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STANDARD FORMAT AND CONTENT FOR A TOPICAL SAFETY ANALYSIS REPORT FOR A SPENT FUEL DRY STORAGE CASK

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

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," specifies that a safety analysis report (SAR) must be included with an application for a license under Part 72. A safety evaluation specifically for the cask to be used for storing spent fuel must be provided in the SAR for an ISFSI license because the cask is important to safety.

This regulatory guide provides guidance on the format and content of a topical safety analysis report (TSAR) for a spent fuel storage cask. There is no regulation that requires the submittal of a TSAR for spent fuel storage casks. However, if a TSAR on a specific spent fuel storage cask is evaluated by the NRC staff and accepted for referencing in licensing actions, appropriate sections of the TSAR could be referenced in other submittals. Applicants for a specific license under Part 72 could reference the appropriate information in their SAR, thus significantly reducing their time, effort, and costs.

Casks used for storage of spent fuel on a reactor site could be those used for shipping spent fuel or could be those designed for storage only. Casks used for shipping must be licensed under 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," which requires stringent quality assurance and cask testing. Casks used for shipping could also be approved for storage of spent fuel if their safety is demonstrated.

Purpose and Applicability

Not all subjects identified in this regulatory guide may be applicable to a specific cask design, e.g., for casks with solid neutron shield material, guidance related to liquid shielding material and its retention. Additional or different subjects may be applicable to some cask designs. The information identified represents the minimum that should be provided, recognizing that not all information requested necessarily applies to all specific designs.

Additional information may be requested for NRC staff review of the TSAR. If any changes in the cask design are made after submittal of the TSAR but before the NRC has completed its review, the TSAR should be updated. This ensures that the TSAR as accepted for referencing reflects the actual cask design.

The TSAR should serve as the principal technical communication between the cask vendor and the NRC. It establishes the design of the cask and the plans for its use.

The TSAR should contain an analysis of the cask design in terms of potential hazards and the means employed to protect against these hazards, including the associated margins of safety. This includes evaluating:

1. The cask's vulnerability to accidents during operations and from natural phenomena,
2. Radiation shielding,
3. Confinement and control of radioactive materials,

4. Reliability of the systems that are important to safety, and
5. The radiological impact associated with normal operations, off-normal conditions, and accidents.

The TSAR should demonstrate the degree of skill, care, and effort used in planning all aspects of the project. A complete, in-depth analysis of all subjects in the report should be provided.

The TSAR should set forth a description, including all pertinent technical information, and a safety assessment of the design bases of the cask and its components in sufficient detail that the NRC staff can make an independent evaluation of the cask. A detailed description of the quality assurance program associated with the design and fabrication activities, including identification of the components and systems to which it will be applied, should be provided.

An analysis of anticipated operations, including consideration of human error, should be presented in the appropriate sections of the TSAR covering:

1. Preoperational tests,
2. Anticipated operations and maintenance,
3. Potential limiting conditions on the use of the cask, including limiting specifications on the fuel to be stored, and
4. Considerations for facilitating decommissioning.

There are no regulatory requirements for a TSAR on spent fuel storage casks. However, the information in the TSAR is intended to be used in the SAR required of license applicants under 10 CFR Part 72. The information collection requirements of 10 CFR Part 72 have been cleared under OMB Clearance No. 3150-0132.

Supplemental Information

Because of the diversity of design possibilities for a spent fuel dry storage cask, the initial enrichment, burnup, cooling time, condition (e.g., cladding integrity) of the fuels to be stored, and other storage conditions, detailed information not explicitly identified in this Standard Format may be included in the TSAR. The following are examples:

1. Information regarding assumed analytical models or calculational methods for design alternatives used by the vendor or its agents, with particular emphasis on rationale and detailed examples used to develop the bases for criticality safety,
2. Technical information in support of new design features of the cask,
3. Reports furnished by consultants.

Proprietary Information

Proprietary information should be submitted separately. When submitted, it should be clearly identified and accompanied with 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."

Style and Composition

To the extent possible, the TSAR should follow the numbering system of this Standard Format at least down to the level of subsections, e.g., 3.1.2 Design Criteria.

References, including author, date, and page number, should be cited within the text if important to the meaning of the statement. References 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 TSAR.

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

Abbreviations should be consistent throughout the TSAR and should be consistent with generally accepted usage. Any abbreviations, symbols, or special terms not in general usage or that are unique to the proposed cask design should be defined when they first appear in the TSAR.

Graphic Presentations

Graphic presentations such as drawings, diagrams, sketches, and tables should be employed when 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 in the section in which they are primarily referenced.

Physical Specifications

Paper size

Text pages: 8-1/2 x 11 inches.

Drawings and graphics: 8-1/2 x 11 inches; however, a larger size is acceptable provided the finished copy when folded does not exceed 8-1/2 x 11 inches.

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

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

Printing

Composition: text pages should be single spaced.

Type face and style: should be suitable for microfilming or image-copying equipment.

Reproduction: may be mechanically or photographically reproduced. All pages of text should be printed on both sides with image printed head-to-head.

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

Page numbering. Pages should be numbered with the digits corresponding to the chapter and first-level section numbers followed by a hyphen and a sequential number within the section, e.g., the third page in Section 4.1 of Chapter 4 should be numbered 4.1-3. Do not number the entire report sequentially. (Note that because of the small number of pages in this guide, this Standard Format is numbered sequentially throughout.)

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.

To avoid confusion between original and updated material, each TSAR supplement should be dated and identified by its supplement number in the lower right-hand corner of the page. Each supplement should be accompanied by a supplement index, also dated and numbered, listing pages to be inserted or removed. The supplement index should identify pages containing new material by page number and the date of the new material.

1. GENERAL DESCRIPTION

Present, in narrative style, the purpose for and a general description of the storage cask. The information in this chapter should enable the reader to obtain a basic understanding of the cask and the protection afforded the public health and safety without having to refer to the subsequent chapters. This general description should enable the reader to follow the detailed chapters with better perspective and to recognize the relative safety importance of each individual item to the overall cask design.

1.1 Introduction

Present briefly the principal design features of the cask. Include a general description of the characteristics of the cask; the nominal capacity of the cask; and the type, form, quantity, and potential sources of the spent fuels to be stored.

1.2 General Description of the Storage Cask

1.2.1 Cask Characteristics

Summarize the principal characteristics of the cask. Include the gross weight, materials of construction, materials used as neutron absorbers and moderators, external dimensions and cavity size, internal and external structures, receptacles, valves, sampling ports, means of passive heat dissipation, volume and type of coolant, outer and inner protrusions, lifting devices, impact limiters if applicable, amount of shielding, pressure relief systems (if applicable), closures, means of confinement, model number, and a description of how individual casks will be identified. The confinement vessel should be clearly identified. Overall and cutaway sketches of the package should be included as part of the description.

If the cask is certified under 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," pertinent information should be provided in this section and details and copies of documents (drawings, etc.) referenced in the cask's Certificate of Compliance should be included in Section 1.5, Supplemental Data.

Drawings and specifications that clearly summarize the safety features considered in the analysis should be included in Section 1.5; for example, material lists, dimensions, and specifications for valves, gaskets, and welds should be included. Detailed construction drawings should not be included.

1.2.2 Operational Features

A discussion of anticipated operations involving the cask should be provided. It should include a schematic diagram showing instrumentation, valves, connections, piping, openings, seals, confinement boundaries, etc. This section should contain a suggested procedure for using the cask. The section should also contain a discussion of the design bases considered for preventing or mitigating the consequences of potential human error.

1.2.3 Cask Contents

State the type and quantity of radionuclides that may be stored in the cask. Include the chemical and physical form, material density, moderator ratios, configurations required for nuclear safety, maximum amount of decay heat, maximum pressure buildup in the inner container, and any other loading restrictions. Estimate the type and quantity of radionuclides available for release.

1.3 Identification of Agents and Contractors

Identify the prime agents or contractors for the design, fabrication, and testing of the cask. All principal consultants and outside service organizations, including those providing quality assurance services, should be identified. The division of responsibility between the designer and fabricator should be delineated.

1.4 Generic Cask Arrays

Identify generic arrays of multiple casks in storage, such as in-line, square, vertical, and horizontal. The information should be sufficient to enable an evaluation of a particular array with regard to thermal and radiological conditions both within the array and at site boundaries.

1.5 Supplemental Data

This section should include detailed information describing the cask and its operational features and contents. Include dimensional drawings, detailed operational schematics, and loading configurations.

2. PRINCIPAL DESIGN CRITERIA

Principal design criteria for the storage cask should be presented in this section. The bases for these criteria should also be discussed. The NRC staff analyzes these design criteria for adequacy in evaluating the cask TSAR. Changes in the criteria are not anticipated after the TSAR is accepted for referencing. Therefore, the criteria selected should encompass all considerations for design alternatives that the vendor may choose.

2.1 Spent Fuel To Be Stored

A detailed description of the physical, thermal, and radiological characteristics of the spent fuels that the cask is designed to store should be provided. Include spent fuel characteristics such as initial enrichment, specific power, burnup, decay time, and heat generation rates.

2.2 Design Criteria for Environmental Conditions and Natural Phenomena

Identify and quantify environmental conditions and natural phenomena used for designing the cask, and identify those components of the cask that are identified as important to safety. Meteorological conditions, flooding, seismicity, ambient temperature range, and peak insolation should be considered, as appropriate. Data and design assumptions should be included.

2.2.1 Tornado and Wind Loadings

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

2.2.1.2 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.

2.2.1.3 Tornado Missiles. The dimensions, energy, velocity, and other parameters should be selected for a potential tornado-driven missile.* An analysis should be presented to show that the cask can withstand the impact of the missile without significantly impairing its confinement ability.

*Paragraph 4 in subsection III of Section 3.5.1.4, "Missiles Generated by Natural Phenomena," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," contains information that may be of value when developing these data. A copy of this section is available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street NW., Washington, DC, under file CE 306-4.

2.2.2 Water Level (Flood) Design

Discuss the applicability of effects from a probable maximum flood (PMF), and, if applicable, discuss the design loads from forces developed by the PMF, including water height and dynamic phenomena such as velocity. Reference the design criteria to PMF data.

2.2.2.1 Flood Elevations. The flood elevations used in the design of the cask for buoyancy and static water force effects should be provided.

2.2.2.2 Phenomena Considered in Design Load Calculations. The phenomena (e.g., flood current, wind wave, hurricane, or tsunami) considered if dynamic water force is a design load should be identified and discussed.

2.2.2.3 Flood Force Application. Describe the manner in which the forces and other effects resulting from flood loadings are applied.

2.2.2.4 Flood Protection. Describe the flood protection measures for cask components that are important to safety.

2.2.3 Seismic Design

Discuss the applicability of effects from seismic events, and, if applicable, discuss the seismic design bases used in the design and fabrication of the cask to establish the required parameters that envelop credible conditions under which the cask may operate. Sufficient detail should be presented to allow an independent evaluation of the criteria selected. If necessary, the following format is suggested.

2.2.3.1 Input Criteria. This section should discuss the input criteria for seismic design of the cask. If response spectral shapes other than those in Regulatory Guide 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants," are proposed for design of the cask, these should be justified and the earthquake time functions or other data from which these were derived should be presented. For damping values that are used in the design, submit a comparison of the response spectra derived from the time history and the design response spectra. The system period intervals at which the spectra values were calculated should be identified.

2.2.3.2 Seismic-System Analyses. This section should discuss the seismic-system analyses applicable to cask components that are important to safety. The following specific information should be included:

1. Seismic Analysis Methods. For all cask components that are important to safety, the applicable methods of seismic analysis should be identified. Applicable descriptions (or sketches) of typical mathematical models used to determine the response should be specified.

2. Methods to Determine Overturning Moments. A description of the dynamic methods and procedures used to determine cask overturning moments should be provided, including a description of the procedures used to account for vertical earthquake effects. Establish the minimum overturning moment that could cause tipping of the cask.

2.2.4 Snow and Ice Loadings

Describe criteria used to ensure that the effects of snow and ice loads can be accommodated, particularly with respect to thermal and stress transients that may be induced.

2.2.5 Combined Load Criteria

For combined loads, describe the criteria selected to provide mechanical and structural integrity. The loads and loading combinations to which the cask is designed should be defined, including the load factors selected for each load component in which a factored load approach is used. The design approach used with the loading combination and any load factors should be specified. 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 thermal effects, effects of creep and shrinkage, and other related effects.

2.3 Safety Protection Systems

2.3.1 General

Identify special considerations in the design that may result from an evaluation of cask operating conditions (e.g., loading, unloading, transport) to ensure the long-term safety and confinement of the stored fuel.

2.3.2 Protection by Multiple Confinement Barriers and Systems

2.3.2.1 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. Include for each:

1. Criteria for protection against any postulated off-normal operations, internal change, or external natural phenomena,
2. Design criteria selected for backup confinement, and
3. Delineation of the extent to which the design is based on achieving the lowest practical level of radioactive releases from the cask.

2.3.2.2 Cask Cooling. Describe the criteria selected for providing suitable passive cooling of the cask under normal and off-normal conditions.

2.3.3 Protection by Equipment and Instrumentation Selection

2.3.3.1 Equipment. Design criteria for cask equipment that is important to safety should be provided. This would include any equipment used to protect against or mitigate the effects of the release of radioactive material.

2.3.3.2 Instrumentation. Discuss the design bases and design criteria for instrumentation selected with particular emphasis on features to provide reliability and testability.

2.3.4 Nuclear Criticality Safety

Supply pertinent design bases to show the appropriate safety margins that ensure that a subcritical situation exists under all credible conditions.

2.3.4.1 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.

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

2.3.4.3 Verification Analyses. Present the criteria for verifying models or computer programs used in criticality analyses. Revision 2 of Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities," provides information on this subject.

2.3.5 Radiological Protection

Based on anticipated storage system operations, an estimate of collective doses (in person-rem) per year, including estimated collective doses associated with cask operation, maintenance, repair, and decommissioning, should be presented.

2.3.6 Fire and Explosion Protection

Provide the design criteria selected to ensure that all safety functions will successfully withstand credible fire and explosion conditions.

2.4 Decommissioning Considerations

Discuss the consideration given in the design of the cask to decommissioning. Examples of subjects to be covered are (1) discussion of neutron activation of the cask and fuel basket materials, (2) provisions for the decontamination and removal of potentially contaminated components, and (3) discussion of the decommissioning processes.

3. STRUCTURAL EVALUATION

This chapter of the TSAR should identify, describe, discuss, and analyze the principal structural engineering design of the cask's components and systems that are important to safety. The design bases for design criteria should be discussed.

3.1 Structural Design

3.1.1 Discussion

Identify the principal structural members and systems that are important to safety, such as the confinement vessel and closure devices. Reference the location of these items on drawings, and discuss their design and performance.

3.1.2 Design Criteria

Describe the load combinations and factors that serve as design criteria. For each of these criteria, state the maximum allowable stresses and strains (as a percentage of the yield or ultimate values) for ductile failure, and describe how the other structural failure modes (e.g., brittle fracture, fatigue, buckling) are considered. If different design criteria are to be allowed in various parts of the cask for different conditions, the appropriate values for each should be indicated. Include the criteria that will be used for impact evaluation. Identify all codes and standards that are used to determine material properties, design limits, or methods of combining loads and stresses. In cases of deviation from standard codes, or when certain components are not covered by standard codes, provide a detailed description of the design criteria used as substitutes for such codes.

3.2 Weights and Centers of Gravity

Provide the total weight of the cask and contents. Tabulate the weights of major individual subassemblies so that the sum of the parts equals the total of the cask. Locate the center of gravity of the cask and any other centers of gravity referred to in the application. It is not necessary to include the calculations made to determine these values, but a sketch or drawing that clearly shows the individual subassembly referred to and the reference point for locating its center of gravity should be included.

3.3 Mechanical Properties of Materials

Provide mechanical properties of materials used in the structural evaluation. These may include yield stress, ultimate stress, modulus of elasticity, ultimate strain, Poisson's ratio, density, and coefficient of thermal expansion. If impact limiters are used, include either a compression stress-strain curve for the material or the force-deformation relationship for the limiter, as appropriate. For materials that are subjected to dynamic loadings or elevated temperatures, the appropriate mechanical properties under these conditions should be specified to the extent used in the structural evaluation. The source of all information in this section should be clearly and specifically referenced as to publication and page number. If material properties were determined by testing, the test procedure, conditions, and measurements should be described in sufficient detail to allow the staff to conclude that the results are valid.

3.4 General Standards for Casks

3.4.1 Chemical and Galvanic Reactions

Discuss possible chemical, galvanic, or other reactions in the cask or between the cask and its contents. For each component material of the cask, list all chemically or galvanically dissimilar materials with which it has contact. Indicate any specific measures that have been taken to prevent contact or reaction between materials, and discuss the effectiveness of such measures.

3.4.2 Positive Closure

Describe and discuss the cask closure system in sufficient detail to show that it cannot be inadvertently opened. This demonstration should include covers, valves, or any other access that must be closed during normal operation.

3.4.3 Lifting Devices

Identify all devices and attachments that can be used to lift the cask or its lid. Show by testing or analysis that these devices, if structurally part of the cask, are capable of supporting three times the weight of the loaded cask without generating stress in any part of the cask in excess of its yield strength. Provide drawings or sketches that show the location and construction of these items. Determine the effects of the forces imposed by lifting on vital cask components, including the interfaces between the lifting devices and other cask surfaces. Documented values of the yield stresses of the materials should be used as the criteria to demonstrate compliance with this section.

3.4.4 Heat

The thermal evaluation for the cask should be reported in Section 4.4.

3.4.4.1 Summary of Pressures and Temperatures. Summarize pressures and temperatures (determined in the thermal evaluation in Chapter 4) that will be used to perform the calculations required for Sections 3.4.4.2, 3.4.4.3, and 3.4.4.4.

3.4.4.2 Differential Thermal Expansion. Calculate the circumferential and axial deformations and stresses (if any) that result from differential thermal expansion. Consider steady-state and transient conditions. These calculations must be sufficiently comprehensive to demonstrate cask integrity under normal operating conditions.

3.4.4.3 Stress Calculations. Calculate the stress from the combined effects of thermal gradients, pressure, and mechanical loads. Provide sketches or free body diagrams that show the configuration and dimensions of the members or systems being analyzed, and locate the points at which the stresses are being calculated. The analysis should consider whether repeated cycles of thermal loadings, together with other loadings, will cause fatigue failure or extensive accumulations of deformation.

3.4.4.4 Comparison with Allowable Stresses. Make the appropriate stress combinations and compare the resulting stresses with the design criteria in Section 3.1.2. Show that all the requirements specified in the regulations have been satisfied.

3.4.5 Cold

Assess the cask for the effects of a steady-state ambient temperature. Consider both material properties and possible freezing of liquids under this condition. For components of the cask that are important to safety, identify the resulting temperatures and the ways they affect the operation of the cask. Brittle fracture should be considered.

3.5 Fuel Rods

When fuel rod cladding is considered in the design criteria for confinement of radioactive material under normal or accident conditions, provide an analysis or test results showing that the cladding will maintain its integrity. Show that fuel rod assemblies can be handled during loading and unloading of the cask without compromising the confinement of radioactive materials.

3.6 Supplemental Data

This section should include information such as justifications of assumptions or analytical procedures; test results; photographs; computer program descriptions, documentation, benchmarks, and input/output; reference lists; and applicable pages from referenced documents.

4. THERMAL EVALUATION

This chapter of the TSAR should identify, describe, discuss, and analyze the thermal engineering design of the cask structures, components, and systems that are important to safety. The bases for the design criteria should be discussed.

4.1 Discussion

Describe the significant thermal design features and operating characteristics of the cask. The operation of all subsystems (e.g., cooling systems, expansion tanks) should be discussed. Summarize the significant results of the thermal analysis or tests and the implication of these results on the overall design. State the minimum and maximum decay heat loads assumed in the thermal evaluation.

4.2 Summary of Thermal Properties of Materials

List the thermal properties of all materials used in the thermal evaluation. References for the data cited should be provided in Section 4.5.

4.3 Specifications for Components

Include the specifications for cask components. For example, in the case of relief devices or rupture discs, the operating pressure range and temperature limits should be included. Data should be supplied in support of technical specifications and should be presented in detail in Section 4.5.

4.4 Thermal Evaluation for Normal Conditions of Storage

4.4.1 Thermal Model

4.4.1.1 Analytical Model. Describe the analytical thermal model in detail. The model should include data on gaskets, valves, fuel assemblies, and the overall containment. Modeling assumptions should be fully justified.

4.4.1.2 Test Model. Describe the tests, models, and procedures used to correlate the test data to the thermal environment for normal conditions. Temperature data should be taken from gaskets, valves, confinement boundaries, and other areas of the cask.

4.4.2 Maximum Temperatures

Provide the maximum temperature distribution for the cask for normal conditions of storage, including the spent fuel, confinement vessel, shielding material, gaskets, valves, etc.

4.4.3 Minimum Temperatures

Provide the minimum temperature distribution for the cask for normal conditions of storage. This evaluation should include the minimum decay heat load that will be experienced. If a decay heat load greater than zero is required for safe operation, assurance of that heat load must be provided. The temperatures of significant components such as gaskets and valves should be reported.

4.4.4 Maximum Internal Pressures

The conditions within the range of normal conditions of storage that result in the worst internal pressures or the worst combination of thermal loadings should be identified. The internal pressures for the conditions should be determined. The evaluation should consider the effects of phase change, gas generation, chemical decomposition, etc.

4.4.5 Maximum Thermal Stresses

Determine the conditions within the range of normal conditions of storage that result in the worst combination of thermal gradient and isothermal stresses. Provide the resulting temperature distribution.

4.4.6 Evaluation of Cask Performance for Normal Conditions of Storage

Evaluate the cask performance, including system and subsystem operations, for normal conditions of storage with respect to the results of the thermal analyses or tests performed. Take into account significant conditions to be found in the ranges bounded by the minimum and maximum ambient temperatures and minimum and maximum decay heat loads. Compare the results with allowable limits of temperature, pressure, etc., for the cask components. Designate the information that is to be used in other chapters of the TSAR. Present the information in summary tables along with discussions as appropriate.

4.5 Supplemental Data

This section should include data in support of thermal evaluations such as justifications of assumptions or analytical procedures; test results; photographs; computer program descriptions, documentation, benchmarks, and input/output; and applicable pages from referenced documents.

5. SHIELDING EVALUATION

This chapter should identify, describe, discuss, and analyze the shielding design of the cask and its systems that are important to safety. The bases for the design criteria should be discussed.

5.1 Discussion and Results

Discuss the significant shielding design features of the cask and the adequacy of the shielding. Table 5-1 (in Section 5.2.2) should be completed.

5.2 Source Specification

The gamma and neutron source terms used in the shielding analysis and the spent fuel loadings that would produce these values should be stated.

5.2.1 Gamma Source

State the quantity of radioactive material assumed as contents of the cask, and tabulate the gamma decay source strength (MeV/sec and photons/sec) as a function of photon energy. Describe in detail the method used to determine the gamma source strength and distribution.

5.2.2 Neutron Source

State the quantity of radioactive material assumed as contents of the cask, and tabulate the neutron source strength (neutron/sec) as a function of energy. Describe in detail the method used to determine the neutron source strength and distribution.

5.3 Model Specification

In this section, describe the model that was used in the shielding evaluation.

5.3.1 Description of the Radial and Axial Shielding Configurations

Include sketches (to scale) and dimensions of the radial and axial shielding materials. Dose point locations for the various calculations exterior to the package should be shown relative to the source regions in the sketches supplied. Voids or irregularities not taken into account in the model should be discussed in detail, showing that the resultant dose rates are conservative. Differences between the models for normal conditions and accident conditions should be clearly identified.

5.3.2 Shield Regional Densities

The material densities (g/cm^3) and the atomic number densities (atoms/barn-cm) for constituent nuclides of all materials used in the calculational models for the normal and accident analyses should be given in this section. The sources of the data should be referenced; provide a copy of the data for uncommon shielding material in Section 5.5.

TABLE 5-1

SUMMARY OF MAXIMUM DOSE RATES
(mrem/hr)

	Cask Surface			1 Meter (3 Feet) from Surface of Cask		
	Sides	Top	Bottom	Sides	Top	Bottom
Normal Conditions						
Gamma						
Neutron						
Total						
Postulated Accident Conditions						
Gamma						
Neutron						
Total						

5.4 Shielding Evaluation

Provide a general description of the basic method used to determine the gamma and neutron dose rates at the selected points outside the cask for both normal conditions of storage and accident conditions. This should include a description of the spatial source distribution and any computer program used, with its referenced documentation. The basic input parameters should be discussed in detail. The basis for selecting the program, attenuation and removal cross sections, and buildup factors should be provided. Flux-to-dose-rate conversion factors as a function of energy should be tabulated. Data are to be supported by appropriate references.

5.5 Supplemental Data

This section should include supplemental data such as justifications of assumptions or analytical procedures; test results; photographs; computer program descriptions, documentation, benchmarks, and input/output; and applicable pages from referenced documents.

6. CRITICALITY EVALUATION

This chapter should identify, describe, discuss, and analyze the criticality safety physics used for design of the cask and its components and systems that are important to safety.

6.1 Discussion and Results

Discuss the significant criticality design features of the cask and the adequacy of the criticality evaluation. A summary of the criticality evaluation should be included in this section.

6.2 Spent Fuel Loading

Provide a summary table showing the maximum spent fuel loading and spent fuel parameters for the cask.

6.3 Model Specification

This section should contain a description of the model used in the criticality evaluation.

6.3.1 Description of Calculational Model

Dimensioned sketches (to scale) or the geometric model used in the calculations should be presented. The sketches should identify the materials used in all regions of the model. Differences between the actual cask configuration and the model should be identified, and the model should be shown to be conservative. Differences between the models for normal conditions of storage and accident conditions should be clearly identified.

6.3.2 Cask Regional Densities

The material densities (g/cm^3) and the atomic number densities (atoms/barn-cm) for constituent nuclides of all materials used in the calculational models for the normal and accident analyses are to be given in this section. Fissionable isotopes are to be considered at their most credible reactivity. Masses for materials in all regions should be consistent with atomic number densities and volumes occupied.

6.4 Criticality Calculation

This section should contain descriptions of the calculational or experimental methods used to determine the nuclear reactivity for the maximum fuel loading intended to be stored in the cask.

6.4.1 Calculational or Experimental Method

A description of the method used to calculate the effective multiplication constant of the cask under normal conditions of storage and accident conditions should be provided. This should include a description of the computer program and neutron cross sections used with their referenced documentation. The basis for selecting the program and cross sections should be discussed.

If an experimental method was used to determine the compliance of the cask with criticality requirements, include a complete description of the method and a discussion demonstrating that the method conservatively takes into account both normal and accident conditions of storage for the cask.

6.4.2 Fuel Loading or Other Contents Loading Optimization

Demonstrate that the maximum reactivity for fuel loading or other contents loading has been evaluated for both a single cask and arrays of casks for normal and accident conditions. Approximations, boundary conditions, calculational convergence criteria, and cross-section adjustments should be itemized and discussed.

6.4.3 Criticality Results

Results of the reactivity calculations establishing the most reactive configurations for a single cask and arrays of casks for both normal conditions of storage and accident conditions should be displayed in tabular and graphic form. Justification should be provided for any interpolations and extrapolations. A discussion of the validity and conservatism of the analysis should be provided, including the bias established with the benchmark calculations in Section 6.5.

6.5 Critical Benchmark Experiments

This section should provide justification for and show the validity of the calculational method and neutron cross-section values used in the analyses. Revision 2 of Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities," provides information on validation of criticality calculations.

6.5.1 Benchmark Experiments and Applicability

Provide a general discussion of selected critical benchmark experiments that are to be analyzed using the method and cross sections given in Section 6.4.1. The applicability of the benchmarks in relation to the cask design and its contents should be shown. References giving documentation on these benchmarks should be provided.

6.5.2 Results of the Benchmark Calculations

Provide the results of the benchmark calculations. Establish and provide a discussion of any calculation bias.

6.6 Supplemental Data

This section should include information such as justifications of assumptions and analytical procedures; test results; photographs; computer program descriptions, documentation, benchmarks, and input/output; and applicable pages from referenced documents.

7. CONFINEMENT

This chapter should identify and discuss cask confinement for normal conditions of storage. The bases for the design criteria should be discussed.

7.1 Confinement Boundary

Identify the confinement boundary of the cask.

7.1.1 Confinement Vessel

A summary of design specifications for the confinement vessel should be provided.

7.1.2 Confinement Penetrations

Identify all penetrations in the primary confinement boundary. Provide a summary of the performance specifications for all components that penetrate the confinement boundary.

7.1.3 Seals and Welds

Identify all seals and welds that affect cask confinement. Provide a summary of the fabrication specifications for these seals and welds, including tests and inspections required for quality assurance.

7.1.4 Closure

Identify the closure devices used for the confinement vessel. Specify the initial bolt torque that will be required to maintain a positive seal during normal conditions of storage and accident conditions.

7.2 Requirements for Normal Conditions of Storage

Summarize the pertinent results of the analyses or tests performed to demonstrate the cask confinement under normal storage conditions.

7.2.1 Release of Radioactive Material

Show that there will be no direct release of particulate radioactive material from the confinement vessel. Describe the means for detecting radioactivity in the confinement vessel without disrupting the sealing system.

7.2.2 Pressurization of Confinement Vessel

Any vapors or gases that could form in the confinement vessel should be identified. Show that any increase in pressure or explosion within the confinement vessel that is caused by these vapors or gases would not result in a radioactive release that exceeds the limits of 10 CFR Part 72.

7.3 Confinement Requirements for Hypothetical Accident Conditions

7.3.1 Fission Gas Products

Estimate the maximum quantity of fission gas products that could be available for release from the confinement vessel under hypothetical accident conditions.

7.3.2 Release of Contents

Show that there can be no significant release of radioactive materials exceeding site boundary requirements.

7.4 Supplemental Data

This section should include supporting information and analyses.

8. OPERATING PROCEDURES

This chapter should describe operating procedures recommended for the preparation for and performance of the processes of loading, testing, storing, unloading, and maintaining the function of the cask. The discussion of these procedures, including appropriate tests, should be presented sequentially in the anticipated order of performance. At a minimum, this chapter should demonstrate that the procedures, if properly followed, will ensure that occupational radiation exposures will be maintained as low as is reasonably achievable and that there is reasonable assurance that the health and safety of the public will be protected. A copy of the recommended procedures and tests should be provided to each user of the cask.

8.1 Procedures for Loading the Cask

The section should include descriptions of recommended procedures for inspections, tests, and special preparations of the cask for loading. If applicable, present a detailed description of the procedures used to ensure that fluids such as shield water and primary coolants fill their respective cavities, in compliance with the design specifications. Also provide details of the procedures used to remove residual moisture from cavities designed to be dry. Provide an evaluation of the effectiveness of such procedures.

8.2 Procedures for Unloading the Cask

This section should include descriptions of recommended procedures for inspections, tests, and special preparations of the cask for unloading. As applicable, provide the procedures used to ensure safe removal of fission gases, contaminated coolant, and solid contaminants. Describe any required cooldown procedure and, if applicable, show that it does not affect reuse of the cask.

8.3 Preparation of the Cask

This section should contain a description of recommended procedures for inspections, tests, and special preparations of the cask necessary to ensure that the cask is properly loaded, closed, decontaminated to prevent the spread of contamination, and delivered to a transport vehicle in such a condition that subsequent transport will not impair the effectiveness of the cask to perform its required safety function.

8.4 Supplemental Data

This section should include supporting documentation, detailed discussions and analyses of procedures, and graphic presentations.

9. ACCEPTANCE CRITERIA AND MAINTENANCE PROGRAM

This chapter should contain a discussion of the cask acceptance criteria and the cask maintenance program. The bases for acceptance criteria should be discussed.

9.1 Acceptance Criteria

Discuss the analyses or tests to be performed prior to the first use of the cask.

9.1.1 Visual Inspection

The visual inspections to be performed and the intended purpose for each inspection should be discussed. The acceptance criteria for each of these inspections, as well as the action to be taken if noncompliance is encountered, should be provided.

9.1.2 Structural

Describe the analyses or tests to be performed for structural acceptance. Present the acceptance criteria and describe the action to be taken when the prescribed criteria are not met. An estimate of the sensitivity of the tests should be provided and the basis for this estimate should be given.

9.1.3 Leak Tests

Describe the leak tests to be performed. Leak tests should be performed on the confinement vessel as well as auxiliary equipment that is important to safety, such as shield tanks. Describe the acceptance criteria and the action to be taken if the criteria are not met. Estimate the sensitivity of these leak tests and give the basis for the estimate.

9.1.4 Components

Analyses and/or tests for components that are important to safety should be discussed. If a characteristic (for instance, longevity) cannot be tested, an upper limit should be justified. Acceptance criteria and actions to be taken if the criteria are not met (e.g., replacement) should be presented.

9.1.4.1 Valves, Rupture Discs, and Fluid Transport Devices. These components should be analyzed or tested under the most severe service conditions for which acceptable performance is assumed for the cask design. When the tests are presumed to adversely affect the continued performance of a component, the results of tests on components of the same model and type may be substituted.

9.1.4.2 Gaskets. Gaskets should be tested under conditions simulating the most severe service conditions under which the gaskets are assumed to perform. Since these acceptance tests may degrade the performance of either the gasket under test or the cask into which it is assembled or both, the tests are not necessarily performed on gaskets or casks to be put into service. The simulation system should ensure adequate representation of those conditions that would prevail if the actual system were used in the test. The manufacturer of the gasket should maintain a quality assurance program adequate to ensure that acceptance testing of a given gasketing device is equivalent to acceptance testing of all gaskets of that model supplied by that manufacturer.

9.1.4.3 Miscellaneous. Any component not listed in Sections 9.1.4.1 and 9.1.4.2 whose failure would impair cask effectiveness should be analyzed or tested under the most severe conditions for which it was designed. Since acceptance tests may degrade the performance of either the component under test or the system into which it is assembled or both, the tests are not necessarily performed on components or systems to be put into service. The analyses should ensure adequate representation of those conditions that would prevail if the actual system were in use. Furthermore, the manufacturer of the component should maintain a quality assurance program adequate to ensure that acceptance testing of a given component device is equivalent to acceptance testing of all devices of that model supplied by that manufacturer.

9.1.5 Shielding Integrity

Discuss the analyses or tests to be performed to ensure adequate shielding for both gamma and neutron sources. The acceptance criteria as well as the action to be taken if the criteria are not met should be described.

9.1.6 Thermal Acceptance

Discuss the analyses or tests to verify that each cask will perform, within some defined variance, in accordance with the results of the thermal analyses or tests for normal conditions of storage.

9.1.6.1 Discussion of Test Setup. Describe the analysis or test setup. The description should include heat sources, instrumentation, and schematics showing thermocouple and heat source locations as well as the placement of other test equipment. Estimate test sensitivities based on instrumentation, test item, and environmental variations.

9.1.6.2 Test Procedure. Discuss the procedures used in all tests and describe the data-recording method. Report the frequency of data recording during the test. The criteria used to define the steady-state (thermal equilibrium) condition of the test item should also be discussed.

9.1.6.3 Acceptance Criteria. Discuss the thermal acceptance criteria and the method employed to compare any acceptance test results with predicted thermal performance. Discuss the action to be taken if the thermal acceptance criteria are not met.

9.2 Maintenance Program

This section should describe the recommended maintenance program that will ensure continued performance of the storage cask. The program should include recommended testing, inspection, and replacement schedules, as well as criteria for replacement and repair of components and subsystems on an as-needed basis.

9.2.1 Subsystems Maintenance

Describe the tests and replacement schedules recommended for storage cask subsystems (e.g., neutron shield tanks) whose inadequate performance could result in the inability of the cask to perform its safety function. Justify the schedules established, using tests or manufacturers' data.

9.2.2 Valves, Rupture Discs, and Gaskets on Containment Vessel

Specify the test and replacement schedule to be used for these components. Justify the recommended schedules.

10. RADIATION PROTECTION

This chapter of the TSAR should provide information on methods for radiation protection and on estimated radiation exposures to operating personnel during anticipated operation (including maintenance, surveillance, inspections, and instrument calibration). This chapter should also include information on planned procedures and programs and the techniques and practices that should be employed by the applicant in meeting the standards of 10 CFR Part 20 for protection against radiation. Reference to other chapters for information needed in this chapter should be specific.

10.1 Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)

10.1.1 Policy Considerations

Discuss ALARA policies on occupational radiation exposure with respect to cask design, inspections, repair, and maintenance.

10.1.2 Design Considerations

Describe considerations of cask design that are directed toward ensuring that occupational radiation exposure is ALARA. Describe how experience from past designs is used to develop improved design for ensuring that incidents of contamination are minimized. Describe how the design is directed toward reducing (1) the need for maintenance of equipment, (2) radiation levels, and (3) time spent on maintenance.

10.1.3 Operational Considerations

Identify and describe procedures and methods that could be used to ensure that occupational radiation exposure is ALARA.

10.2 Radiation Protection Design Features

Describe cask design features used for ensuring a high degree of integrity for the confinement of radioactive materials.

Provide scale drawings of the cask showing the locations of all sources described in Section 5.2. Include specific activity, physical and chemical characteristics, and expected radioactivity concentrations. Other information provided should include the potential radiation dose rate for the storage area, maintenance and repair activities, and estimates of radioactive materials that might be discharged during storage. Reference may be made to specific sections of the TSAR for this information.

10.3 Estimated Onsite Collective Dose Assessment

Provide the assumed annual occupancy times, including the anticipated maximum total hours per year for any individual and total person-hours per year for all personnel for each radiation area during normal operation and anticipated operational occurrences. Also provide the objectives and criteria for estimated dose rates in various areas and an estimate of the annual collective person-rem doses associated with major functions such as handling and storage operations, ancillary activities (e.g., offgas handling), maintenance, decontamination, and inservice inspection. Supply the bases, models, and assumptions for the above values. State assumptions made in determining the time-related dose rates.

11. ACCIDENT ANALYSES

The evaluation of cask safety is accomplished in part by analyzing the response of the cask to postulated off-normal and accident events. Consider (1) minimizing the causes of such events, (2) identification and mitigation of the consequences of accidents, and (3) the ability to cope with each situation if it occurs. These analyses are an important aspect of the reviews made by the NRC in evaluating a cask design.

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 off-normal and accident occurrences and their causes and potential consequences. For each situation, reference should be made to the appropriate chapter and section that describe the design considerations to prevent or mitigate the accident. The analyses should relate incidents to anticipated cask use at nuclear power reactor sites and spent fuel storage systems.

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 for use in the design of an ISFSI that uses a dry environment as a mode of storage subject to certain caveates.

11.1 Off-Normal Operations

In this section, design events pertaining to off-normal operation for expected operational occurrences are considered. They may include equipment malfunctions, radiation leakage, or human error. In general, the consequences of the events discussed in this section would not have a significant effect beyond the cask storage area. The following format should be used to present the desired detail.

11.1.1 Event

Identify the event, including the portion of the cask involved, the type of failure or malfunction, the component, system or systems involved, and the effects, consequences, and corrective actions.

11.1.1.1 Postulated Cause of the 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.

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

The following should be provided:

1. Starting conditions and assumptions;
2. A step-by-step sequence of the course of each accident, identifying all protection systems required to function at each step; and
3. Identification of any personnel 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 cask safety features. The performance of backup protection systems during the entire course of the event should be analyzed. 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 be used to determine which components, systems, and controls are important to safety and what actions are required under the anticipated operational occurrence.

11.1.1.2 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 an assessment of response time.

11.1.1.3 Analysis of Effects and Consequences. Analyze the effects of the event, particularly any radiological consequences. 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. Explain how the cask components and their materials of construction provide the needed safety margins. Provide data to support conclusions regarding design assumptions.

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

11.1.2 Radiological Impact from Off-Normal Operations

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

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

11.2 Accidents

An analysis of potential accidents to the cask (e.g., free fall, overturn, fire) should be presented. Include any credible incident that could potentially result in a dose of $\geq$25 mrem beyond a postulated controlled area. If there are no such credible potential accidents, provide the rationale for such a statement. 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. Events that could occur during the cask lifetime, e.g., earthquakes or other low-probability events, should be included. Design events of the third and fourth types defined in ANSI/ANS-57.9-1984 should be included in this section.

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

11.2.1 Analysis of Accidents

Identify the accident, the portion of the cask involved, and the type of accident. Discuss each accident sequentially (e.g., 11.2.2, 11.2.3 ...).

11.2.1.1 Cause of Accident. For each accident analyzed, describe and list the sequence of events leading to the initiation of the accident. Identify the type of event such as natural phenomenon, human error, component malfunction, or component failure. Include an estimate of probability and how this probability estimate was determined.

11.2.1.2 Accident Analysis. Analyze the effects of each accident, particularly any radiological consequences. 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 on the site.

In addition to the assumptions and conditions employed in the course of events and consequences, provide information on the following:

1. The mathematical or physical models employed in accident analyses. Include a description of each simplification introduced to perform the analyses. Identify the bases for the models used with specific reference to:

   a. The distribution and fractions of the radioactive material inventory assumed to be released from the cask,
   b. The concentrations of airborne radioactive materials in the confinement atmosphere and buildup during the postaccident time intervals analyzed, and
   c. The conditions considered in the analyses such as meteorology, topography, and combinations of adverse conditions.

2. Identification of any digital computer program or analog simulation used in the analysis, with principal emphasis on a detailed description of 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 listings, and complete listings of input data.

3. The time-dependent characteristics, activity, and release rate of transmissible radioactive materials that could escape to the environment via leakages in the confinement boundaries.

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

5. 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.

6. The extent of system interdependency (confinement systems and other engineered safety features) contributing directly or indirectly to controlling or limiting leakages from the confinement systems.

7. 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.

11.2.1.3 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. 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.

12. OPERATING CONTROLS AND LIMITS

Throughout the previous sections of this regulatory guide, the need to identify safety limits, limiting conditions, and surveillance requirements has been indicated. It is from such information that the cask operating controls, limits, and supporting bases should be developed. These limits should be defined and proposed as the operating controls and limits for the cask in the TSAR.

12.1 Proposed Operating Controls and Limits

Identify and justify the selection of those variable conditions and limits based on the design criteria of the cask or determined, as a result of safety assessment and evaluation, to be probable subjects of operating controls and limits for the cask. The operating controls and limits should be complete; i.e., to the fullest extent possible, numerical values and other pertinent data should be provided, including the support for selection of the technical and operating conditions. For each control or limit, reference the applicable sections and develop, through analysis and evaluation, the details and bases for the control or limit. Operating controls and limits should be proposed in the TSAR and accepted by NRC review and evaluation.

Each cask should have technical specifications, limiting conditions for operation, design features, and surveillance requirements. Operating controls and limits should be proposed in the TSAR along with an analyses of the bases for the technical specifications and a description of anticipated surveillance requirements.

12.1.1 Content of Operating Controls and Limits

Operating controls and limits should include both technical and administrative matters on those features of the cask that are important to safety (e.g., spent fuel loadings, operating variables, or components). In addition, operating controls and limits should address the attainment of ALARA levels of releases and exposures.

12.1.2 Bases for Operating Controls and Limits

When an operating control and limit has been selected, the basis for its selection and its significance to the safety of the operation should be described. This can be done in a summary statement of the technical and operational considerations justifying the selection. The TSAR should fully develop the details of these bases through analysis and evaluation. The format for presenting operating controls and limits assumes importance since the collection of controls and limits and their written bases form a document that delineates those features and actions important to the safety of operation, the reasons for their importance, and their relationships to each other.

12.2 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.

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

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

12.2.2 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 cask necessary for continued operation.

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

12.2.2.2 Technical Conditions and Characteristics. Technical conditions and characteristics should be stated in terms of allowable quantities, e.g., storage temperatures, radioactivity levels in gas samples, area radiation levels, and allowable configurations of equipment and spent fuel assemblies during operations. Specify the allowable quantities associated with limiting conditions. Specific definitions should be provided for limiting conditions even if they appeared in previous chapters.

12.2.3 Surveillance Specifications

Operating limits and technical specifications should be developed and presented for anticipated normal, off-normal, and accident operating conditions. Recommended surveillance procedures, including tests, calibrations, and inspections, should be provided to cask users to verify availability and performance of systems and components that are important to safety. These surveillance specifications should be described in this section.

12.2.4 Design Features

These operating controls and limits should cover design characteristics of special importance to each of the physical barriers and to maintenance of safety margins in the cask design. The principal objective of this category is to control changes in the design of essential equipment.

12.2.5 Suggested Format for Operating Controls and Limits

1. Title:

2. Specification: (e.g., maximum radiation level at any surface)

3. Applicability: The 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 TSAR should contain 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. If a safety limit 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 or limits in categories referenced in Sections 12.2.2 and 12.2.3, 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 frequency of required action should be given.

c. Operation. The margins and the bases that relate to the safety limits and normal operation 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 expected system responses, operational transients, and malfunctions. References to related limits should be made.

13. 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. Cask systems and components that are important to safety should be identified in the TSAR. The QA program should be applied to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of cask systems and components identified as important to safety. The applicable QA criteria should be executed to an extent that is commensurate with their importance to safety.

A QA program that meets the applicable criteria in Appendix B to 10 CFR Part 50 and that has been accepted by the NRC will be acceptable if it is established, maintained, and executed with regard to the design, testing, fabrication, and repair of the spent fuel storage cask. Prior to first use, the applicant should notify the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, of its intent to apply its previously accepted QA program to spent fuel storage casks. The applicant should identify the program by date of submittal, docket number, and date of NRC acceptance.

A branch technical position entitled "Quality Assurance Programs for 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 also be applied to a QA program for spent fuel storage casks.

*A copy of this branch technical position is available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street, NW., Washington, DC, under file CE 306-4. 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 proposed version of this guide (Task CE 306-4) when the draft guide was published for public comment in April 1986. No changes to 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 2120 L Street NW., Washington, DC, under Task CE 306-4.