special design features, and operating limitations.

5.1.3 Identification of Subjects for Safety and Reliability Analysis

A safety and reliability analysis should be made of the following systems. This analysis may reference other discussions of design and operating features, procedures, and relevant support documents and studies.

5.1.3.1 Criticality Prevention. Provide a summary description of the principal design features, procedures, and special techniques used to preclude criticality in the design and operation of the storage system.

5.1.3.2 Instrumentation. Provide a summary description of the instruments used to detect off-normal operations. The description should include testability, redundancy, system failure conditions, and operator responses to normal and anticipated off-normal conditions.

5.1.3.3 Maintenance Techniques. Discuss the rationale and outline the techniques to be used for major maintenance tasks, such as on the storage cask.

5.2 Control Room and Control Areas

If applicable, a control room or a central panel area provided for the spent fuel installation should be described. Discuss the location and purpose of annunciators or other alarm devices. Describe how appropriate personnel will be notified, how specific off-normal conditions should be interpreted, and what remedial actions should be taken.

5.3 Spent Fuel Accountability Program

A description of the record system and records showing acquisition, receipt, inventory, location, disposal, and transfer of spent fuel should be presented. For purposes of the estimated special nuclear material content of the spent fuel, spent fuel storage should be a separate material balance area.

5.4 Spent Fuel Transport

The means provided for transport of the spent fuel from loading/unloading to storage should be described. The description should include the transport vehicle and roadway locations and construction

6. WASTE MANAGEMENT

By reference to Chapter 3, "Principal Cask Design Criteria," provide the primary design bases and supporting analyses for demonstrating that radioactive waste materials will be safely confined. The existing waste handling system at the collocated reactor may be used to handle the storage system radioactive waste. Reference may be made to this section of the nuclear power plant's FSAR for information concerning design, capacity, operating limitations, and procedures.

Classify anticipated radioactive wastes with respect to source, chemical and radiological composition, and method and design for treatment and handling. Previously submitted flowsheets and diagrams may be cross-referenced.

7. RADIATION PROTECTION

This chapter should provide information on methods for radiation protection and on estimated radiation exposures to operating personnel during normal operation and anticipated operational occurrences (including radioactive material handling, packaging, transfer, processing, storage, and disposal; maintenance; routine operational surveillance; and calibration). This chapter should also provide information on layout and equipment design, the planning and operating programs, and the techniques and practices employed by the applicant in meeting the standards of 10 CFR Part 20 for protection against radiation, including ALARA. Reference to other chapters of this SAR or to the collocated nuclear power plant's FSAR should be made where appropriate. A description of how the existing ALARA program may be modified and applied to the spent fuel storage system could simplify presentations in this chapter.

7.1 Ensuring That Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)

7.1.1 Policy Considerations and Organization

Describe the management policy and organizational structure related to ensuring that occupational exposures to radiation are ALARA. Describe the activities that will be conducted by the individuals having responsibility for radiation protection.

7.1.2 Design Considerations

Describe the storage system layout and equipment design considerations that are directed toward ensuring that occupational radiation exposures are ALARA. Describe how the design is directed toward reducing the (1) need for maintenance of equipment, (2) radiation levels and time spent where maintenance is required, and (3) contamination control in handling, transfer, and storage of radioactive materials.

7.1.3 Operational Considerations

Describe the methods and procedures used to ensure that occupational radiation exposure will be ALARA.

7.2 Radiation Sources

7.2.1 Characterization of Sources

The sources of radiation that are the bases for the radiation protection design and the basis for determining their curie values should be described. For shielding calculations, the description should include a tabulation of all sources by isotopic composition, x- and gamma-ray energy groups from zero to the maximum photon energy and the respective photon yield, and source geometry. In addition to the spent fuel in storage, the sources should include radioactive materials contained in equipment and storage containers throughout the storage system. This should include items such as crud that may be removed during fuel handling in the spent fuel pool, if pertinent. Indicate the physical and chemical forms of these sources.

7.2.2 Airborne Radioactive Material Sources

The sources of radioactive material that may become airborne in areas accessible to, or normally occupied by, operating personnel should be described. This may include operations that occur in the nuclear power plant's spent fuel pool but are associated with the storage system such as loading and unloading of the storage cask. The description should include a tabulation of the calculated concentrations of airborne radioactive material by nuclides expected during normal and anticipated operational occurrences in areas normally occupied by operating personnel. This description should include both gaseous and particulate radioactive material. Provide the models and parameters for calculating airborne concentrations of radioactive materials.

7.3 Radiation Protection Design Features

7.3.1 Storage System Design Description

Describe equipment and system design features used for ensuring that occupational exposures to radiation are ALARA and that a high degree of integrity is obtained for the confinement of radioactive materials.

Provide scaled layout and arrangement drawings of the storage system showing the locations of all sources described in Section 7.2. Include specific activity, physical and chemical characteristics, and expected concentrations. Provide on the layouts the radiation area designations, including area boundaries and type of interface (e.g., partitions, locked gates, barriers, fences).

The layouts should show shield wall thicknesses, controlled access areas, personnel and equipment decontamination areas, contamination control areas and type of controls, traffic patterns, location of the health physics facilities, location of airborne radioactive material monitors and area radiation monitors at the storage site, and location of the counting room. Provide the design radiation dose rate for each area and activity. Describe the facilities and equipment involved, including any special equipment provided specifically for radiation protection.

7.3.2 Shielding

Provide information on the shielding for the appropriate radiation sources identified in Section 7.2. Show the design of penetrations, the material of construction, the method by which the shield parameters (e.g., attenuation coefficients, buildup factors) were determined, and the assumptions, codes, and techniques used in the calculations. Describe special protective features that use shielding, geometric arrangement (including equipment separation), or remote handling to ensure that occupational exposure to radiation will be ALARA in normally occupied areas. Describe the use of portable shielding, berms, or special buildings at the storage site used for shielding if applicable.

This information may be included in the approved topical report for specific cask designs. If this is the case, reference the appropriate sections of the topical report for the storage cask shielding description and calculations.

7.3.3 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Describe the fixed area radiation monitors and airborne monitoring instrumentation and their placement. Describe the criteria and methods used for determining setpoints for alarms from the radiological monitoring system. Provide information on any auxiliary and emergency power supplies (if used), range, sensitivity, accuracy, performance testing, energy dependence, calibration methods and frequency, alarm setpoints, recording devices, and location of detectors, readouts, and alarms for the monitoring instrumentation. Describe the intended operational personnel's responses to radiation alarms and emergency conditions.

7.4 Estimated Onsite Collective Dose Assessment

The estimated annual occupancy for each radiation area within the storage system should be tabulated and the bases for the values provided. Provide estimates of annual collective doses (in person-rems) for the functions related to the spent fuel storage installation and the assumptions used in determining these values.

7.5 Offsite Collective Dose

If radioactive effluents from the ISFSI are anticipated to exceed 10% of the currently estimated offsite collective dose from the collocated nuclear power plant, provide the estimated annual collective dose (in person-rem) related to the ISFSI. Details on estimated radioactive effluents and models and equations used to determine the dose should be presented.

7.6 Health Physics Program

Describe how the health physics organization, equipment, and procedures at the collocated nuclear power plant will be revised to accommodate the storage system. Descriptions of changes to the existing health physics program that result from the spent fuel installation should facilitate presentation.

7.7 Environmental Monitoring Program

Changes and additions, if any, to the existing environmental monitoring program that may be required as a result of the spent fuel storage installation should be described.

8. ACCIDENT ANALYSES

The evaluation of the safety of the storage system is accomplished in part by analyzing the response of the system to postulated accident events in terms of (1) minimizing the causes of such events, (2) the quantitative identification and mitigation of the consequences, and (3) the ability to cope with each situation if it occurs.

In previous chapters, features important to safety have been identified and discussed. The purpose of this chapter is to identify and analyze a range of credible accident occurrences (from minor accidents to the design basis accidents) and their causes and consequences. For each situation, reference should be made to the appropriate chapter and section describing the considerations to prevent or mitigate the accident.

ANSI/ANS-57.9-1984, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type),"* defines four categories of events that provide a means of establishing design requirements to satisfy safety criteria. The first design event is associated with normal operation. The second and third design events apply to events that are expected to occur during the life of the installation. The fourth design event is concerned with natural phenomena or low probability events. Regulatory Guide 3.60, "Design of an Independent Spent Fuel Storage Installation (Dry Storage)," endorses ANSI/ANS-57.9-1984, with certain exceptions and modifications, for use in the design of an ISFSI that uses a dry environment as a mode of storage.

8.1 Off-Normal Operations

In this section, design events of the second type as defined in ANSI/ANS-57.9-1984 should be considered. They may include malfunctions of systems, minor leakage, limited loss of external power, or operator error. In general, the consequences of the events discussed in this section would not have a significant effect beyond the controlled area. The following format should be used to present the desired detail.

8.1.1 Event

Identify the event, including the location of the event, type of failure or misoperation, and system or systems involved. Those events that are common to the collocated nuclear power plant and have been analyzed in its FSAR need only be listed with reference to the appropriate section of the power plant's FSAR if the consequences are the same.

8.1.1.1 Postulated Cause of Event. Describe the sequence of occurrences that could initiate the event under consideration and the bases upon which credibility or probability of each occurrence in the sequence is determined.

The following should be provided:

1. Starting conditions and assumptions;

*Copies may be obtained from the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, IL 60525.

2. A step-by-step sequence of the course of each event, identifying all protection systems required to function at each step; and

3. Identification of any operator actions necessary.

The discussion should show the extent to which protective systems should function, the effect of failure of protective functions, and the credit taken for operation safety features. The performance of backup protection systems during the entire course of the event should be analyzed. The discussion also should include credit taken for the functioning of other systems and consequences of failure.

The analysis given should permit an independent evaluation of the adequacy of the protection system as related to the event under study. The results can then be used to determine which functions, systems, interlocks, and controls are important to safety and what actions may be required.

8.1.1.2 Detection of Event. Discuss the means or methods, such as visual or audible alarms or routine inspections performed on a stated frequency, to be provided to detect the event. Provide for each event an assessment of response time.

8.1.1.3 Analysis of Effects and Consequences. Analyze the effects and particularly any radiological consequences of the event. The analysis should

1. Show the methods, assumptions, and conditions used in estimating the course of events and the consequences,

2. Identify the time-dependent characteristics and release rate of radioactive materials within the confinement system that could escape to the environment, and

3. Describe the margin of protection provided by whatever system is depended on to limit the extent or magnitude of the consequences.

8.1.1.4 Corrective Actions. For each event, give the corrective actions necessary to return to a normal situation.

8.1.2 Radiological Impact from Off-Normal Operations

The capability of the system to operate safely within the range of anticipated operation variations, malfunctions of operating equipment, and operator error should be shown. The information may be presented in tabular form with the situations analyzed listed in one column accompanied by other columns that identify

1. Estimated doses (in person-rems),
2. Method or means available for detecting the respective situations,
3. Causes of the particular situation,
4. Corrective actions, and
5. Effects and consequences.

8.2 Accidents

An analysis of potential accidents that could affect structures, systems, and components important to safety should be presented (e.g., storage cask free-fall, fire, accident in transit). Any credible incident that could result in a potential radiation dose of 25 mrem or more beyond the controlled area should be considered for analysis. Such analyses should address situations wherein direct radiation or radioactive materials may be released in such quantity as to endanger personnel within the controlled area. Design events of the third and fourth types as defined in ANSI/ANS-57.9-1984 should be considered in this section.

The following format should be used to provide the desired detail.

8.2.1 Accidents Analyzed

Identify the accident, the location or portion of the storage system involved, and the type of accident. Discuss each accident sequentially (e.g., 8.2.2, 8.2.3 ...). Accidents that are common to the collocated nuclear power plant and have been analyzed in its FSAR need only be listed with reference to the appropriate section of the nuclear power plant's FSAR if the consequences are the same.

8.2.1.1 Cause of Accident. For each accident analyzed, describe and list the sequence of events leading to the initiation of the accident. Identify, with respect to natural phenomena, human error, equipment malfunction, or equipment failure. Include an estimate of probability and how this probability estimate was determined.

8.2.1.2 Accident Analysis. Analyze the effects and particularly any radiological consequences of each accident. Show the methods, assumptions, and conditions used in estimating the consequences, the recovery from the consequences, and the steps used to mitigate each accident. Assess the consequences of the accident to persons and property onsite. Provide the following information:

1. The mathematical or physical models employed, including a description of any simplification introduced to perform the analyses.

2. Identification of any digital computer program or analog simulation used in the analysis with principal emphasis on the input data and the extent or range of variables investigated. This information should include figures showing the analytical models, flow path identification, actual computer listing, and complete listing of input data. The detailed description of mathematical models and digital computer programs or listings may be included by reference with only summaries provided.

3. The physical or mathematical models used in the analyses and the bases for their use with specific reference to

    a. The distribution and fractions of the radioactive material inventory assumed to be released from the source into offgas systems;

b. The concentrations of airborne radioactive materials in the confinement atmosphere and buildup on filters during the post-accident time intervals analyzed; and

c. The conditions of meteorology, topography, or other circumstances and combinations of adverse conditions considered in the analyses.

4. The time-dependent characteristics, activity, and the release rate of transmissible radioactive materials within the confinement system that could escape to the environment via leakages in the confinement boundaries and leakage through lines that could exhaust to the environment.

5. The considerations of uncertainties in calculational methods, equipment performance, instrumentation response characteristics, or other indeterminate effects that should be taken into account in evaluating the results.

6. The conditions and assumptions associated with the events analyzed, including any reference to published data or research and development investigations in substantiation of the assumed or calculated conditions.

7. The extent of system interdependency with the nuclear power plant system (confinement system and other engineered safety features) contributing directly or indirectly to controlling or limiting leakages from the confinement systems or other sources such as the contribution of confinement air systems and air purification and cleanup systems.

8. The results and consequences derived from each analysis and the margin of protection provided by whatever system is depended on to limit the extent or magnitude of the consequences.

8.2.1.3 Accident Dose Calculations. For each accident analyzed, provide and discuss the results of conservative calculations of potential integrated whole-body and critical-organ doses to an individual from exposure to radiation as a function of distance and time after the accident. Present the results in terms of a 50-year dose commitment. Discuss the results and consequences derived from the analysis and the margin of protection provided by whatever system is depended on (i.e., remains operative) to limit the extent or magnitude of the consequences.

8.3 Site Characteristics Affecting Safety Analysis

Describe in summary form the site characteristics that have a bearing on the safety analysis, and show how these have been considered in developing suitable margins of safety for the spent fuel storage system.

9. CONDUCT OF OPERATIONS

The plan for operation of the spent fuel storage system should be described. Sufficient detail should be provided to indicate how the applicant intends to conduct operations and ensure that a technically competent staff will be maintained to provide continued implementation of administrative and operating procedures and programs.

9.1 Organizational Structure

9.1.1 Corporate Organization

Describe the corporate arrangement or organization responsible for the spent fuel storage system operations. Provide sufficient information to demonstrate the financial capabilities for construction, operation, and decommissioning of the storage system. References to the appropriate sections of the collocated reactor FSAR could facilitate presentation.

9.1.1.1 Corporate Functions, Responsibilities, and Authorities. Describe corporate functions, responsibilities, and authorities with respect to engineering and design, construction, quality assurance, testing, operation, and other applicable activities.

9.1.1.2 Applicant's In-House Organization. A description should be provided of the applicant's in-house organization established for the design and construction, quality assurance functions, and operations.

9.1.1.3 Relationships with Contractors and Suppliers. The working relationships and organizational interfaces between the applicant, the architect-engineer, and other suppliers and contractors should be described.

9.1.1.4 Applicant's Technical Staff. Describe the duties, responsibilities, and authority of the engineering technical staff, and state numbers of personnel and their qualifications, educational backgrounds (disciplines), and pertinent technical experience.

Indicate the technical support to be provided by outside consultants. If such arrangements are to be used, the specific areas of responsibility and functional working arrangements of these support groups should be provided.

9.1.2 Operating Organization, Management, and Administrative Control System

This section should describe the structure, functions, and responsibilities of the spent fuel storage system operating organization. The following specific information should be included:

9.1.2.1 Onsite Organization. Provide a description of the organizational arrangement of the facility showing the title of each position, the flow of responsibility as depicted by an organizational chart, and the number of personnel in each unit. Describe the organizational arrangement for ensuring safe operation, the mode of operation, and assigned responsibilities.

9.1.2.2 Personnel Functions, Responsibilities, and Authorities. Describe the functions, responsibilities, and authorities of major personnel positions,

including a discussion of specific succession of responsibility for overall operation of the facility and specifically the storage system in the event of absences, incapacitation, or other emergencies.

9.1.3 Personnel Qualification Requirements

Describe the proposed minimum qualification requirements for onsite storage system personnel. Any changes in required qualifications and the identification and qualifications of staff personnel finally selected should be presented to the NRC as these occur. The following specific information should be included.

9.1.3.1 Minimum Qualification Requirements. The minimum qualifications for major operating, technical, and maintenance supervisory personnel should be stated.

9.1.3.2 Qualifications of Personnel. The qualifications of the persons assigned to the managerial and technical positions described should be presented.

9.1.4 Liaison with Other Organizations

Discuss arrangements made with outside organizations, including those providing expertise on technical issues concerning storage site selection, system design and construction, equipment selection or development, and safety evaluations for the spent fuel storage system. Additionally, any arrangements made with other government agencies should be presented. The method or system used to monitor the interfaces between each participant should be included.

9.2 Startup Testing and Operation

Describe the preoperational testing and operating startup plans for the storage system. The plans should include preoperational testing of a cask and the operational sequence involving its use in the storage system, e.g., loading, sealing, storage, unloading. Emphasize those parts of the plan demonstrating the planned operations. Test plans should be presented to verify the integrity of the structures and equipment and to substantiate the safety analyses. Results obtained from carrying out the planned tests should be recorded and reported as a supplement to the SAR.

9.2.1 Administrative Procedures for Conducting Test Program

Describe the system used for (1) preparing, reviewing, approving, and executing testing procedures and instructions and (2) evaluating, documenting, and approving the test results, including the organizational responsibilities and personnel qualifications of the applicant and its contractors. Describe also the administrative procedures (i.e., the system for review and audit) for incorporating any needed system modifications or procedure changes, based on the results of the tests (e.g., test procedure inadequacies or test results contrary to expected test results).

9.2.2 Test Program Description

Describe the test objectives and the general methods for accomplishing these objectives, the acceptance criteria that will be used to evaluate the test results, the basis for acceptance criteria, and the general prerequisites

for performing the tests, including special conditions to simulate normal and off-normal operating conditions of the tests listed.

9.2.2.1 Physical Facilities. For the physical facilities, components, and equipment, identify the items to be tested, type of test, response, and validation.

9.2.2.2 Operations. Identify those operations to be tested, type of test, response, and validation. Tests related to storage casks should be of an operational nature, such as loading, drying, sealing, and unloading.

9.2.3 Test Discussion

For each preoperational test, provide the following information:

1. Describe the purpose of the test;

2. Outline the requirements, responsibilities, and authority for conducting the test;

3. Define the response expected in terms of design bases and criteria discussed in previous chapters, and indicate the margin of difference acceptable for safe operation;

4. Discuss necessary corrective action if the results of the preoperational test do not confirm the expected response; and

5. Discuss the impact on the collocated nuclear power plant of performing the test on the storage system.

9.3 Training Program

Describe the proposed training program, including the scope of training in (1) the storage system operations and design, instrumentation and control, methods of dealing with operating malfunctions, decontamination procedures, and emergency procedures, (2) health physics subjects such as nature and sources of radiation, methods of controlling contamination, interactions of radiation with matter, biological effects of radiation, use of monitoring equipment, and (3) nuclear criticality control. Describe the method used to develop the proposed training program. The Instructional System Development Review used for the collocated reactor may be used as appropriate for analyses of the spent fuel storage installation, including INPO accreditation if appropriate. The proposed program should include refresher training. The capability of entry level personnel should be stated. Identify personnel classification with level of instruction. A description of the changes and additions to the existing training program could simplify presentations.

9.4 Normal Operations

9.4.1 Procedures

The applicant should conduct operations that are important to safety in accordance with approved written procedures. A description of the review,

change, and approval practices for storage system operating, maintenance, and testing procedures should be included. Reference to the procedure approval system for the collocated reactor could facilitate presentation.

9.4.2 Records

Present the management system for maintaining records relating to the operation of the storage system. This should include quality assurance records; operating records, including principal maintenance, alterations, or additions made; accountability records; records of off-normal occurrences; records of events associated with radioactive releases; and environmental survey records.

9.5 Emergency Planning

Describe plans for coping with emergencies. Reference to the existing collocated nuclear power plant's emergency plan and a statement of how it will be applied in the case of the spent fuel storage system is adequate.

9.6 Physical Security Plan

A description of and a schedule for proposed changes, related to the spent fuel storage system, to the NRC-approved physical security plan should be provided.

10. OPERATING CONTROLS AND LIMITS

The operating controls and limits for the spent fuel storage system are derived from the safety assessment of the storage system and include all important safety, environmental, materials, equipment, and plant protection aspects of operation. The safety and environmental analyses should support the conclusion that the health and safety of the public and operating personnel and the environmental values will be protected during operation if all operations are performed within certain prescribed limits. These limits are defined and established in the operating controls and limits.

Except for changes that involve license conditions, safety questions that have not been reviewed, significant increases in occupational exposure, or significant environmental impacts that have not been reviewed, changes may be made without amending the license. Changes in operating controls and limits require NRC staff review and approval before being instituted. The operating controls and limits should be proposed by the applicant and reviewed and issued by the NRC in the form of license conditions, including technical specifications.

10.1 Proposed Operating Controls and Limits

Identify and justify the selection of those variable conditions or other items based on the design criteria of the storage system or determined, as a result of safety assessment and evaluation, to be probable subjects of operating controls and limits for the system.

The operating controls, limits, and bases proposed by the applicant should be included in this chapter of the SAR. The operating controls and limits should be complete to the fullest extent possible. Numerical values and other pertinent data, including the technical and operating conditions supporting the selection, should be provided. For each control or limit, the applicable sections that show the analysis, evaluation, and bases for establishing the control or limit should be referenced.

Each license issued by the NRC to store spent fuel at the storage site will contain technical operating limits, conditions, and requirements imposed on the conduct of operations in the interest of the health and safety of the public. The operating controls and limits are proposed by the applicant. A statement of the bases or reasons for proposed controls or limits should be included in the SAR. After review by the NRC staff, they are modified as necessary before becoming part of the license.

10.1.1 Content of Operating Controls and Limits

Operating controls and limits should include both technical and administrative matters. Operating controls and limits related to technical matters should consist of those features of the storage system that are of controlling importance to safety (e.g., operating parameters, systems, or components). In addition, operating controls and limits related to technical matters should include environmental monitoring and controls or limits addressed to the attainment of ALARA levels of exposures. Operating controls and limits related to administrative matters should address those organizational and functional requirements that are important to the achievement and maintenance of safe operation of the storage system.

10.1.2 Bases for Operating Controls and Limits

When an operating control and limit has been selected, the bases for its selection and its significance to safety of operation should be defined. This can be done by the provision of a summary statement of the technical and operational considerations justifying the selection. The SAR should show the bases used for selection of operating controls and limits.

10.2 Development of Operating Controls and Limits

Refer to § 72.44, "License Conditions," of 10 CFR Part 72 for guidance on the categories of activities and conditions requiring operating controls and limits. Additional categories may be designated by the applicant or the NRC if deemed necessary to ensure the protection of the environment or public health and safety.

10.2.1 Functional and Operating Limits, Monitoring Instruments, and Limiting Control Settings

Controls or limits of this category apply to operating variables that are observable and measurable (e.g., evidence of cask leakage). Control of such variables is directly related to the performance and integrity of equipment and confinement barriers.

10.2.2 Limiting Conditions for Operation

This category of operating controls and limits covers two general classes: (1) equipment and (2) technical conditions and characteristics of the installation necessary for continued operation, as discussed below.

10.2.2.1 Equipment. Operating controls and limits should establish the lowest acceptable level of performance for a system or component and the minimum number of components or the minimum portion of the system that should be operable or available.

10.2.2.2 Technical Conditions and Characteristics. Technical conditions and characteristics should be stated in terms of allowable quantities, e.g., storage cask temperatures, radioactivity levels in gas samples, area radiation levels, or allowable configurations of equipment and spent fuel assemblies and rods during transfer and storage operations.

10.2.3 Surveillance Requirements

Surveillance procedures should be developed to ensure the integrity of systems and components that are important to safety. Tests, calibrations, and inspections should verify the performance and availability of equipment and confirm that operations are within functional and operating limits. Discuss surveillance procedures in this section.

10.2.4 Design Features

The operating controls and limits cover design characteristics of special importance to each of the physical barriers and to the maintenance of safety

margins in the design. The principal objective of this section is to show how changes in the design of structures, systems, and components important to safety are developed, reviewed, and controlled, i.e., a description of the review and audit system for design and design changes.

10.2.5 Administrative Controls

The SAR should contain a full description and discussion of organizational and administrative systems and procedures, recordkeeping, review and audit, and the reporting necessary to ensure that the operations involved in the storage of spent fuel at the storage site are performed in a safe manner.

10.2.6 Suggested Format for Operating Controls and Limits

1. Title: (e.g., maximum radiation level at any surface of the storage cask).

2. Specification: (limits).

3. Applicability: Systems or operations to which the control or limit applies should be clearly defined.

4. Objective: The reasons for the control or limit and the specific unsafe conditions it is intended to prevent.

5. Action: What is to be done if the control or limit is exceeded; clearly define specific actions.

6. Surveillance Requirements: What maintenance and tests are to be performed and when.

7. Bases: The SAR should contain all pertinent information and an explicit detailed analysis and assessment supporting the choice of the item and its specific value or characteristics. The basis for each control or limit should contain a summary of the information in sufficient depth to indicate the completeness and validity of the supporting information and to provide justification for the control or limit. The following subjects may be appropriate for discussion in the bases section:

a. Technical Basis. The technical basis is derived from technical knowledge of the process and its characteristics and should support the choice of the particular variable as well as the value of the variable. The results of computations, experiments, or judgments should be stated, and analysis and evaluation should be summarized.

b. Equipment. A safety limit often is protected by or closely related to certain equipment. Such a relationship should be noted, and the means by which the variable is monitored and controlled should be stated.

For controls and limits in categories referenced in Sections 10.2.2 through 10.2.4, the bases are particularly important. The function of the equipment and how and why the requirement is selected should be noted here. In addition, the means by which surveillance is accomplished should be

noted. If surveillance is required periodically, the basis for the frequency of the required action should be given.

c. Operation. The margins and the bases that relate to the safety limits and the normal operating zones should be stated. The roles of operating procedures and of protective systems in guarding against exceeding a limit or condition should be stated. Include a brief discussion of such factors as system responses, operational transients, malfunctions, and procedural errors. Reference to related controls or limits should be made.

11. QUALITY ASSURANCE

Subpart G of Part 72 requires that a quality assurance (QA) program be established, maintained, and executed for structures, systems, and components important to safety. The QA program to be applied to the spent fuel storage system should be described. The applicant should identify systems and components that are important to safety and will be covered by the QA program. The QA program should be applied to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of structures, systems, and components identified as important to safety. The applicable QA criteria should be executed to an extent that is commensurate with the importance to safety.

A QA program that has been accepted by the NRC as meeting Appendix B to 10 CFR Part 50 or Subpart G of 10 CFR Part 72 may be applied to the spent fuel storage system. The applicant should state the intent to apply this QA program, the date on which the QA program was submitted to the NRC, the docket number, and the date of NRC acceptance.

A branch technical position entitled "Quality Assurance Programs for an Independent Spent Fuel Storage Installations (ISFSI) 10 CFR 72"* has been adopted by the NRC staff for implementing review of quality assurance programs submitted by applicants. This document could be applied to a QA program for an onsite spent fuel storage system.

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*A copy of this branch technical position is available for inspection and copying for a fee at the NRC Public Document Room, 1717 H Street NW., Washington, DC, under Task CE 301-4. Single copies may be obtained by writing to the Fuel Cycle Safety Branch, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

VALUE/IMPACT STATEMENT

A draft value/impact statement was published with the draft regulatory guide (Task CE 301-4) when the draft guide was published for public comment in April 1986. No changes in the value/impact statement were necessary, so a separate value/impact statement for the final guide has not been prepared. A copy of the draft value/impact statement is available for inspection and copying for a fee at the Commission's Public Document Room at 1717 H Street NW., Washington, DC, under Task CE 301-4.