USNRC REGULATORY GUIDE SERIES

REGULATORY GUIDE 3.26

STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR FUEL REPROCESSING PLANTS

FEBRUARY 1975

U.S. NUCLEAR REGULATORY COMMISSION

U.S. NUCLEAR REGULATORY COMMISSION

February 1975

REGULATORY GUIDE

REGULATORY GUIDE 3.26

STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR FUEL REPROCESSING PLANTS

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

CHAPTER 7.0 WASTE CONFINEMENT AND MANAGEMENT

CHAPTER 8.0 RADIATION PROTECTION

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

INTRODUCTION

In accordance with 10 CFR Part 50, "Licensing of Production and Utilization Facilities," Safety Analysis Reports (SARs) are required in support of an application for a construction permit and an operating license for a nuclear fuel reprocessing plant. Submission of a Preliminary Safety Analysis Report (PSAR) to the Nuclear Regulatory Commission is required for the construction permit, and a Final Safety Analysis Report (FSAR) is required for the operating license. When a construction permit is issued, the information in the PSAR, which presents the principal design criteria and the design bases selected by the applicant, is incorporated following §50.35 of 10 CFR Part 50 as a binding part of the permit along with any other appropriate conditions. Similarly, the FSAR and Technical Specifications developed from the FSAR are incorporated in the operating license.

The SARs serve as the principal technical communications between the applicant and the Commission. They set forth the design of the reprocessing plant and the plans for its use. In the PSAR and FSAR, the applicant analyzes the facility in terms of potential hazards and the means employed to protect against the hazards, including the associated margins of safety. This includes evaluating the site and its relation to accidents from natural phenomena, evaluating radiation shielding, confinement and control of radioactive material, effluent treatment, projected effluent quantities and concentrations, reliability of the systems essential to safety, and the radiological impact associated with normal operations, abnormal conditions, and accidents.

Each applicant must show in the SAR that the process to be performed, the operating procedures, the facility and equipment, and the applicant's capability collectively provide reasonable assurance that the plant can be constructed and operated without undue risks to the health and safety of the public.

Section 50.34, "Contents of Applications: Technical Information," of 10 CFR Part 50 specifies in general terms the information to be supplied in the SARs. The applicant must develop the Safety Analysis Reports for a fuel reprocessing plant in a manner consistent with the safety considerations applicable to the particular operation proposed.

This "Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants" has been prepared for use by applicants to identify the type of information needed, to emphasize in various areas the depth of detail required in the two reports (PSAR, FSAR), and to indicate the desired format to facilitate an orderly review. Although conformance with the Standard Format is not required, the Standard Format does represent a format acceptable to the NRC staff. Thus, while Safety Analysis Reports with differing formats will be acceptable to the staff if they ptovide an adequate basis for the findings required for the issuance of a license or permit, the staff review time for such reports may be longer and there is a greater likelihood that the information will be regarded by the staff to be incomplete.

The information identified herein should not be construed as all the information that may be required, but the minimum needed for SARs. To obtain guidance as to the depth of analysis required in the SARs, the applicant is invited to confer with the staff in advance of preparing his Safety Analysis Reports. The Commission also is issuing guides describing needed information and acceptable methods for implementing specific details outlined by this Standard Format. Additionally, guidance will be provided to applicants regarding the information to be submitted on material and plant protection aspects.

The applicant should provide for certain selected areas a complete, in-depth analysis, which may be presented in supplemental reports and incorporated in the SAR by reference.

The PSAR should set forth the principal architectural-engineering and design criteria and design bases for all systems and components of the facility in sufficient detail so that an independent determination by the staff can be made regarding reasonable assurance that safe operation can be achieved. A detailed description of the Quality Assurance Program associated with the plant construction is required with the PSAR submittal. With respect to certain information which may not yet be available at the time of submission of the PSAR, the following should be included:

1. The development work which is yet to be completed.

2. The criteria and bases being used to develop the required information.

3. The concepts and/or alternatives under consideration.

4. The schedule for completion of obtaining this information.

There must also be reasonable assurance that such information can be provided or that an acceptable alternative can be substituted.

The FSAR should describe in detail the final plant design and should present the final safety analysis. Changes from the criteria, designs, and bases included in the PSAR should be identified and justified in the FSAR. The safety significance of each change should be discussed. A detailed presentation on the conduct of operations should be included covering:

1. Plans for preoperational testing.

2. Startup and normal operation.

3. Emergency plans.

4. Organizational structure.

5. Personnel qualifications.

6. Operator training.

7. Quality assurance.

8. Decommissioning plan.

9. Proposed technical specifications.

In accordance with the regulations in 10 CFR Part 2, the staff initially makes a preliminary or screening review of each application for a construction permit or an operating license for completeness. Only those applications determined to be sufficiently complete to warrant review are accepted for docketing. The completeness review will include among other things the quality assurance program, particularly as it relates to design and procurement.

USE OF THE STANDARD FORMAT

The SAR should follow the numbering systems of this Standard Format, at least down to the level of sections identified by three digits.

Due to the wide diversity of process and design possibilities for a nuclear fuel reprocessing plant, the applicant may wish to include appendices to the SAR to provide detailed supplemental information not explicitly identified in the Standard Format. Examples are:

1. A glossary of unusual terms or abbreviations used by the applicant.

2. 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.

3. Reports furnished the applicant by consultants.

Proprietary Information

Proprietary information must 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 10 CFR Part 2, Paragraph 2.790.

Style and Composition

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

The applicant should strive for clear, concise presentations of the information provided in the SAR.

Where numerical values are stated, the number of significant figures given should reflect the accuracy or 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 usage or unique to the proposed plant should be defined where first appearing 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 assure that all information so presented is legible, that symbols are defined, and that scales are not reduced to the extent that visual aids are necessary to interpret pertinent items of information presented. These graphic presentations should be located with the section where they are primarily referenced.

A reference should be presented as a footnote on the page where referenced or at the end of the chapter.

Physical Specifications

1. Paper size

Textual pages: 8-1/2 x 11 inches

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

2. Paper stock and ink

Suitable quality in substance, paper color, and ink density for handling and reproduction by microfilming.

3. Page Margins

A margin of no less than one inch is to be maintained on the top, bottom, and binding side of all pages submitted.

4. Printing

Composition: textual pages should be single-spaced.

Type face and style: should be suitable for microfilming.

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

5. Binding

Pages should be punched for loose-leaf ring binding.

6. Page numbering

Pages should be numbered by chapters and sections and sequentially within the section. Do not number the entire report sequentially. For example, the first page of Section 3.1 should be numbered 3.1-1. All references to this Standard Format should be by chapter and section.

Procedures for Updating or Revising Pages

The updating or revising of data and text should be on a replacement page basis.

The changed or revised portion on each page should be highlighted by an identifying mark. This mark should be on the margin opposite the binding margin for each line changed or added. All pages submitted to update, revise, or add pages to the report should show the date of change. The transmittal letter should include an index page listing the pages to be inserted and the pages to be removed. Where major changes or additions are made, a revised Table of Contents should be provided. In addition, when major changes are made to the SAR, there should be a list submitted which identifies the pages of the SAR in effect following page replacement.

STATUS OF THE STANDARD FORMAT

This Standard Format document is issued for comment and interim use. It is the responsibility of the applicant to comply with the Commission's regulations so as to ensure that its plant design and operating practices will result in the degree of safety required.

As developments in the nuclear industry occur, the Commission's requirements for information prior to issuance of construction permits and operating licenses may need modification, and revisions to the contents of the Standard Format will be made to accommodate these new requirements. Revisions of the Commission's needs for the information in the licensing of fuel reprocessing plants will be conveyed to the industry and the public in the following principal ways: (1) by amendments to the Standard Format, (2) by the issuance of new or revised regulatory guides, (3) by Public Announcements, and (4) by direct communications to the applicant by the staff as needed.

STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR FUEL REPROCESSING PLANTS

CHAPTER 1.0 INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT

Provide introductory information, the purpose for, and the general description of the reprocessing plant. The information in this chapter and Chapter 2.0, "Summary Safety Analysis," should enable the reader to obtain a basic understanding of the facility and the protection afforded the public health and safety without having to delve into the subsequent chapters. Review of the detailed chapters which follow can then be accomplished with better perspective and with recognition of the relative safety importance of each individual item to the overall plant design.

1.1 Introduction

Present briefly the principal aspects of the overall application. Include the following: the production activity for which a license is requested, a brief description of the proposed location of the plant, the plant, its nominal capacity, the type and exposure of fuel to be reprocessed, the products, the corporate entities involved, and the estimated time schedules for construction and operation.

1.2 General Plant Description

Include a summary description of the principal characteristics of the site, and a concise description of the plant. The plant description should include a brief discussion of the principal design criteria; operating characteristics and safety considerations for the engineered safety features and emergency systems; instrumentation, control, and electrical systems; fuels handling, cooling water, and other auxiliary systems, and the radioactive waste management system. The arrangement of major structures and equipment should be indicated on plan and elevation drawings in sufficient number and detail to provide a reasonable understanding of the general layout of the plant. Any additional features of the plant likely to be of special interest because of their relationship to safety should be identified.

1.3 General Process Description

Include a summary description of the process to be used in the reprocessing plant, including process origin and background. Identify basic material flow and balance for the product and waste streams. Provide sufficient detail in the discussion and accompanying charts and tables to provide an understanding of the processes involved.

1.4 Identification of Agents and Contractors

Identify the prime contractors for the design, construction, and operation of the fuel reprocessing plant. All principal consultants and outside service organizations (including those providing audits of the quality assurance program) should be identified. The division of responsibility among the process designer, architect-engineer, constructor, and plant operator should be delineated.

1.5 Requirements for Further Technical Information

For the PSAR, itemize and discuss in this section any aspects of the facility or process that will require developing additional information to support the design bases used for the reprocessing facility prior to or during construction. Reference this information to the appropriate sections in Chapters 5.0, 6.0, 7.0, and 8.0 and to any appendices or topical reports filed with the Commission. The discussion may be presented in summary form and should include:

1. An identification and differentiation between those programs that will be required to determine the adequacy of the design, and those that will be used to demonstrate the margin of conservatism of a proven design.

2. A summary description of the technical information that must be obtained to demonstrate acceptable resolution of the problems.

3. A summary description to show how the information will be obtained.

4. The estimated time schedule for commencing and completing each program.

5. An identification of design alternatives or operational restrictions available in the event that the results of the programs do not demonstrate acceptable resolution of the problems.

1.6 Comparison of Final and Preliminary Information

In the FSAR, describe, with details, the changes since submittal of the PSAR. Summarize the information obtained to satisfy the requirements in Section 1.5 above, changes resulting from additional considerations, and the reasons for these modifications. Additionally, in this section provide a complete summary which identifies and discusses all significant changes that have been made in the facility design since submittal of the PSAR. Each item should be cross-referenced to the appropriate section in the FSAR that describes the detailed changes and the reasons for them.

CHAPTER 2.0 SUMMARY SAFETY ANALYSIS

Provide a summary of all aspects considered which relate to providing a safe operation with respect to the protection of operating personnel and the public. Include also a summary of the information presented in Chapter 9.0, "Accident Safety Analysis."

2.1 Site Analysis

2.1.1 Natural Phenomena

From information presented in Chapter 3.0, "Site Characteristics," summarize the frequency and severity or magnitude of natural phenomena which characterize the site and influence design features and design criteria selected. Include earthquakes, lightning, tornadic or hurricane type winds, missiles, inundation by water from possible sources, loss of water supply, and snow load. Include in the summary the methods used to cope with the impact of those phenomena.

2.1.2 Site Characteristics Affecting the Safety Analysis

Describe in summary form the site characteristics which have a bearing on the safety analysis and how these have been considered to show that suitable margins of safety have been developed.

2.1.3 Effect of Nearby Industrial, Transportation, and Military Facilities

Summarize items that have been considered which may present a hazard to the plant facilities from nearby activities. Chapter 3.0, Section 3.2, identifies typical activities to be analyzed. Typical considerations to be evaluated are:

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

2. The effects of explosions of large natural gas pipelines which cross or pass close to the plant.

3. The effect of detonation of the maximum amount of explosives that is permitted to be stored at mines or stone quarries near the site.

4. The potential effects of fires in adjacent oil and gasoline plants or storage facilities, fires at adjacent industries, brush and forest fires, and fires from transportation accidents.

5. The potential effects of accidental releases of toxic gases from onsite storage facilities, nearby industries, and transportation accidents.

6. The effect of expected airborne pollutants on important plant components.

7. For sites in the vicinity of airports, the potential effects of aircraft impacts on the plant and stack, taking into account aircraft size, velocity, weight, and fuel loading.

In the event high natural-draft cooling towers or other tall structures such as discharge stacks are used onsite, evaluate the potential for damage to equipment or structures important to safety in the event of collapse.

2.2 Radiological Impact of Normal Operations

For the gaseous, liquid, and solid wastes, provide:

1. A summary identifying each waste.

2. Amount generated per tonne of spent fuel processed.

3. Quantity of each radionuclide in each stream.

4. The locations considered most impacted by the radioactive effluents which are beyond the restricted areas, as defined in Section 20.3 of 10 CFR Part 20 and beyond the exclusion area defined in Section 100.3 of 10 CFR Part 100.

5. For these locations the amount of each radionuclide and its man-rem contribution of radiation dose to human occupants that can accrue under normal operational circumstances.

6. A discussion and sample calculations of, or reference to, the reliability of the estimated values presented.

7. For each effluent, the constraints imposed on process systems and equipment to ensure safe operation.

8. A discussion of how the "as low as practicable" concept in Section 20.1 of 10 CFR Part 20 will be met and the alternatives considered.

2.3 Radiological Impact from Abnormal Operations

Show the capability of the plant to operate safely within the range of anticipated process variations, malfunctions of process equipment, and operator error. The information may be presented in tabular form, with the situations analyzed listed in one column accompanied by other columns identifying:

1. Estimated man-rem exposure.

2. Method or means available for detecting the respective situations.

3. Causes of the particular situation.

4. The corrective actions.

5. Effects and consequences.

Include a summary of the information presented in Chapter 9.0, "Accident Safety Analysis."

2.4 Accidents

Provide analyses to cover those credible situations which create demands beyond the possible capability of the process, equipment, or confinement features, whether or not mitigated by operation of standby or engineered protection features.

2.5 Conclusions

Provide conclusions with respect to the impact of the plant and its operation on the health and safety of the public and operating personnel.

CHAPTER 3.0 SITE CHARACTERISTICS

This chapter should provide information on the location of the plant and a description of the geographical, demographic, meteorological, hydrological, seismological, and geological characteristics of the site and surrounding vicinity. The objective is to indicate what site characteristics influence plant design and process selection. An evaluation of the site characteristics from a safety viewpoint should be developed. Assumptions should be identified that need to be applied in making the safety appraisal and further related by cross reference to the criteria developed in Chapter 4.0, "Principal Design Criteria." The design bases selected in subsequent chapters used to meet the criteria should also be identified.

3.1 Geography and Demography of Site Selected

Information concerning the site, geography, population, and land usage is needed in the Safety Analysis Report.

3.1.1 Site Location

The location of the plant site should be presented with sufficient clarity that there is no ambiguity about its location in relation to features developed later in this chapter. The site location should be described by specifying the latitude and longitude of the reprocessing plant to the nearest second, and the Universal Transverse Mercator coordinates* to the nearest 100 meters. The State and county in which the site is located should be identified, as well as the location of the site relative to prominent natural and manmade features such as rivers and lakes. To facilitate presenting this information, maps and aerial photographs should be provided. The general location map should include an area within at least a 50-mile radius from the plant. Additional maps should be provided to present detail near the plant and site plots to establish orientation of buildings, vaults, streams, ponds, transmission lines, and neighboring structures. Detail in this section may be referred to in subsequent chapters, to minimize repetition.

3.1.2 Site Description

A map of the site should be included in the application and should be of suitable scale to clearly define the boundary of the site and the distance from significant facility features to the site boundary. The area to be considered as the exclusion area should be delineated clearly if its boundaries are not the same as the boundaries of the plant site. The application should include a description of the applicant's legal rights with respect to the properties described (ownership, lease, easements, etc.).

---

*As found on U.S. Geological Survey topographical maps.

The topography of the site and vicinity should be described by suitable contour maps that indicate the character of surface drainage patterns and the potential impact of surface winds.

Vegetative cover and surface soil characteristics should be described sufficiently to indicate potential erosion and fire hazards.

Traffic and transportation routes and onsite transmission lines should be identified.

3.1.2.1 Site Boundary. For any activity conducted within the area controlled by the applicant but not related to the reprocessing plant operation, identify the boundaries within which the applicant will control such activity.

3.1.2.2 Boundaries for Establishing Effluent Release Limits. Identify the restricted area as defined in 10 CFR Part 20, paragraph 20.3(a)(14) to show the boundary line which will be used to establish effluent release limits. This boundary line, which may or may not be the same as the plant property lines or the exclusion area boundary line, demarcates the area, access to which will be actively controlled for purposes of protection of individuals from exposure to radiation and radioactive materials. The degree of access control required is such that the licensee is able to comply with the radiation protection requirements of 10 CFR Part 20. The site map discussed above may be used to identify this area, or a separate map of the site may be used. Indicate the location of the boundary line with respect to nearby rivers and lakes. Distances from plant effluent release points to the boundary line should be clearly presented.

3.1.3 Population, Distribution, and Trends

Population information based on the most recent census data should be presented to show the population distributions as a function of distance and direction. On a map of suitable scale which identifies places of significant population grouping, such as cities and towns within the 50-mile radius, concentric circles should be drawn, with the reprocessing plant at the center point, at distances of 1, 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles. The circles should be divided into 22-1/2 degree segments, with each segment centered on one of the 16 cardinal compass points (i.e., north, north-northeast, etc.). Within each area thus formed by the concentric circles and radial lines, the current resident population should be specified, as well as the projected population by decade for at least four decades. Describe the basis for the projection. Significant transient or seasonal population variations should be identified and discussed.

3.1.4 Uses of Nearby Land and Waters

Uses of nearby lands and waters within at least a 5-mile radius should be described. Sufficient characterization of farming, dairy, industrial, residential, and recreational activities should be presented to permit estimation of potential population radiation dose commitments resulting from plant effluents. Localized populations in facilities such as schools and institutions should be identified with respect to location and number of persons.

Identify the nature of activities conducted, if any, within the site boundaries other than those directly related to the operation of the facility. Explain the interrelation of these activities to the plant.

3.2 Nearby Industrial, Transportation, and Military Facilities

Provide the location and identification of nuclear facilities within a 50-mile radius. Also, nearby industrial, transportation, and military installations should be identified on a map which clearly shows their distance and relationship to the plant.* As appropriate for each, provide a description of products or materials produced, stored, or transported and the maximum quantities for each, with detailed emphasis on those items which could present a hazard to the safe operation of the reprocessing plant.

Consideration must be given in Chapter 2.0 of the SAR to any features identified as potential safety problems.

3.3 Meteorology

This section should provide a meteorological description of the site and its surrounding area. Meteorological conditions which influence the design and operation of the facility must be identified. Sufficient information should be included to permit an independent evaluation by the staff of atmospheric diffusion characteristics of the local area. The sources of information and data supplied should be stated.

3.3.1 Regional Climatology

Describe the climate of the region, pointing out characteristics attributable to the terrain. Indicate seasonal weather conditions including temperature, precipitation, relative humidity, and prevalent wind direction. Provide data:

1. Which can be applied to the analysis of hydrological problems.

2. Which summarizes the history of intensity and frequency of severe cold and acute thaws.

3. On the occurrence and intensity of heavy rain, snow, and ice storms.

4. On the occurrence and intensity of thunderstorms and lightning strike frequencies.

*All activities within five miles of the site should be considered. Activities at greater distances should be described and evaluated as appropriate to their significance.

5. On the occurrence and intensity of strong winds and tornadoes.

Report those data in sufficient detail to indicate impacts on plant design and operation.

3.3.2 Local Meteorology

3.3.2.1 Data Sources. Qualify onsite data summaries and/or nearby weather summaries of data presented, identifying the methods and frequencies of collection and pointing out data collection undertaken specifically for this reprocessing application.

3.3.2.2 Normal and Extreme Values of Meteorological Parameters. Provide monthly summaries of wind (direction and speed combined), temperature, atmospheric water vapor (absolute and relative), precipitation (rain and snow), fog, and atmospheric stability (if available). Provide the daily high, low, and mean joint temperatures and specific humidity throughout the year.

3.3.2.3 Topography. Provide a detailed topographic description of the site, including a topographic map to a radius of 50 miles from the plant and topographic cross sections in 16 compass point sectors radiating from the plant to at least a distance of 5 miles.

3.3.3 Onsite Meteorological Measurement Program

Describe the onsite meteorological measurement program being conducted to develop local data and the programs which will be used during operations to estimate offsite concentrations of monitored stack effluents. Provide joint frequency distributions of wind speed, wind direction, and atmospheric stability based on appropriate meteorological measurement heights and data reporting periods.

3.3.4 Short-Term (Accident) Diffusion Estimates

3.3.4.1 Basis. Provide conservative estimates of atmospheric dilution at the site boundary, for appropriate time periods after an accident, based on onsite and local meteorological data. Include consideration of any influence local topography may have.

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

3.3.5 Long-Term (Routine) Diffusion Estimates

3.3.5.1 Basis. Provide realistic estimates of atmospheric dilution to a distance of 50 miles based on appropriate meteorological data.

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

3.4 Surface Hydrology

Provide sufficient information to allow an independent review to be made of all hydrologically related design bases, performance requirements, and operating procedures important to safety. Provide a description characterizing the features relating to hydrology of the region, area, and site, including additional topographic maps of the site and area as required to provide clarity. Identify the sources of the hydrological information, the types of data collected, and the methods and frequency of collection.

3.4.1 Hydrologic Description

Describe the drainage basin and the watercourse flow for streams, rivers, lakes, and reservoirs. Provide watercourse flow data to indicate minimum and maximum historical observations. Identify population groups that use as a potable supply surficial water subject to normal or accident effluents from the plant, as well as the size, use rates, and location of the population groups.

Include a drainage plot of the site and adjacent areas as they may relate to water supply or adverse action on the plant due to natural or unnatural causes. Refer to the topographic map(s) provided in Section 3.1.2 and identify the location of the plant and other engineered features such as water supply ponds, cooling towers, and retention basins. If applicable, include the location and description of upstream and downstream flow control structures and explain the criteria governing their operation.

3.4.1.1 Site and Facilities. Describe the site and all safety-related structures, exterior accesses thereto, and safety-related equipment and systems from the standpoint of hydrologic considerations. Provide a topographic map of the site, and indicate thereon any proposed changes to natural drainage features.

3.4.1.2 Hydrosphere. Describe the location, size, shape, and other hydrological characteristics of streams, rivers, lakes, shore regions, and groundwater environments influencing the plant site. Include a description of upstream and downstream river control structures, and provide a regional topographic map showing the major hydrologic features. List the owner, location, and rate of use of surface water users whose intakes could be adversely affected by accidental or normal releases of contaminants from the plant. Refer to Section 3.5.1 for the tabulation of groundwater users.

3.4.2 Floods

Provide information on the frequency, intensity, and cause of past flooding and other water-inundation occurrences such as tidal or wind-blown floodwaters which may or may not be coincident with one another.

3.4.2.1 Flood History. Provide a synopsis of the flood history (date, level, peak discharge, etc.) in the site region. A "flood" is defined as any abnormally high water stage or overflow from a stream, floodway, lake, or coastal area that results in significant detrimental effects. Include river or stream floods, surges, tsunami, dam failures, ice jams, etc.

3.4.2.2 Flood Design Considerations. Discuss the general capability of safety-related facilities, systems, and equipment to withstand floods, flood waves, and wave action erosion. The design flood protection for safety-related components and structures and facilities necessary to protect such from floods, erosion, and wave action of the plant should be based on the highest calculated floodwater elevations and flood wave effects resulting from analysis of several different hypothetical floods. All possible flood conditions up to and including the highest and most critical flood level resulting from any of several different probable maximum events should be considered as the basis for the design protection level for safety-related components and structures of the plant. The probable maximum water level from a stream flood, surge, combination of surge and stream flood in estuarial areas, wave action, or tsunami (whichever is applicable and/or greatest) may cause the highest water level. Other possibilities are the flood level resulting from the most severe flood wave at the plant site caused by an upstream landslide, dam failure, or dam breaching resulting from a seismic or foundation disturbance or inadequate design capability. The effects of coincident wind-generated wave action should be superimposed on the applicable flood level. The assumed hypothetical conditions should be evaluated both statically and dynamically to determine the design flood protection level and dynamically induced loadings. The topical information needed is generally outlined in Sections 3.4.3 through 3.4.7, but the type of events considered and the controlling event should be summarized in this section.

3.4.2.3 Effects of Local Intense Precipitation. Describe the effects of local probable maximum precipitation (see Section 3.4.3.1) on adjacent drainage areas and site drainage systems, including the roofs of safety-related structures. Tabulate rainfall intensities for the selected and critically arranged time increments, provide characteristics and descriptions of runoff models, and estimate the resulting water levels. Summarize the design criteria for site drainage facilities, and provide analyses which demonstrate the capability of site drainage facilities to prevent flooding of safety-related facilities due to local probable maximum precipitation. Estimates of precipitation based on publications of the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce (formerly U.S. Weather Bureau) with the time distribution based on critical distributions such as those employed by the Corps of Engineers usually provide acceptable bases. Sufficient detail should be provided (1) to allow an independent review of rainfall and runoff effects on safety-related facilities and (2) to judge the adequacy of design criteria.

Describe the design bases for ice accumulations on the roofs of safety-related structures and on exposed safety-related equipment. Discuss any effects on the operational capabilities of the structures, the safety-related equipment within, and any exposed safety-related equipment. In addition, provide a discussion of the effect of ice accumulation on site facilities where such accumulation could coincide with local probable maximum (winter) precipitation and cause flooding or other damage to safety-related facilities. Similarly, provide the design bases for snow accumulations on the roofs of safety-related buildings and on exposed safety-related equipment. Lastly, compare the above ice and snow design bases with historical maximum events in the region, and discuss the consequences of exceeding the design bases for safety-related structures, systems, and components (including available design margin).

3.4.3 Probable Maximum Flood (PMF) on Streams and Rivers

Describe the PMF using hypothetical flood characteristics (peak discharge, volume, and hydrograph shape) that are considered to be the most severe "reasonably possible" at a particular location. Consider all factors contributing to a maximum flood runoff. Summarize all locations and associated water levels for which PMF determinations have been made, including site drainage.

3.4.3.1 Probable Maximum Precipitation (PMP). The PMP is the theoretically greatest precipitation over the applicable drainage area that would produce flood flows that have virtually no risk of being exceeded. These estimates usually involve detailed analyses of actual flood-producing storms in the general region of the drainage basin under study, and certain modifications and extrapolations of historical data to reflect more severe rainfall-runoff relations than actually recorded, insofar as those are deemed "reasonably possible" of occurrence on the basis of hydrometeorological reasoning. Discuss considerations of storm configuration (orientation of areal distribution), maximized precipitation amounts (include a description of maximization procedures and/or studies available in the area such as reference to National Weather Service and Corps of Engineers determinations), time distributions, orographic effects, storm centering, seasonal effects, antecedent storm sequences, antecedent snowpack (depth, moisture content, areal distribution), and any snowmelt model. Present the selected maximized storm precipitation distribution (time and space).

3.4.3.2 Precipitation Losses. Describe the absorption capability of the basin including consideration of initial losses, infiltration rates, and antecedent precipitation. Provide verification of those assumptions by reference to regional studies or by presenting detailed local storm-runoff studies.

3.4.3.3 Runoff Model. Describe the hydrologic response characteristics of the watershed to precipitation (such as unit hydrographs), verification from historic floods or synthetic procedures, and the nonlinearity of the model at high rainfall rates, and provide a description of subbasin drainage areas (including a map), their sizes, and topographic features of watersheds. Include a tabulation of all drainage areas, and runoff, reservoir, and channel routing coefficients.

3.4.3.4 Probable Maximum Flood Flow. Present the PMF runoff hydrograph as defined as resulting from the probable maximum precipitation (and snowmelt, if pertinent) which considers the hydrologic characteristics of the potential influence of existing and proposed upstream dams and river structures for regulating or increasing the water level. If such dams or structures are designed to withstand a PMF, their influence on the regulation of water flow and levels should be considered; however, if they are not designed or constructed to withstand the PMF (or inflow from an upstream dam failure), the maximum water flows and resulting static and dynamic effects from their failure by breaching should be included in the PMF estimate (refer to Section 3.4.4.2). Discuss the PMF stream-course response model and its ability to compute floods of various magnitudes up to the severity of a PMF. Present any reservoir and channel routing assumptions with appropriate discussions of initial conditions, outlet works (both uncontrolled and controlled), spillways (both uncontrolled and controlled), the ability of any dams to withstand coincident reservoir wind wave action (including discussions of setup, the significant wave height, the maximum wave height, and runup), the wave protection afforded, and the reservoir design capacity (i.e., the capacity for PMF and coincident wind wave action). Finally, provide the estimated PMF discharge hydrograph at the site and, when available, provide a similar hydrograph without upstream reservoir effects to allow evaluation of reservoir effects and a regional comparison of the PMF estimate to be made.

3.4.3.5 Water Level Determinations. Describe the translation of the estimated peak PMF discharge to elevation, using (when applicable) cross-section and profile data, reconstitution of historical floods (with consideration of high water marks and discharge estimates), standard step methods, roughness coefficients, bridge and other losses, verification, extrapolation of coefficients for the PMF, estimates of PMF water surface profiles, and flood outlines.

3.4.3.6 Coincident Wind Wave Activity. Discuss the runup, wave heights, and resultant static and dynamic effects of wave action on each safety-related facility from wind-generated activity which may occur coincidently with the peak PMF water level.

3.4.4 Potential Dam Failures (Seismically Induced)

Discuss the evaluation of the effects of potential seismically induced dam failures on the upper limit of flood capability for sites along streams and rivers. Consider the potential influence of upstream dams and river structures for regulating or increasing the water level. The maximum water flow and level resulting from failure of a dam or dams by seismically induced breaching under the most severe probable modes of failure should be taken into account, including the potential for subsequent downstream domino-type failures due to flood waves, where such structures cannot be shown sufficient to withstand severe earthquakes. The simultaneous occurrence of the PMF and an earthquake capable of failing the upstream dams is not considered, since each of these events considered singly has a low probability of occurrence. The suggested worst conditions at the dam site may be evaluated by considering (1) a 25-year flood with full reservoirs coincident with an earthquake determined by a procedure similar to that used to determine the characteristics of the Safe Shutdown Earthquake, and (2) a standard-project flood (as defined by the Corps of Engineers), or one-half the probable maximum flood, with full reservoirs coincident with the maximum earthquake determined on the basis of historic seismicity. Where downstream dams also regulate water supplies, their potential seismically induced failures also should be discussed herein.

3.4.4.1 Reservoir Description. Include a description of the locations of existing or proposed dams (both upstream and downstream) that influence conditions at the site, tabulate drainage areas above reservoirs, and provide descriptions of types of structures, all appurtenances, ownership, seismic design criteria, and spillway design criteria. Provide the elevation-storage relationships for pertinent reservoirs, and tabulate short- and long-term storage allocations.

3.4.4.2 Dam Failure Permutations. Discuss the locations of dams (both upstream and downstream), potential modes of failure, and results of seismically induced and other types of dam failures that could cause the most critical conditions (floods or low water) with respect to the site for such an event (see Section 3.4.3.4). Consideration should be given to possible landslides, antecedent reservoir levels, and river flows at the coincident flood peak (base flow). Present the determination of the peak flow rate at the site for the worst possible dam failure, and summarize an analysis to show that the presented condition is the worst permutation. Include the description of all coefficients and methods used.

3.4.4.3 Unsteady Flow Analysis of Potential Dam Failures. In determining the effect of dam failures at the site (Section 3.4.4.2), the analytical methods presented should be applicable to artificially large floods with appropriately acceptable coefficients, and should also consider floodwaves through reservoirs downstream of failures. Domino-type failures due to floodwaves should be considered where applicable. Discuss estimates of antecedent flow and static and dynamic floodwave effects which are included to attenuate the dam failure floodwave downstream.

3.4.4.4 Water Level at Plant Site. Describe the backwater, unsteady flow, or other computation leading to the water elevation estimate (Section 3.4.4.2) for the most critical upstream dam failure, and discuss its reliability. Superimpose wind wave conditions that may occur simultaneously in a manner similar to that described in Section 3.4.3.6.

3.4.5 Probable Maximum Surge and Seiche Flooding

3.4.5.1 Probable Maximum Winds and Associated Meteorological Parameters. The mechanism is defined as a hypothetical hurricane or other cyclonic type windstorm that might result from the most severe combinations of meteorological parameters that are considered reasonably possible in the region involved, if the hurricane or other type of windstorm should move along a critical path and at optimum rate of movement. The determination of probable maximum meteorological winds, which involves detailed analyses of actual historical storm events in the general region and certain modifications and extrapolations of data to reflect a more severe meteorological wind system than actually recorded (insofar as these are deemed "reasonably possible" of occurrence on the basis of meteorological reasoning), should be presented in detail. The probable maximum conditions are the most severe combinations of hydrometeorological parameters (such as the meteorological characteristics of the probable maximum hurricane as reported by NOAA in their unpublished report HUR 7-97* for the East and Gulf Coasts, or the most severe combination of meteorological parameters of moving squall lines for the Great Lakes, etc.) considered reasonably possible that would produce a surge or seiche which has virtually no risk of being exceeded. This hypothetical event is postulated along a critical path at an optimal rate of movement from correlations of storm parameters of record. Sufficient bases and information should be provided to assure that the parameters presented are the most severe combination.

3.4.5.2 Surge and Seiche History. Discuss the proximity of the site to large bodies of water from which surge or seiche type flooding can reach safety-related facilities. The probable maximum water level (surges) for shore areas adjacent to large water bodies is the peak of the hypothetical surge or seiche stage hydrograph (still-water levels), and coincident wave effects. It is based on relatively comprehensive hydrometeorological analyses and the application of probable maximum meteorological criteria (such as hurricanes, moving squall lines, or other cyclonic windstorms), in conjunction with the critical hydrological characteristics, to estimate the probable maximum water level at a specific location. The effects of the probable maximum meteorological event are superimposed on the coincidental maximum annual astronomical and ambient tide levels and associated wave action to determine the effects of water level and wave action on structures. Provide a description of the surge and/or seiche history in the site region.

3.4.5.3 Surge and Seiche Sources. Discuss considerations of hurricanes, frontal (cyclonic) type windstorms, moving squall lines, and surge mechanisms which are possible and applicable to the site. Include the antecedent water level (with reference to the spring tide for coastal locations, the average monthly recorded high water for lakes, and a forerunner or ambient water level where applicable), the determination of the controlling storm surge or seiche (include the probable maximum meteorological parameters such as the storm track, wind fields, the fetch or

*This report, HUR 7-97, "Interim Report - Meteorological Characteristics of the Probable Maximum Hurricane, Atlantic and Gulf Coasts of the United States," is available upon request from the Hydrometeorological Branch, Office of Hydrology, NOAA, 8060 13th Street, Silver Spring, Md. 20910.

direction of approach, bottom effects, and verification with historic events), the method used, and the results of the computation of the probable maximum surge hydrograph (graphical presentation).

3.4.5.4 Wave Action. Discuss the wind-generated activity which can occur coincidentally with a surge or seiche, or independently thereof. Estimates of the wave period, the significant wave height and elevations, and the maximum wave height and elevations, with the coincident water level hydrograph, should be presented. Specific data should be presented on the largest breaking wave height, setup, and runup that can reach each safety-related facility.

3.4.5.5 Resonance. Discuss the possibility of oscillations of waves at natural periodicity, such as lake reflection and harbor resonance phenomena, and any resulting effects at the site.

3.4.5.6 Runup. Provide estimates of wave runup on the plant facilities. Include a discussion of the water levels on each affected facility and the protection to be provided against static effects, dynamic effects, and splash. Refer to Section 3.4.5.4 above for breaking waves.

3.4.5.7 Protective Structures. Discuss the location and design criteria for any special facilities for the protection of safety-related facilities against surges, seiches, wave reflection, and other wave action.

3.4.6 Probable Maximum Tsunami Flooding

For sites adjacent to coastal areas, discuss historical tsunami, either recorded or translated and inferred, which provide information for use in determining the probable maximum water levels, and the geoseismic generating mechanisms available with appropriate references to Section 3.6.

3.4.6.1 Probable Maximum Tsunami. This event is defined as the most severe tsunami at the site which has virtually no risk of being exceeded. Consideration should be given to the most reasonably severe geoseismic activity possible in determining the limiting tsunami-producing mechanism (such as fractures, faults, landslide potential, volcanism, etc.). In the analysis, present such considerations as the orientation of the site relative to the earthquake epicenter or generating mechanism, shape of the coastline, offshore land areas, hydrography, and stability of the coastal area.

3.4.6.2 Historical Tsunami Record. Provide local and regional historical tsunami information.

3.4.6.3 Source Tsunami Wave Height. Provide estimates of the maximum tsunami wave height possible at each major local generating source considered and the maximum offshore deepwater tsunami height from distant generators. Discuss the controlling generators for both locally and distantly generated tsunami.

3.4.6.4 Tsunami Height Offshore. Provide estimates of the tsunami height in deep water adjacent to the site, or before bottom effects appreciably alter wave configuration, for each major generator.

3.4.6.5 Hydrography and Harbor or Breakwater Influences on Tsunami. Present the routing of the controlling tsunami, including breaking wave formation, bore formation, and any resonance effects (natural frequencies and successive wave effects), that result in the estimate of the maximum tsunami runup on each pertinent safety-related facility. Include a discussion of the analysis used to translate tsunami waves from offshore generator locations, or in deep water, to the site, and antecedent conditions. Provide, where possible, verification of the techniques and coefficients used by reconstituting tsunami of record.

3.4.7 Ice Flooding

Present design criteria for protection of safety-related facilities from the most severe ice jam flood, wind-driven ice ridges, or ice-produced forces that are reasonably possible and could affect safety-related facilities with respect to adjacent rivers, streams, lakes, etc., and the location and proximity of such facilities to ice-generating mechanisms. Describe the regional ice and ice jam formation history.

3.4.8 Water Canals and Reservoirs

3.4.8.1 Canals. Present the design bases for capacity and protection of canals against wind waves with acceptable freeboard, and (where applicable) the ability to withstand a probable maximum flood, surge, etc.

3.4.8.2 Reservoirs. Provide the design bases for capacity, the PMF design capability including wind wave protection, with verified runoff models (unit hydrographs), flood routing, emergency spillway design, and outlet protection.

3.4.9 Channel Diversions

Discuss the potential for the upstream diversion or rerouting of the source of water, such as river cutoffs, ice jams, or subsidence, with respect to historical and topographical evidence in the region. Present the history of flow diversions in the region. Describe available alternative water sources in the event diversions are possible.

3.4.10 Flooding Protection Requirements

Describe the static and dynamic consequences of all types of flooding on each pertinent safety-related facility. Present the design bases, and refer to appropriate discussions in other sections of the SAR where implemented, required to ensure that safety-related facilities will be capable of surviving all design flood conditions.

3.4.11 Low Water Considerations

3.4.11.1 Low Flow in Rivers and Streams. Estimate the probable minimum flow rate and level resulting from the most severe drought considered reasonably possible in the region if the water supply is safety-related.

3.4.11.2 Low Water Resulting from Surges, Seiches, or Tsunami. Determine the surge-, seiche-, or tsunami-caused low water level that could occur from probable maximum meteorological or geoseismic conditions. Include a description of the probable maximum meteorological event producing such conditions, its track, associated parameters, antecedent conditions, and the computed low water level, or tsunami conditions applicable. Also consider, where applicable, ice formation, or ice jams causing low flow as such conditions may affect the water source.

3.4.11.3 Historical Low Water. Discuss historical low water controls, minimum stream flows or minimum surges and elevations, and probabilities (unadjusted for historical controls and adjusted for historical and future controls and uses) only when statistical methods are used to extrapolate flows and/or levels to probable minimum conditions.

3.4.11.4 Future Control. If water is to be used for safety-related purposes, provide the estimated flow rate, durations, and levels for probable minimum flow conditions considering future uses. Substantiate any provisions for flow augmentation available for plant use.

3.4.12 Environmental Acceptance of Effluents

Describe the ability of the surface-ground water environment to disperse, dilute and/or concentrate normal and inadvertent or accidental liquid releases of radioactive effluents for the full range of anticipated operating conditions as such releases may relate to existing and/or potential future use of surface or ground water resources. Describe any safety-related effects of normal or accidental releases of radionuclides and heated water on surface and ground waters, such as any potential for recirculation, sediment concentration, hydraulic short circuiting of cooling ponds, etc.

3.4.13 Chemical and Biological Composition of Adjacent Watercourses

Provide details of the prevailing chemical and biological composition of watercourses which may be affected by location of the reprocessing plant. This information, together with other hydrological data, will be used to ensure that no safety problems will be created by the plant operation.

3.5 Subsurface Hydrology

3.5.1 Regional and Area Characteristics

Describe the ground water aquifers, formations, sources, and sinks in relation to the site location. Discuss the flow directions, gradients, the potential for reversibility of ground water flow, and the effects of potential future use on ground water recharge areas within influence of the plant. Provide a survey of uses, users (amounts, water levels, location, and drawdown) and piezometric levels, location of springs, and details of factors affecting flow within the zone of potential plant influence.

3.5.2 Site Characteristics

Provide data on ground water levels, flow, permeability, porosity, flow, and gradients at the site, as well as chemical analysis of the ground water. Also state the proposed sources and usage anticipated by the plant facility. Provide a water table contour map showing the location of any monitoring wells used to evaluate possible outleakage from the plant. Identify any potential groundwater recharge areas within influence of the plant and discuss the effects of construction, including dewatering, on such areas.

3.5.3 Contaminant Transport Analysis

By use of the hydrological gradients, permeability, dispersion, dilution, ion exchange, and channeling characteristics at the site, develop a model which will allow evaluation of the extent to which contamination from the plant operation could migrate in ground water, including the time required to reach the nearest existing or potential future user.

3.6 Geology and Seismology

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

3.6.1 Basic Geologic and Seismic Information

Present the basic geologic and seismic information for the region and the site. Information obtained from published reports, maps, private communications, or other sources should be referenced. Information from surveys, geophysical investigations, borings, trenches, or other investigations should be adequately documented by descriptions of techniques, graphic logs, photographs, laboratory results, identification of principal investigators, and other data. Identify each area where the data has been analyzed and selected as a source to be used in developing design criteria and bases and accident analyses in subsequent chapters.

3.6.1.1 Regional Geology.

1. Describe the regional physiography. The relationship between the regional and the site physiography should be discussed. A regional physiographic map showing the site location should be included.

2. Describe the regional geology, including geologic and tectonic maps of the region surrounding the site.

3. Discuss the regional geologic setting. Indicate the geologic province and the relation to other geologic provinces. Include regional geologic maps indicating the site location, and showing both surface and bedrock geology.

4. Discuss the geologic history of the region.

5. Describe the lithologic, stratigraphic, and structural geologic conditions of the region surrounding the site, and relate these conditions to its geologic history. Provide geologic profiles showing the relationship of the regional and local geology to the site location.

6. Identify and describe tectonic structures underlying the region surrounding the site, such as folds, faults, basins, domes, etc. Include a discussion of the geologic history of the tectonic features. Include a regional tectonic map showing the site location.

a. Provide detailed discussions of the regional tectonic structures of significance to the site. The detailed analyses of faults to determine their capacity for generating ground motions at the site and to determine the potential for surface faulting should be included in Sections 3.6.2 and 3.6.3, respectively.

b. Identify and describe areas of actual or potential surface or subsurface subsidence, uplift, or collapse resulting from:

i. Natural features such as tectonic depressions, cavernous conditions or karst terrains, and potential landslides;

ii. Man's activities, such as withdrawal or addition of subsurface fluids, or mineral extraction;

iii. Regional warping.

7. Provide a discussion of the regional ground water conditions. Cross reference to Section 3.5.1.

<u>3.6.1.2 Site Geology</u>. Material pertaining to this section may be included as appropriate in Section 3.6.4, "Stability of Subsurface Materials," and cross referenced in this section.

1. Describe the site physiography, discussing the relationship between the regional and site physiography. A site topographic map should be included, showing the locations of the principal plant facilities. Describe the configuration of the land forms and relate the history of geologic changes that have occurred. Areas should be evaluated that are significant to the site of actual or potential landsliding, surface or subsurface subsidence, uplift, or collapse resulting from natural features such as tectonic depressions and cavernous or karst terrains.

2. Describe the lithologic, stratigraphic, and structural geologic conditions of the site, and relate to geologic history and regional geology. Describe the thicknesses, physical characteristics, origin, and degree of consolidation of each lithologic unit. Furnish summary logs of borings and excavations such as trenches used in the geologic evaluation.

3. Furnish a detailed discussion of the structural geology in the vicinity of the site, with particular attention to specific structural units of significance to the site, such as folds, faults, synclines, anticlines, domes, basins, etc. Provide a large-scale site structural geology map showing bedrock surface contours and including the locations of the plant structures.

4. Furnish a large-scale geologic map of the site area which shows surface geology and which includes the locations of major structures of the reprocessing plant. Areas of bedrock outcrop identified by direct observations should be distinguished from areas which are covered and concerning which geologic interpretation has been extrapolated. When the interpretation differs substantially from the published geologic literature on the area, the differences should be noted and documentation for the new conclusions presented.

5. Discuss the geologic history of the site and relate it to a regional geologic history. Include a local geologic stratigraphic column.

6. Furnish a plot plan showing the locations of major structures of the reprocessing plant, and the locations of all borings, trenches, and excavations along with a description, logs, and maps of the borings, trenches, and excavations, as necessary to indicate the results.

7. Provide geologic profiles showing the relationship of the major foundations of the reprocessing plant to subsurface materials, including ground water, and the significant engineering characteristics of the subsurface materials.

8. Provide plan and profile drawings showing the extent of excavations and backfill planned at the site and compaction criteria for all engineered backfill.

9. Include an evaluation from an engineering geology standpoint of the local geologic features which affect the plant structures. Geologic conditions underlying all structures, dams, dikes, and pipelines should be described in detail.

a. Describe physical evidence concerning the behavior during prior earthquakes of the surficial geologic materials and the substrata underlying the site from the lithologic, stratigraphic, and structural geologic studies.

b. Identify and evaluate deformational zones, such as shears, joints, fractures, and folds, or combinations of these features relative to structural foundations.

c. Describe and evaluate zones of alteration or irregular weathering profiles, and zones of structural weakness composed of crushed or disturbed materials.

d. Describe unrelieved residual stresses in bedrock.

e. Describe all rocks or soils that might be unstable because of their mineralogy, lack of consolidation, water content, or potentially undesirable response to seismic or other events. (Seismic response characteristics to be considered include liquefaction, thixotropy, differential consolidation, cratering, and fissuring.)

f. Evaluate the effects of man's activities, such as withdrawal or addition of subsurface fluids, or mineral extraction at the site.

10. Define site ground water conditions and cross reference to Section 3.6.4.6.

11. Provide profiles and tables showing the results of any geophysical surveys (seismic refraction, seismic reflection, acoustic, aeromagnetic, etc.) conducted to evaluate the stratigraphic structure and bedrock, and subsurface material characteristics of the site. Provide results of compressional and shear wave velocity surveys, and cross hole and uphole velocity surveys, where performed.

12. Furnish static and dynamic soil and rock properties of the site, including grain-size classification, Atterberg limits, water content, unit weight, shear strength, relative density, shear modulus, Poisson's ratio, bulk modulus, damping, consolidation characteristics, and strength under cyclic loading. These properties should be substantiated with appropriate representative laboratory test records.

13. Discuss the detailed safety-related criteria, analysis techniques to be used, and the factors of safety for the materials underlying the foundations for all reprocessing plant structures and for all embankments under dynamic conditions combined with adverse hydrologic conditions.

3.6.2 Vibratory Ground Motion

Information should be presented to describe how the data was selected for determination of the design basis for vibratory ground motion. The following specific information and determinations should also be included to the extent necessary to clearly establish the design basis for vibratory ground motion. Information presented in other sections may be referred to and need not be repeated.

3.6.2.1 Geologic Conditions of the Site. Describe the lithologic, stratigraphic, and structural geologic conditions of the site and the region surrounding the site, including its geologic history.

3.6.2.2 Underlying Tectonic Structures. Identify tectonic structures underlying the site and the region surrounding the site.

3.6.2.3 Behavior During Prior Earthquakes. Describe physical evidence concerning the behavior during prior earthquakes of the surficial geologic materials and the substrata underlying the site from the lithologic, stratigraphic, and structural geologic studies.

3.6.2.4 Engineering Properties of Materials Underlying the Site. Describe the static and dynamic engineering properties of the materials underlying the site. Included should be properties needed to determine the behavior of the underlying material during earthquakes and the characteristics of the underlying material in transmitting earthquake-induced motions to the foundations of the plant, such as seismic wave velocities, density, water content, porosity, and strength.

3.6.2.5 Earthquake History. List all historically reported earthquakes which have affected or which could be reasonably expected to have affected the site, including the date of occurrence and the following measured or estimated data: magnitude or highest intensity, and a plot of the epicenter or region of highest intensity. Where historically reported earthquakes could have caused a maximum ground acceleration of at least one-tenth the acceleration of gravity (0.1g) at the foundations of the proposed plant structures, the acceleration or intensity and duration of ground shaking at these foundations should also be estimated. Since earthquakes have been reported in terms of various parameters, such as magnitude, intensity at a given location, and effect on ground, structures, and people at a specific location, some of these data may have to be estimated by use of appropriate empirical relationships. Where appropriate, the comparative characteristics of the material underlying the epicentral location or region of highest intensity and of the material underlying the site in transmitting earthquake vibratory motion should be considered.

3.6.2.6 Correlation of Epicenters with Geologic Structures. Provide a correlation of epicenters or regions of highest intensity of historically reported earthquakes, where possible, with tectonic structures, any part of which is located within 200 miles of the site. Epicenters or regions of highest intensity which cannot be reasonably correlated with tectonic structures should be identified with tectonic provinces, any part of which is located within 200 miles of the site.

3.6.2.7 Identification of Active Faults. For faults, any part of which is within 200 miles of the site and which may be of significance in establishing the design criteria for earthquake protection, determine whether these faults should be considered as capable faults.

3.6.2.8 Description of Capable Faults. For faults, any part of which are within 200 miles of the site, which may be of significance in establishing the earthquake criteria and which are considered as capable faults, determine the length of the fault; the relationship of the fault to regional tectonic structures; and the nature, amount, and geologic history of the maximum Quaternary displacement related to any one earthquake along the fault.

3.6.2.9 Maximum Earthquake. Determine the historic earthquakes of greatest magnitude or intensity which have been correlated with tectonic structures. For capable faults, the earthquake of greatest magnitude related to the faults should be determined, taking into account geologic evidence. The vibratory ground motion at the site should be determined, assuming the epicenters of the earthquakes are situated at the point on the structures closest to the site.

Where epicenters or regions of highest intensity of historically reported earthquakes cannot be related to tectonic structures but are identified with tectonic provinces in which the site is located, determine the accelerations at the site, assuming that these earthquakes occur adjacent to the site.

Where epicenters or regions of highest intensity of historically reported earthquakes cannot be related to tectonic structures but are identified with tectonic provinces in which the site is located, determine the accelerations at the site, assuming that the epicenters or regions of highest intensity of these earthquakes are located at the closest point to the site on the boundary of the tectonic province.

3.6.2.10 Safe Shutdown Earthquake. The earthquake producing the maximum vibratory accelerations at the site should be designated the Safe Shutdown Earthquake for vibratory ground motion. The Safe Shutdown Earthquake should be defined by response spectra corresponding to the maximum vibratory accelerations.

3.6.2.11 Operating Basis Earthquake. The Operating Basis Earthquake, when one is selected by the applicant, should also be defined by response spectra.

3.6.3 Surface Faulting

Information should be presented which describes whether and to what extent the plant need be designed for surface faulting. The following specific information and determinations should also be included to the extent necessary to clearly establish the design basis for surface faulting. Information presented in Section 3.6.1 may be referred to and need not be repeated.

3.6.3.1 Geologic Conditions of the Site. Describe the lithologic, stratigraphic, and structural geologic conditions of the site and the area surrounding the site, including its geologic history.

3.6.3.2 Evidence of Fault Offset. Determine the geologic evidence of fault offset at or near the ground surface at or near the site.

3.6.3.3 Identification of Capable Faults. For faults greater than 1,000 feet long, any part of which is within 5 miles of the site, determine whether these faults should be considered as capable faults.

3.6.3.4 Earthquakes Associated With Capable Faults. List all historically reported earthquakes which can be reasonably associated with capable faults greater than 1,000 feet long, any part of which is within 5 miles of the site, including the date of occurrence and the following measured or estimated data: Magnitude or highest intensity, and a plot of the epicenter or region of highest intensity.

3.6.3.5 Correlation of Epicenters With Capable Faults. Provide a correlation of epicenters or regions of highest intensity of historically reported earthquakes with capable faults greater than 1,000 feet long, any part of which is located within 5 miles of the site.

3.6.3.6 Description of Capable Faults. For capable faults greater than 1,000 feet long, any part of which is within 5 miles of the site, determine: the length of the fault; the relationship of the fault to regional tectonic structures; the nature, amount, and geologic history of displacements along the fault; and the outer limits of the fault established by mapping fault traces for 10 miles along its trend in both directions from the point of its nearest approach to the site.

3.6.3.7 Zone Requiring Detailed Faulting Investigation. Determine the zone requiring detailed faulting investigation.

3.6.3.8 Results of Faulting Investigation. Where the site is located within a zone requiring detailed faulting investigation, present details and results of this investigation, to determine the need to take into account surface faulting in the design of the reprocessing plant.

Where it is determined that surface faulting need not be taken into account, present sufficient data to justify the determination clearly.

3.6.4 Stability of Subsurface Materials

Information should be presented concerning the stability of soils and rock underneath the facility foundations during the vibratory motion associated with earthquake design criteria. Evaluation of the following geologic features which could affect the foundations should be presented. Information presented in other sections may be referred to and need not be repeated.

3.6.4.1 Geologic Features. Describe the following geologic features:

1. Areas of actual or potential surface or subsurface subsidence, uplift, or collapse resulting from:

a. Natural features such as tectonic depressions and cavernous or karst terrains, particularly those underlain by calcareous or other soluble deposits;

b. Man's activities, such as withdrawal or addition of subsurface fluids, or mineral extraction;

c. Regional warping.

2. Deformational zones, such as shears, joints, fractures, and folds or combinations of these features.

3. Zones of alteration or irregular weathering profiles, and zones of structural weakness composed of crushed or disturbed materials.

4. Unrelieved residual stresses in bedrock.

5. Rocks or soils that might be unstable because of their mineralogy, lack of consolidation, water content, or potentially undesirable response to seismic or other events. (Seismic response characteristics to be considered include liquefaction, thixothropy, differential consolidation, cratering, and fissuring.)

3.6.4.2 Properties of Underlying Materials. Describe in detail the static and dynamic engineering properties of the materials underlying the site. Furnish the physical properties of foundation materials, such as grain-size classification, consolidation characteristics, water content, Attenberg limits, unit weight, shear strength, relative density, shear modulus, damping, Poisson's ratio, bulk modulus, strength under cyclic loading, seismic wave velocities, density, porosity, and strength characteristics. These data should be substantiated with appropriate representative laboratory test records.

3.6.4.3 Plot Plan. Provide a plot plan or plans showing the locations of all borings, trenches, seismic lines, piezometers, geologic profiles, and excavations, and superimpose the locations of all reprocessing plant structures. Furnish profiles showing the relationship of the foundations of structures to subsurface materials, including ground water and significant engineering characteristics of the subsurface materials.

3.6.4.4 Soil and Rock Characteristics. Provide the results by means of table and profiles of compressional and shear wave velocity surveys performed to evaluate the characteristics of the foundation soils and rocks. Provide graphic core boring logs and the logs of trenches or other excavations.

3.6.4.5 Excavations and Backfill. Furnish plan and profile drawings showing the extent of excavations and backfill planned at the site and compaction criteria for all engineered backfill. The criteria should be substantiated with representative laboratory or field test records. (Where possible, those plans and profiles may be combined with profiles in Section 3.6.4.3 or Section 3.6.4.4.)

3.6.4.6 Ground Water Conditions. Provide a history of ground water fluctuations beneath the site and a discussion of ground water conditions during construction of the reprocessing plant and during plant life.

3.6.4.7 Response of Soil and Rock to Dynamic Loading. Furnish analyses of the responses of soil and rock to dynamic loading.

3.6.4.8 Liquefaction Potential. Provide a discussion of the liquefaction potential of material beneath the site. Either demonstrate that there are no liquefaction-susceptible soils beneath the site, or provide the following information regarding soil zones where the possibility for liquefaction exists: relative density, void ratio, ratio of shear stress to initial effective stress, number of load cycles, grain-size distribution, degrees of cementation and cohesion, and ground water elevation fluctuations.

3.6.4.9 Earthquake Design Basis. Provide the earthquake design basis on which these analyses are based.

3.6.4.10 Static Analyses. Discuss the static analyses, such as settlement analyses (with appropriate representative laboratory data), lateral pressures (with backup data), etc.

3.6.4.11 Criteria and Design Methods. List and furnish a brief discussion of the criteria, references, or methods of design employed (or to be employed), and factors of safety (documented by test data).

3.6.4.12 Techniques to Improve Subsurface Conditions. Discuss and provide specifications for required techniques to improve subsurface conditions, such as grouting, vibrafloration, dental work, rock bolting, anchors, etc.

3.6.5 Slope Stability

Information and appropriate substantiation should be presented concerning the stability of all slopes, both natural and manmade (both cut and fill), the failure of which could adversely affect the plant.

3.6.5.1 Slope Characteristics. Cross sections of the slopes should be provided, along with a summary of the static and dynamic properties of embankment and foundation soil and rock underlying the slope, substantiated with representative laboratory test data.

3.6.5.2 Design Criteria and Analyses. The design criteria and analyses used to determine slope stability should be described, including factors of safety, along with the adverse conditions considered in the analyses, such as sudden drawdown, earthquake, steady seepage at anticipated pool levels, etc.

3.6.5.3 Logs of Core Borings. Furnish logs of core borings or test pits taken in proposed borrow areas.

3.6.5.4 Compaction Specifications. Provide compaction specifications along with representative laboratory data on which they are based.

3.7 Summary of Conditions Affecting Facility Construction and Operating Requirements

Summarize all factors developed in this chapter that are deemed significant to the selection of design bases for the reprocessing plant and associated facilities.

CHAPTER 4.0 PRINCIPAL DESIGN CRITERIA

The contents of this chapter partially describe the information required by 10 CFR Part 50, §50.34, "Contents of Applications: Technical Information." Principal design criteria are established by the applicant in the PSAR. They should conform with the appropriate general criteria defined in 10 CFR Part 50, Appendix K, "General Design Criteria for Nuclear Fuel Reprocessing Plants." The remaining criteria of proposed Appendix P should be established in the respective chapters discussing them.

An analysis by the staff is made of the fuel reprocessing plant design criteria to determine their adequacy before a construction permit can be issued. It is not anticipated that the criteria will be changed after the permit is issued. The criteria selected, therefore, should encompass all considerations for alternatives which the applicant may choose to fulfill the criteria.

4.1 Purpose of Plant

Describe in general terms the plant, its functions and operation, process capacity, type of feed, and products.

4.1.1 Plant Feed

Provide a detailed description of the physical, chemical, and radiological characteristics of the spent fuel to be processed in the plant. Include feed specifications, such as fissile material limits, forms of the material, and packaging. Presentation of radioactivity characteristics should include irradiation history, minimum cooling time at receipt, time to processing, and fission product concentrations.

4.1.2 Plant Products and Byproducts

Identify the products and byproducts which will result from the plant operation. Include product characteristics and specifications.

4.1.3 Facility Functions

Provide information related to the overall functioning of the plant as a reprocessing operation. Include onsite waste processing, waste disposal or holding areas, transportation, and utility and water supplies.

4.2 Structural and Mechanical Safety Criteria

Based on the site selected, identify and quantify the environmental and geologic features which are used as design criteria.

4.2.1 Wind Loadings

Provide information on wind velocity including the vertical wind velocity and gust factor, and a determination of applied forces which are used for structural design as follows:

4.2.1.1 Design Wind Velocity. Present the design wind velocity and recurrence interval.

4.2.1.2 Basis for Wind Velocity Selection. Discuss the basis for the wind velocity selection that was made, including wind histories and supporting data.

4.2.1.3 Vertical Velocity Distribution and Gust Factor. Present the specific vertical velocity distribution and the gust factor employed for the selected design wind velocity.

4.2.1.4 Determination of Applied Forces. Describe the procedure used to translate the wind velocity into applied forces on the structures, including the wind force distribution and drag coefficients being applied. The applied force magnitude and distribution which is calculated for each structure should be specified.

4.2.2 Tornado Loadings

Provide the design parameters, such as translational and rotational velocity, pressure differential, and associated time interval, together with the methods used to translate this data into forces exerted on the reprocessing plant structures.

4.2.2.1 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.

4.2.2.2 Determination of Forces on Structures. Describe the methods used to convert the tornado loadings into forces on the structures, including the distribution across the structures and the combination of applied loads. If factor loads are used, the basis for selection of the load factor used for tornado loading should be furnished.

4.2.2.3 Ability of Reprocessing Plant Structures to Perform Despite Failure of Structures not Designed for Tornado Loads. Information to show that the failure of any structures not being designed for tornado loads will not affect the ability of other structures or systems to perform their intended design functions should be presented.

4.2.3 Water Level (Flood) Design

As applicable, discuss design load from forces developed by the maximum probable flood, including water height and dynamic phenomena such as velocity. Relate by reference the design criteria to data developed in Section 3.4, "Surface Hydrology."

4.2.3.1 Flood Elevations. The flood elevations that will be used in the design of each structure for buoyancy and static water force effects should be provided.

4.2.3.2 Phenomena Considered in Design Load Calculations. The phenomena, such as flood current, wind wave, hurricane, or tsunami, that are being considered if dynamic water force is a design load for any structure should be identified and discussed.

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

4.2.3.4 Flood Protection. The flood protection measures for vital systems and components which are located below grade or below flood level should be described.

4.2.4 Missile Protection

Describe the design criteria with respect to internal and external missile protection, providing detail on the assumed missile velocity and forces involved.

4.2.4.1 Missile Barriers and Loadings. Present a tabulation of the structures, shields, and barriers that will be designed to withstand missile effects.

4.2.4.2 Missile Selection. The missiles that have been selected for each structure and the basis for their selection should be discussed. For each selected missile, specify the origin, weight, and dimensions, the impact velocity and orientation, the material composition, and any other parameters required to determine missile penetration.

4.2.5 Seismic Design

From data developed in Chapter 3.0 and as defined in 10 CFR Part 100, Appendix A, present the design criteria to be used in the construction of the plant and associated equipment. Sufficient detail must be presented to make possible an independent evaluation of the criteria selected. For clarity, refer to appropriate information presented in Section 3.6, "Geology and Seismology."

4.2.5.1 Input Criteria. This subsection should discuss the input criteria for seismic design of the plant, including the following specific information:

1. Design Response Spectra. Design response spectra (for the SSE) should be provided. If applicable, design response spectra for the OBE should be submitted. A discussion of the effects of the following parameters should also be included:

a. Earthquake duration.

b. Earthquake distance and depths between the seismic disturbances and the site.

c. Existing earthquake records and the associated amplification response range where the amplification factor is greater than one.

2. Design Response Spectra Derivation. The response spectra which envelops the design response spectra derived from the actual or synthetic earthquake time motion records should be provided. A comparison, for all the damping values that are used in the design, of the response spectra derived from the time history and the design response spectra should be submitted. The system period intervals at which the spectra values were calculated should be identified.

3. Critical Damping Values. The specific percentage of critical damping values used for Category I structures, systems, components, and soil should be provided, e.g., damping values for the type of construction or fabrication (such as prestressed concrete and welded pipe) and the applicable allowable design stress levels for these plant features should be submitted.

4. Bases for Site-Dependent Analysis. The bases for a site-dependent analysis, if used to develop the shape of the design response spectra from bedrock time history or response spectra input, should be provided. Specifically, the bases for use of in situ soil measurements, soil layer location, and bedrock earthquake records should be provided. If the analytical approach used to determine the shape of the design response spectra neglects vertical amplification and possible slanted soil layers, these assumptions as well as the effect of possible predominant thin soil layers on the analytical results should be discussed.

5. Soil-Supported Structures. A list of all soil-supported structures should be provided, including the depth of soil over bedrock for each structure listed.

6. Soil-Structure Interaction. Describe the soil-structure interaction techniques used in the analyses of the structures. Nonlinear, or equivalent linear finite element technique should be used as the analytical tool for soil-structure interaction analysis for all structures where the foundations are deeply embedded in soil. For shallowly embedded structures on deep uniform soil strata, the soil spring model based on the elastic half-space theory is adequate. For shallowly embedded structures with shallow soil overburden over rock or layered soil with varying soil properties, the finite element approach or multiple shear beam spring approach should be used.

4.2.5.2 Seismic System Analysis. This section should discuss the seismic system analyses applicable to structures, systems, and components. The following specific information should be included:

1. Seismic Analysis Methods. For all structures, systems, and components identified in Section 4.2, including any items to be designed for an OBE, the applicable methods of seismic analysis (modal analysis response spectra, modal analysis time history, equivalent static load, etc.) should be identified in the PSAR. Applicable stress or

deformation criteria and descriptions (sketches) of typical mathematical models used to determine the response should be specified. If empirical methods (tests) are used in lieu of analysis, the testing procedure, load levels, and acceptance bases for structures, systems, components, and equipment should also be provided (FSAR). All seismic methods of analyses used should be described (FSAR).

2. Natural Frequencies and Response Loads (FSAR). A summary of natural frequencies and response loads (e.g., in the form of critical mode shapes and modal responses) determined by the seismic system analysis should be provided. In addition, the response spectra at critical plant equipment elevations and points of support should be specified.

3. Procedures Used to Lump Masses (FSAR). A description of the procedure used to lump masses for the seismic system analyses (the ratio of system mass and compliance to component mass and compliance, and the ratio of floor mass and compliance to supported equipment mass and compliance) should be provided.

4. Rocking and Translational Response Summary (FSAR). If a fixed base in the mathematical models for the dynamic system analyses is assumed, a summary of the rocking and translational responses should be provided. A brief description should be included of the method, mathematical model, and damping values (rocking vertical, translation, and torsion) that have been used to consider the soil-structure interaction.

5. Methods Used to Couple Soil with Seismic System Structures. A description should be provided of the methods and procedures used to couple the soil with the seismic system structures and components in the event a finite element analysis for the layered site is used.

6. Development of Floor Response Spectra. If a modal response spectra multi-mass method of analysis is used to develop floor response spectra, a discussion of the conservatism of this method should be presented. The discussion should address equivalency to a multi-mass time history method or should identify other equivalent theoretical or experimental methods.

7. Differential Seismic Movement of Interconnected Components. The stress and deformation criteria that will be used to consider the differential seismic movement of interconnected components between floors should be provided.

8. Effects of Variations on Floor Response Spectra. Consideration in the analyses of the effects on floor response spectra (e.g., peak width and period coordinates) of expected variations of structural properties, dampings, soil properties, and soil-structure interactions should be described.

9. Use of Constant Vertical Load Factors. The use of constant vertical load factors as vertical response loads for the seismic design of

all reprocessing plant structures, systems, and components in lieu of the use of a vertical seismic-system multi-mass dynamic analysis method should be identified.

10. Method Used to Account for Torsional Effects. The method employed to consider the torsional modes of vibration in the seismic analysis of the structures should be described. The use of static factors to account for torsional accelerations in the seismic design structures, or in lieu of the use of a combined vertical, horizontal, and torsional multi-mass system dynamic analysis, should be indicated.

11. Comparison of Responses (FSAR). Where applicable, the responses obtained from both modal analysis response spectrum and time history methods at selected points in the reprocessing plant structure should be submitted.

12. Methods for Seismic Analysis of Dams. A description of the analytical methods and procedures that will be used for the seismic system analysis of dams that impound bodies of water, if safety-related, should be provided.

13. Methods to Determine Reprocessing Plant Structure Overturning Moments. A description of the dynamic methods and procedures used to determine structure overturning moments should be provided, including a description of the procedures used to account for soil reactions and vertical earthquake effects.

14. Analysis Procedure for Damping. The analysis procedure followed to account for the damping in different elements of the model of a coupled system should be described, including the criteria used to account for composite damping in a coupled system with different elements.

4.2.5.3 Seismic Subsystem Analysis. The discussion of the seismic subsystem analysis should include the following specific information:

1. Determination of Number of Earthquake Cycles. Procedures should be described that are used to determine the number of earthquake cycles during one seismic event. The number of maximum amplitude loading cycles for which structures, systems, and components are designed should be specified.

2. Basis for Selection of Forcing Frequencies. The basis should be provided for the selection of forcing frequencies to preclude resonance (i.e., the earthquake specified for the site, and the structure and component response characteristics produce forcing frequencies that are removed from the natural frequencies).

3. Root Mean Square Basis. The term "root-mean-square basis," if used in describing the procedure for the combination of modal responses, should be mathematically defined.

4. Procedure for Combining Modal Responses. A description of the procedure for combining modal responses (shears, moments, stresses, deflections, and/or accelerations) should be provided if a response spectrum modal analysis method is used and normal frequencies are closely spaced.

5. Significant Dynamic Response Modes. A discussion should be provided addressing the inclusion of all significant dynamic modes of response under seismic excitation if static loads equivalent to the peak of the floor spectrum curve are used for the seismic design of components, structures, and equipment.

6. Design Criteria and Analytical Procedures for Piping. The design criteria and a description of the analytical procedures applicable to piping that account for the relative displacements between piping and support points (i.e., floors and components) at different elevations within a building and between buildings should be provided.

7. Basis for Computing Combined Response. The basis for the methods used to determine the possible combined (two-component) horizontal and vertical amplified response loading for the seismic design of piping and equipment, including the effect of the seismic response of the supports, equipment, and structures and components, should be submitted.

8. Amplified Seismic Responses. If a constant load factor is used as the vertical floor response load for the seismic design of structures, components, and equipment, a discussion should be provided addressing the following considerations:

a. The possible combined (two-component) horizontal and vertical amplified input loading for the seismic design of equipment and components due to the amplified response of the structures and floors.

b. The possible combined (two-component) horizontal and vertical amplified input loading for the seismic design of piping and equipment due to the amplified response of structures, floors, supports, and components.

9. Use of Simplified Dynamic Analysis. If a simplified (e.g., other than a multi-mass modal analysis) dynamic analysis is used for Category I piping, the magnitude by which the resonant periods of a selected piping span are removed from the predominant supporting building and component periods should be indicated (FSAR). A summary of typical results comparing the simplified dynamic methods and response spectra modal analysis methods should be submitted (FSAR). The basis for simplified (e.g., other than a multi-mass modal analysis) dynamic analyses methods and procedures that will be used for seismic design of structures, systems, and components should be provided. In addition, the criteria that will be used to avoid the predominant input frequencies produced by the response of structures, supports, and components to the earthquake input should be provided.

10. Modal Period Variation. The procedures used to account for modal period variation in the mathematical models for the reprocessing plant structure due to variations in material properties should be specified.

11. Torsional Effects of Eccentric Masses. The criteria that will be employed to account for the torsional effects of valves and other eccentric masses (e.g., valve operators) in the seismic piping analyses should be provided.

12. Piping Outside Reprocessing Plant Structure. With respect to piping designed to withstand the earthquake and buried or otherwise located outside the confinement structure, the seismic design criteria and methods employed to ascertain that allowable piping and structural stresses are not exceeded due to differential movement at support points, at confinement penetrations, and at entry points into other structures should be described.

13. Interaction of Other Piping With Earthquake-Designed Piping. Describe the design criteria to account for the seismic motion of piping systems not earthquake-designed which may interface with those that are.

14. Field Location of Supports and Restraints (FSAR). The criteria employed to determine the field location of seismic supports and restraints for earthquake-designed piping, piping system components, and equipment, including placement of snubbers and dampers, should be provided. The procedures followed to ensure that the field location and the seismic design of these supports and restraining devices are consistent with the assumptions made in the dynamic seismic analysis should be described.

15. Seismic Analysis of Overhead Cranes. The provisions taken to ensure that all overhead cranes located in the buildings will not be dislodged from their rails in the event of seismic excitation should be described.

16. Seismic Analysis of Specific Safety Features. The integrity of specific safety-related design features (e.g., boron raschig ring systems) in the event of an earthquake.

4.2.6 Snow Loadings

Describe design load criteria used to ensure that a maximum snow load can be accommodated.

4.2.7 Process and Equipment Derived Loads

For structural purposes, establish the load criteria to accommodate the contribution of process equipment and materials contained therein. The plant conditions and design loading combinations (e.g., normal service or operating loads, seismic loads, etc.) that provide the bases for design of components (or systems) should be listed for each system. The combination of design loadings should be categorized (as applicable) with respect to plant conditions identified as normal, upset, emergency, or faulted. The design stress limits and deformation criteria associated with each of the plant conditions should be specified.

4.2.8 Combined Load Criteria

Describe for combined loads the criteria selected to provide mechanical and structural integrity. The loads and loading combinations which the facility is subjected to should be defined, including the load factors selected for each load component where a factored load approach is used. The design approach used with the loading combination and any load factors should be specified. The loads acting on the structures, such as dead loads, live loads, and earth pressure loads, as well as the design basis accident loads, loads resulting from natural phenomena such as earthquakes, floods, tornadoes, hurricanes, and missile effects unique for the site, should be described. The design loading combinations utilized to examine the effects on localized areas such as penetrations, structural discontinuities, prestressing tendon anchor zones, crane girder brackets, and local areas of high thermal gradients, etc. 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.

4.2.9 Subsurface Hydrostatic Loadings

Describe the design bases for ground water-induced hydrostatic loadings on subsurface portions of the safety-related structures, systems, and components. Discuss the development of these design bases. Where dewatering during construction is critical to the integrity of safety-related structures, describe the bases for subsurface hydrostatic loadings assumed during construction and the dewatering methods to be employed in achieving these loadings. Where wells are proposed for safety-related purposes, discuss the hydrodynamic design bases for protection against seismically induced pressure waves. The above design bases should be consistent with the ground water conditions described in Section 3.6.4.6.

4.3 Safety Protection Systems

4.3.1 General

Identify items requiring special consideration in design because of site selection, process selection, and safe shutdown requirements.

4.3.2 Protection by Multiple Confinement Barriers and Systems

4.3.2.1 Confinement Barriers and Systems. Discuss each method of confinement which 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 internal accident or external natural phenomena.

2. Design criteria selected for vessels, piping, effluent systems, and backup confinement.

3. Delineate for each case the extent to which the design is based on achieving the lowest practical level of releases from the operation of the plant.

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

4.3.2.2 Ventilation - Offgas. Describe the criteria selected for providing suitable ventilation by showing capacity standards for normal and abnormal conditions, zone interface flow velocity and differential pressure standards, the flow pattern and assured continuity of operation under accident conditions and special control instrumentation.

Establish the criteria for the design of the ventilation and offgas systems, including (1) air flow patterns and velocity with respect to contamination control, (2) minimum negative pressures at key points in the system to maintain proper flow control, (3) interaction of offgas systems with ventilation systems, (4) minimum filter performance with respect to particulate removal efficiency and maximum pressure drop, (5) minimum performance of other radioactivity removal equipment, (6) minimum performance of dampers and instrumented controls, and (7) ensured continuity of operation under all credible operating conditions.

4.3.3 Protection by Equipment and Instrumentation Selection

4.3.3.1 Equipment. Itemize design criteria for key equipment items which have been specifically selected to provide protection.

4.3.3.2 Instrumentation. In similar fashion to the above, discuss the design criteria for instrumentation selected, with particular emphasis on features to provide testability and contingency for safety purposes.

4.3.4 Nuclear Criticality Safety

Provide all pertinent criteria related to assurance that appropriate safety margins are provided to ensure that a subcritical situation exists at all times.

4.3.4.1 Control Methods for Prevention of Criticality. Present the methods to be used to ensure subcritical situations in operations and storage and under the worst credible conditions.

4.3.4.2 Error Contingency Criteria. To support the above information, define the error contingency criteria selected for the plant.

4.3.4.3 Verification Analyses. Present the criteria for establishing verification.

4.3.5 Radiological Protection

A portion of the radiological protection design criteria will have been discussed earlier in this chapter, Section 4.3.2, "Protection by Multiple Confinement Barriers and Systems." Present the additional radiological protection design criteria.

4.3.5.1 Access Control. Describe the methods and procedures to be designed into the facility to limit access as necessary to minimize exposure to people.

4.3.5.2 Shielding. Provide an estimate of personnel exposures in man-rem per year in each area. Where special provisions such as time and distance are to be included, determine the design dose rate in occupancy areas. Show that further reduction of exposure is not practicable in terms of cost per man-rem reduction.

4.3.5.3 Radiation Alarm Systems. Describe the criteria used for action levels from radiation alarm systems.

4.3.6 Fire and Explosion Protection

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

4.3.7 Fuel and Radioactive Waste Handling and Storage

4.3.7.1 Spent Fuel Receiving and Storage. Describe the design criteria for spent fuel receipt and storage. Include the criteria for cooling, contamination control, maintaining water quality (if a water pool is used for storage), prevention and/or mitigation of cask drop, and receipt of a damaged cask.

4.3.7.2 Radioactive Waste Treatment. Establish the criteria to be used for the treatment and storage of radioactive wastes, including (1) reduction in volume, (2) minimizing releases of radioactivity during treatment, (3) conversion to solid forms, (4) suitability of forms for storage, (5) safe confinement during storage, (6) monitoring during storage to demonstrate safe confinement, (7) suitability of high-activity waste and containers to meet the requirements of 10 CFR Part 50, Appendix F, and (8) final decontamination, retrieval, and disposal during decommissioning.

4.3.7.3 Storage Facilities. As appropriate from the above list, state the design criteria of storage containers and facilities associated with onsite storage.

4.3.8 Industrial and Chemical Safety

Any specific design criteria should be described that is important to personnel and plant safety. Effects of various industrial accidents should be presented (fire, explosion, etc.), as well as hazardous chemical reactions (vigorous chemical reactions, hydrogen explosions, etc.).

4.4 Classification of Structures, Components, and Systems

Provide a classification of the structures, components, and systems selected in the design according to their importance as to the safety function they perform, the seismic considerations, and the relationship of the quality of an item with respect to its function and performance. As appropriate, this classification presentation should relate to details presented in Chapter 5.0, "Facility Design," and Chapter 6.0, "Process Systems."

Define the criteria used to select the categories used for the classifications related to safety, seismic, and quality assurance.

4.5 Decommissioning

As required by 10 CFR Part 50, Appendix F, "Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities," arrangements must be included for safe decommissioning of the plant. Provide in this section the design criteria incorporated in the plant for fulfilling this requirement. Discuss the design philosophy to be used to allow ease of facility decontamination and future isolation of all radioactive materials from the public while maximizing the land area returned to the public domain.

CHAPTER 5.0 FACILITY DESIGN

In support of the PSAR evaluation, provide descriptive information on the buildings and other installed features for the plant and their locations on the site. Use drawings and maps as appropriate. Describe and evaluate each part of the facility, with emphasis on those features which serve a confinement function. Fully describe and evaluate special design features employed to withstand environmental forces and accident forces. Relate the design bases and use of industrial codes to the design criteria presented in Chapter 4.0. Reference those features which require inclusion in the Quality Assurance Program. For the FSAR, identify areas which have been changed or added, the reasons for the changes, and the safety implications of the changes. Also, present the results of research and development activities which have related to the construction and/or operating criteria.

5.1 Summary Description

5.1.1 Location and Facility Layout

Identify the location of the buildings and other installed facilities of the reprocessing plant on a map or drawing to scale. Also, include in this presentation roadways, railroad lines, and utility and water service locations.

5.1.2 Principal Features

5.1.2.1 Site Boundary. Show the boundary which encompasses the area owned and/or leased by the applicant.

5.1.2.2 Exclusion Area. Show the exclusion area. For this purpose, the exclusion area is defined in 10 CFR Part 100, §100.3.

5.1.2.3 Restricted Area. In like manner, show the restricted area as defined in 10 CFR Part 20, §20.3.

5.1.2.4 Site Utility Supplies and Systems. Identify the utility supplies and systems, as well as the source or sources of water. Include the location of test wells and cooling tower.

5.1.2.5 Storage Facilities. Show the location of holding ponds, process chemical and gas storage vessels, or other tankage not located in a building.

5.1.2.6 Stack. Show the location of the ventilation stack or stacks in relation to the other facilities.

5.2 Process Building

Provide the design bases for the process building, including analysis and design procedures for tornado, earthquake, missile, fire, and explosion effects, the general analysis and design procedures for normal, abnormal, and special loadings and load combinations, allowable foundation loads and deflections and deformation stresses for structures, and provisions and methods for making connections between the existing plant and future plant modification and additions.

5.2.1 Structural Specifications

Establish the bases and engineering design required to maintain the confinement integrity of the building. Where applicable, identify nationally recognized codes and standards and the materials of construction, fabrication, and inspection to be used, and itemize in tabular form features which will be used in the Quality Assurance Program discussed in Chapter 12, "Quality Assurance." Identify the specifications and design details to meet the required information discussed in Section 5.2 above. Include also consideration given to combination stress loadings.

5.2.2 Building Layout

5.2.2.1 Process Building Plan. By use of engineering type drawings, show the layout of the functional features of the building. Provide plans and elevations in sufficient detail to identify all features to be discussed later in this chapter. Include sufficient spatial and equipment identification data directly on the layouts with suitable designations in tabular listings.

5.2.2.2 Process Building Sections. Include sectional drawings to clearly relate all features to be discussed later in this chapter.

5.2.2.3 Confinement Features. Identify and discuss general layout criteria for the process building which have been included in the design to ensure confinement of radioactivity. This should be a general discussion, with details to be presented in the appropriate part of this chapter. Included in the discussion should be ventilation, filters, piping, and other physical means such as barriers, encasements, liners, and protective coatings. Identify the interfaces between the systems and discuss the safety aspects of the interfaces. Details on ventilation operation are to be presented in Chapter 8.0, "Radiation Protection."

5.2.3 Individual Facility Description

List each facility sequentially from the receiving facility through the various operations. Typical items would be: Fuel Receiving and Storage, Remote Process Cell, Process Offgas Treatment, Control Room, Service Galleries, Waste Treatment, Product Loadout and Storage, Low and High Level Waste Storage, and Remote and Contact Maintenance Shops. Show the location of each by use of engineering drawings.

5.2.3.1 Function. Describe the function of the individual operational areas and discuss the performance objectives.

5.2.3.2 Components. Discuss the components in the area under discussion. Use individual equipment sketches, layouts of equipment location to identify aspects of the components that must be relied upon, and limits that may be imposed on the design to achieve safety.

5.2.3.3 Design Bases and Safety Assurance. Present the design bases as developed, design codes used, and any additional specifications which are necessary to provide a sufficient margin of safety between normal and accident conditions so that a single failure will not result in the release of significant radioactivity. Details on backup provisions and interface with other areas should be included. Include also a discussion of the features used to ensure radiation protection and to prevent criticality.

5.3 Support Systems

Provide information on those systems which are in support to the main process and confinement features. Emphasis should be placed on provisions for coping with unscheduled occurrences in a manner which will preclude an unsafe condition. Define the design bases, codes, specifications, and standards that will provide a safety margin such that a single failure within a support system will not result in the release of radioactivity. Provide information on those systems which are in support to the main process and confinement features. Emphasis should be placed on provisions for coping with unscheduled occurrences in a manner which will preclude an unsafe condition.

5.3.1 Development of Support Requirements

For certain auxiliary systems involving building ventilation, electrical, air, and water, three categories of loads are possible:

1. Loads determined by normal processing operations.

2. Reduced load situations resulting from primary failure and/or accident conditions.

3. Emergency load, defined as the minimum requirement for the total safety of a shutdown process operation, including its surveillance requirements.

Minimum loads are further defined as the required loads for the confinement systems, which are required to remain functional following a maximum hypothetical occurrence to prevent the release of radioactivity. Summarize the auxiliary systems, what the systems service, the design capacity for each, and the operating load during normal, emergency, and required confinement operations.

Also, include details of support systems such as the fire protection system, design provisions for maintenance, and "cold" chemical systems.

5.3.2 Arrangement of Support Systems

Discuss the location of the various support facilities in relation to their functional objectives. This section should refer to drawings developed in Section 5.2.2 and should present additional details to identify the detailed physical arrangement. For each, as appropriate, provide single line drawings and a narrative description of its operating characteristics and safety considerations.

5.4 Description of Service and Utility Systems

5.4.1 Building Ventilation

Provide the design bases, design operating features, and limitations for performance of the ventilation-filtration systems in detail to show that there will be sufficient backup, excess capacity, repair and replacement capability, and structural integrity to ensure controlled continuous air flow in all credible circumstances to minimize release of radioactive particulates. Supplement the discussion with appropriate drawings to show the flow distribution, pressure differentials, flow quantity, velocity, filter, and fan housing arrangements. Identify each of the areas serviced and the interfaces between areas in the following subsections.

Include in the description, with reference to drawings, the interface considerations between components of the systems and the offgas treatment systems. Include a discussion of the design limits selected for operation and the performance limits that must be met for safety. Also, discuss the program to determine the efficiencies of each component during the operating life of the plant.

5.4.1.1 Major Components and Operating Characteristics. Describe the components making up the system, their relation to one another in terms of air supply, their collection and distribution systems, modes of gas conditioning, jetting, sequence of filtration, filter protection, the exhaust fans, and the stack. For clarity, provide and refer to in the discussion appropriate engineering drawings and sketches.

Also, discuss with reference to appropriate engineering drawings and tables the interrelation of component parts and controls to:

1. Prevent spread of radioactivity in normal plant operations.

2. Minimize spread of radioactivity during abnormal operations or under accident conditions.

3. Control contamination between areas.

4. Control air contamination when personnel access doors or cell hatches are opened.

5. Interface with process offgases.

6. Limit the spread of radioactivity within the ventilation system.

7. Provide for ventilation exhaust in the event of stack failure.

8. Provide for power outages.

9. Limit radioactivity in the stack effluent.

5.4.1.2 Safety Considerations and Controls. Relate the following in such a manner that the provisions for structural integrity, design velocity, flow and flow direction, control instrumentation, and features for testing and monitoring of the system establish continued performance integrity.

Present a detailed discussion of the evaluations made that show that the system by itself and in conjunction with other ventilation systems will be operable. Also, show that sufficient margins exist between normal and accident conditions that a single component failure will not result in an uncontrolled release of radioactivity.

Emphasize the design features to assure confinement of radioactive particulates under conditions of power failure, adverse natural phenomena, breakdown of equipment, fire and explosion, improper flow of air, contaminated spills, and loss of filter integrity.

Give your estimate of the radioactivity contribution discharged by the system. Present source terms in type of material, concentration, activity, and total quantity per unit time to be used in determining radiation exposure data presented in Section 8.6.

5.4.2 Electrical

5.4.2.1 Major Components and Operating Characteristics. Discuss the source and characteristics of the primary electrical system providing normal power to the plant.

Describe the source of the secondary system, if such is to be installed.

Describe the design providing for the emergency power source(s) and the means for ensuring an uninterruptible service to those items requiring it. For each of these latter items, list the location, the equipment and systems serviced, locations, required kilowatts, and type of startup system.

5.4.2.2 Safety Considerations and Controls. Itemize and discuss the mechanisms and sequence and timing of events which will occur for a partial loss of normal power and for a total loss of normal power to ensure safe operation and shutdown. Present the design features which make possible an automatic restart sequence on emergency power. Also, describe the procedure for subsequent reestablishment of normal load service.

5.4.3 Compressed Air

5.4.3.1 Major Components and Operating Characteristics. Present the design bases for supplying the compressed air needs of the plant and supply air for protective masks and clothing, the components, their location, and operating characteristics. Include a description of the compressors, receivers and dryers, and distribution systems.

5.4.3.2 Safety Considerations and Controls. Discuss in detail the backup provisions for the instrument air system and its relation to providing emergency functioning.

5.4.4 Steam Supply and Distribution

5.4.4.1 Major Components and Operating Characteristics. Present the design for supplying steam to the facility, including a discussion of the fuel supply and boiler type.

5.4.4.2 Safety Considerations and Controls. Discuss features of the steam supply system in relation to continuity of operations and safe shutdown features.

5.4.5 Water Supply

5.4.5.1 Major Components and Operating Characteristics. Discuss the primary source of the water supply, alternative sources, storage facilities, and plant supply loops. Itemize design considerations to demonstrate a continuity of a water supply. Also, itemize by service (potable, process, and fire) the quantities of water utilized under normal conditions.

5.4.5.2 Safety Considerations and Controls. Discuss the effects of loss of water supply source, failure of main supply pump(s) or supply loops, and power failure. Also, discuss the means for coping with drought and flood.

5.4.6 Cooling Water

5.4.6.1 Major Components and Operating Characteristics. Provide the design bases for the components required to provide cooling for the facilities, including fuel storage pool, the high level waste holding area, and process. Also, provide information on cooling ponds or towers and means for maintaining water quality.

5.4.6.2 Safety Considerations and Controls. Discuss the implications and methods of control which will be used should there be an interruption of the water supply, loss of components of the cooling systems, and need for cooling emergency auxiliary systems.

5.4.7 Sewage Treatment

5.4.7.1 Sanitary Sewage. Describe the sanitary sewage handling system to show that no radioactive material can be discharged in this effluent.

5.4.7.2 Chemical Sewage. Describe any system which may be used for handling and treatment of nonradioactive effluents.

5.4.8 Safety Communications and Alarms

5.4.8.1 Major Components and Operating Characteristics. Discuss the system(s) to be utilized for communications externally and internally, with particular emphasis on the facilities to be used under emergency conditions.

5.4.8.2 Safety Considerations and Controls. Describe the functioning of the communication systems and alarms in response to normal and abnormal operations and under accident conditions.

5.4.9 Fire Protection System

5.4.9.1 Design Basis.

1. Identify (PSAR) the fires that could indirectly or directly affect safety-related structures, systems, and components. Describe and discuss those fires which provide the bases for the design of the fire protection system, i.e., fires that are considered to be the maximum fire that may develop in local areas assuming that no manual, automatic, or other fire-fighting measures have been started and the fire has passed flashover and is reaching its peak burning rate before firefighting can start. Consider fire intensity, location, and (depending upon the effectiveness of fire protection) the duration and effect on adjacent areas.

2. Discuss fire characteristics (PSAR), such as maximum fire intensity, flame spreading, smoke generation, production of toxic contaminants, and the contribution of fuel to the fire for all individual plant areas which have combustible materials and are associated with safety-related structures, systems, and components. Include in the discussion the use and effect of noncombustible and heat-resistant materials. Provide a list (FSAR) of the dangerous and hazardous combustibles and the maximum amounts estimated to be present, and state where these will be located in the facility in relation to safety systems.

3. Discuss and list (PSAR) the features of buildings and facility arrangements and the structural design features that provide for fire prevention, fire extinguishing, fire control, and control of hazards created by fire. List and describe in the discussion the egress, fire barriers, firewalls, and the isolation and containment features provided for flame, heat, hot gases, smoke, and other contaminants.

4. Specify (PSAR) the seismic design requirements for each type of fire protection system incorporated in the facility and the reactor plant site, and the fire protection system requirements used in the basic design in the general areas of water supply, water distribution systems, and fire pump capacity.

5. List (PSAR) the codes and standards considered and used for the design of the fire protection systems, including published standards of the National Fire Protection Association.

6. Discuss (PSAR) the fire hazards and potentials during construction of multiple units and the additional fire prevention and control provisions that will be provided during the construction period while one unit is in operation. This discussion should include the professional fire department coverage.

5.4.9.2 System Description.

1. Provide a general description of the system, including preliminary drawings (PSAR) showing the physical characteristics of the plant location which outline the fire prevention and fire suppression systems to be provided for all areas associated with safety-related structures, systems, and components.

2. Discuss (PSAR) the protection and suppression systems provided in the control room and other operating areas containing safety-related equipment.

3. Describe (PSAR) the design features of detection systems, alarm systems, automatic fire suppression systems, and manual, chemical, and gas systems for fire detection, confinement, control, and extinguishing. Discuss the relationship of the fire protection system to the onsite a.c. and d.c. power sources.

4. Discuss (PSAR) smoke, heat, and flame control; combustible and explosive gas control; and toxic contaminant control, including the operating functions of the ventilating and exhaust systems during the period of fire extinguishing and control. Discuss the fire annunciator warning system, the appraisal and trend evaluation systems provided with the alarm detection system in the proposed fire protection systems, and the backup or public fire protection if this is to be provided in the installation. Include drawings (FSAR) and a list of equipment and devices which adequately defines the principal and auxiliary fire protection systems.

5. Describe (PSAR) electrical cable fire protection and detection and the fire containment, control, and extinguishing systems provided. Define integrity of the essential electric circuitry needed during the fire for safe shutdown of the plant and for firefighting. Describe the provisions made for protecting this essential electrical circuitry from the effects of fire-suppressing agents.

5.4.9.3 System Evaluation. Provide an evaluation for those fires identified in Section 5.4.9.1. This evaluation should consider the quantities of combustible materials present, the plant design, and the fire protection systems provided. Describe the estimated severity, intensity, and duration of the fires, and the hazards created by the fires. Indicate for each of the postulated events the total time involved and the time for each step from the first alert of the fire hazard until safe control or extinguishment and safe shutdown of the plant is accomplished. Provide a failure mode and effects analysis that demonstrates that operation of the fire protection system in areas containing process safety features would not produce an unsafe condition or preclude safe shutdown. An evaluation of the effects of failure of any portion of the fire protection system not designed to seismic requirements should be provided with regard to the possibility of damaging other equipment. Include an analysis of the fire detection and protection system with regard to design features to withstand the effects of single failures.

5.4.9.4 Inspection and Testing Requirements. List and discuss the installation, testing, and inspection planned during construction of the fire protection systems to demonstrate the integrity of the systems as installed (PSAR). Describe the operational checks, inspection, and servicing required to maintain this integrity (FSAR).

Discuss the testing necessary to maintain a highly reliable alarm detection system (FSAR).

5.4.9.5 Personnel Qualification and Training. State the qualification requirements for the fire protection engineer or consultant who will assist in the design and selection of equipment, inspect and test the completed physical aspects of the system, develop the fire protection program, and assist in the firefighting training for the operating plant (PSAR). Discuss the initial training and the updating provisions such as fire drills provided for maintaining the competence of the station firefighting and operating crew, including personnel responsible for maintaining and inspecting the fire protection equipment (FSAR).

5.4.10 Maintenance Systems

5.4.10.1 Major Components and Operating Characteristics. Provide the design bases, locations, and modes of operation which will relate to the maintenance programs for the plant. Emphasis should be placed on provisions for remote work; decontamination and disposal of equipment, piping, and valves; quality control; and testing.

5.4.10.2 Safety Considerations and Controls. Discuss the means for conducting required maintenance with a minimum of personnel radiation exposure or injury and by providing assured confinement of process materials and radioactive wastes as necessary.

5.4.11 Cold Chemical Systems

Describe the major components and operating characteristics of facilities which will be used in association with cold chemical operations. Where hazardous chemicals or materials are involved, discuss the provisions which will be made to mitigate accidents. Itemize the chemicals and materials which will be used, their quantities, and where they will be used, and codify with respect to hazard.

5.5 Items Requiring Further Development

Identify, describe, and discuss those safety features or components for which further technical information will be required in support of the issuance of a construction permit, but which have not been supplied in the PSAR. This section should:

1. Identify and distinguish between those technical information development programs that will be required to determine the adequacy of a new design, and those that will be used to demonstrate the margin of conservatism of a proven design,

2. Characterize the specific technical information that must be obtained to demonstrate acceptable resolution of the problems,

3. Outline the program in sufficient detail to show how the information will be obtained,

4. Provide a schedule of completion of the program as related to the projected startup date of the proposed plant, and

5. Discuss the design alternatives or operational restrictions available in the event that the results of the program do not demonstrate acceptable resolution of the problems.

Provide reasonable assurance that the alternatives which will be considered will be acceptable substitutes.

5.6 Changes from the PSAR

This section will appear only in the FSAR. Describe the results of the development work identified in the PSAR. Present an evaluation of the results and the application made of them, and identify and justify the changes made. Each item should be cross-referenced to the appropriate section in the FSAR that describes the changes and the reasons for them. Include a summary of special technical information development programs undertaken to establish the final design and/or to demonstrate the conservatism of the design, and a discussion of any programs that will be conducted during operation in order to demonstrate the acceptability of contemplated future changes in design or modes of operation.

CHAPTER 6.0 PROCESS SYSTEMS

6.1 Process Description

In this chapter, provide a detailed description of all processes, including systems, equipment, and instrumentation, their operating characteristics, and identification of potentially hazardous process systems. Provisions made for safety engineered features to ensure against a hazard should be so designated in the details presented. That latter information should include, but not be limited to, listing of systems necessary for safe shutdown under normal and abnormal conditions and maintenance of the plant in a safe shutdown condition, secondary confinement, and backup or standby features. In addition to describing the process, include reference to the items which will require attention for the Quality Assurance Program during construction. For each system, describe the considerations used to achieve as low as practicable levels of radioactivity in plant effluents and to ensure subcritical conditions at all times. The FSAR should show changes from the PSAR, reasons for the changes, and a final definition of limits and parameters for developing the Technical Specifications.

6.1.1 Narrative Description

Describe the proposed process and relate it to the equipment and associated controls. Include in this discussion ancillary activities as pertinent to the use of the main process, i.e., preparation of reactants, offgas handling, volume reduction of wastes, and decontamination. In the description, identify the interfaces between systems and discuss the safety aspects of the interfaces.

6.1.2 Flowsheets

In support of the description above, supply flowsheets showing the process, materials and heat balances, ana instrumentation. Provide identification of the process and effluent streams in sufficient detail that an independent review can be made to ensure a safe operation. That should include stream flow quantities, activities, compositions, properties, sample points, and identification of primary control points. Provide the flow input characteristics for effluent control equipment, as well as its output, to show the efficiencies obtained. Sufficient detail should be given to provide source terms for radiation exposure determinations to be developed in Chapter 8.0, "Radiation Protection." Include equipment descriptions with dimensions, design and operating temperatures and pressures, materials of construction, special design features, and process limitations. Also provide appropriate engineering and process instrumentation details and flow diagrams.

6.1.3 Identification of Items for Safety Analysis Concern

Provide identification of areas or items for safety analysis concern. Reference this part of the chapter, as applicable, in subsequent discussion of design and operating features and items discussed in Chapter 2.0, "Summary Safety Analysis."

6.1.3.1 Criticality Prevention. Provide a summary description of the principal policies, approaches, and special techniques used to preclude criticality in various portions of the plant.

6.1.3.2 Chemical Safety. Provide a summary description of the principal chemical hazards (hydrogen, red oil, solvent flammability, fluorine) and the approaches used to preclude associated accidents. (Refer to Section 6.2, below.)

6.1.3.3 Process Shutdown Modes. Describe the general plant conditions and surveillance needs in various shutdown modes--extended, short-term, emergency. Indicate the time required to shut down and start up for each mode.

6.1.3.4 Instrumentation. A summary description of the instruments used to detect process conditions and the systems used to control the process. The description should include testability, redundancy, and failure conditions. Also, describe effluent and process monitors and data loggers.

6.1.3.5 Remote and Contact Maintenance Techniques. Discuss the rationale, and outline the techniques to be used. This should include a statement of the cells where the techniques apply. Include system and component spares.

6.2 Process Chemistry and Physical Chemical Principles

Present in detail the process chemistry and physical chemical data appropriate to characterize the process. Where side reactions may occur, present the chemistry and discuss the extent to which such reactions will be expected under normal and abnormal conditions.

6.3 Mechanical Process Systems

Each of the following sections is intended to give the reader a good idea of the functions, design bases, and pertinent design features of a process system as they relate to plant or environmental safety. To the extent pertinent, sketches should be used to describe unique equipment or design features.

6.3.1 Fuel Receiving, Storage, Handling, and Transfer

Describe the systems associated with fuel receipt, storage, and transfer. From the design criteria, present the provisions for cooling, cleanup of pool water, when used, maintaining fuel assemblies in subcritical form, and provisions for shielding.

6.3.1.1 Functional Description. Present a flow diagram and functional description of the fuel receiving and storage system. Include drawings or references to drawings as needed.

6.3.1.2 System Description. Describe the fuel unloading systems, cask decontamination, pool size and equipment functions, and contamination control systems. Use sketches and dimensions as appropriate. Discuss handling of ruptured fuel elements and aqueous wastes.

6.3.1.3 Safety Features. Describe all safety-related features, systems, or special handling techniques included in the system to provide for the safety of the operation under both normal and abnormal conditions. Include the limit(s) selected for a commitment to action.

6.3.2 Feed Preparation and Hull Handling

Present a description of the mechanism for feed preparation and hull handling as it relates to the type of spent fuels to be reprocessed. Include in this section the method to be used for monitoring the hulls for radiation and residual SNM material.

6.3.2.1 Functional Description. Describe the functions of the mechanical processing system. Provide or refer to drawings as needed.

6.3.2.2 System Description. Describe fuel transfer, disassembly, end-section handling, and fuel-fuel cladding separation systems equipment and procedures. Describe the method to be used for monitoring the hulls for radiation and residual SNM material.

6.3.2.3 Safety Features. Describe all safety-related features, systems, and special techniques included in the system to provide for the safety of the operation under both normal and abnormal conditions. Include the limit(s) selected for a commitment to action.

6.4 Chemical Process Systems

Relate each process system to the process description and appropriate flowsheets. Where appropriate, identify the system as a source of effluents and wastes which are discussed in Chapter 7.0, "Waste Confinement and Management," and Chapter 8.0, "Radiation Protection." Reference should be made to physical layout presentations found in Chapter 5.0, "Facility Design." Use subsections to present the information on each process system.

6.4.1 Process System

Name the actual process system described in this subsection. Continue additional process systems sequentially, e.g., 6.4.2, 6.4.3,....

6.4.1.1 Functional Description. Describe the portion of the process to be discussed, what its function is, and how it will be accomplished.

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

6.4.1.3 Design Description. Discuss the design bases, including materials of construction; pressure and temperature limits; detailed dimensions, especially as related to criticality consideration if not discussed elsewhere; corrosion allowances; and standards or codes used. Itemize material and fabrication specifications pertaining to the system in sufficient detail to relate to the Quality Assurance Program to be discussed in Chapter 12.0, "Quality Assurance." Include such items as material of construction, identification, assembly, welding, installation, and testing. With suitable cross reference, it will not be necessary to duplicate this information in Chapter 12.0.

6.4.1.4 Safety Criteria and Assurance. From the parameters discussed in the preceding subsections, summarize the criteria, the means of ensuring a safe system as constructed, operated, and maintained. Summarize those limit(s) selected for commitment to action. Also, identify those items which can be characterized as being engineered safety features and which are considered additionally necessary beyond normal process operation and control. Emphasis should be placed on criticality considerations.

6.4.1.5 Operating Limits. Identify limits, conditions, and performance requirements in sufficient detail to make possible an evaluation as to whether a technical specification may be necessary. The interface relation to other systems should be clearly described.

6.4.2 Component/Equipment Spares

Describe, in detail, design features which include installation of spare or alternative equipment to provide continuity of safety under normal and abnormal conditions. This may include vessels, jets, pumps, remote jumper pipes, heaters or coolers, and valves. Particular emphasis is needed on design selection to minimize radiation exposure for maintenance operations. Also, describe the bases for inspection, preventive maintenance, and testing programs to ensure continued safe functioning.

6.5 Process Support Systems

Although effluent handling systems may be considered process support, provision is made to discuss these in Chapter 7.0, "Waste Confinement and Management." To the extent a system is designed for complete recycle within the main process, it should be discussed in this section. Describe any cold chemical systems which will supply or regenerate reactants being used. Principal auxiliary backup equipment is to be discussed in Chapter 5.0, "Facility Design."

6.5.1 Instrumentation and Control Systems

By reference to instrumentation engineering flowsheet(s) and the process, discuss the instrumentation and control features associated with process control, process monitors, and alarms, and the relationship of one to the other. Identify aspects that must be relied upon to establish that adequate reliability is provided and that provisions have been included in the design to ensure continued safe operation or safe shutdown under accident conditions. Relate these to the design criteria presented in Chapter 4.0, "Principal Design Criteria." Discuss how instrumentation and control systems monitor safety-related variables and operating systems over anticipated ranges for normal operation, for abnormal operation, for accident conditions, and for safe shutdown. Describe the redundancy of engineered safety features required to ensure adequate safety of process and utility operations. The safety-related variables and systems that require constant surveillance and control include the overall confinement system, each confinement barrier and its associated systems, and other process systems that affect the overall safety of the plant. Discuss the provisions for in situ testability of the instrumentation and control systems. Describe how instrumentation and control systems are designed to be fail-safe or to assume a state demonstrated to be acceptable if conditions such as disconnection, loss of energy or motive power, or adverse environments are experienced. For each, provide the following information:

6.5.1.1 Functional Description.

6.5.1.2 Major Components.

6.5.1.3 Detection System and Locations.

6.5.1.4 Operating Characteristics.

6.5.1.5 Safety Criteria and Assurance.

6.5.2 System and Component Spares

Describe in detail installation of spare or alternative instrumentation designed to provide continuity of operation under normal and abnormal conditions. Also, describe the bases for inspection, preventive maintenance, and testing programs to ensure continued safe functioning.

6.6 Control Room

Discuss how a control room and/or control areas are to be designed to permit occupancy and actions to be taken to operate the plant safely under normal conditions and to maintain the plant in a safe condition under accident or other abnormal conditions. Describe the redundancy which allows the plant to be put into a safe condition if any control room or control area is removed from service.

6.7 Sampling--Analytical

Discuss provisions for obtaining samples for process analysis and control necessary to ensure that operations are within prescribed limits. Describe the facilities and analytical equipment which will be available to perform the analyses, as well as the destination of laboratory wastes.

6.8 Product Handling

For the product or products resulting from operation of the reprocessing plant, provide the details of the system and the methods which will be used for their handling and storage.

6.8.1 Uranium Storage and Load-Out Systems

6.8.1.1 Functional Description.

6.8.1.2 Major Components. Describe the calcination and storage systems and equipment, both surge storage before fluorination and onsite storage of low value uranium. Include accountability/decontamination measurements for discard portion.

6.8.1.3 Design Description.

6.8.1.4 Safety Criteria and Assurance.

6.8.1.5 Operating Limits.

6.8.2 Plutonium Storage and Load-Out Systems

6.8.2.1 Functional Description. Describe plutonium storage and load-out system.

6.8.2.2 Major Components. Describe concentration, calcination and storage equipment, and procedures. Include special features for accountability, polymer control, etc.

6.8.2.3 Design Description.

6.8.2.4 Safety Criteria and Assurance. Describe all safety-related features, systems, and special techniques to be employed to ensure the safety of the operation. Include systems needed for criticality control and radiological safety.

6.8.2.5 Operating Limits.

6.9 Items Requiring Further Development

As described in Chapter 5.0, Section 5.5, present in the PSAR the details for each item requiring the development of additional information or data. Identify the item, what is needed, and how and when the information will be obtained. Indicate times when data are expected to be available and options that are available in the event satisfactory results are not obtained. Reference this information to Chapter 1.0, Section 1.6.

6.10 Changes from the PSAR

In the FSAR, describe in detail the results of the development work identified in the PSAR. Present an evaluation of the results and the application made of them, and identify and justify the changes made.

CHAPTER 7.0 WASTE CONFINEMENT AND MANAGEMENT

7.1 Waste Management Criteria

By reference to Chapter 4.0, "Principal Design Criteria," and 10 CFR Part 50, Appendix F, "Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities," provide the primary design bases and supporting analysis for demonstrating that all radioactive waste materials will be contained safely over the life of the reprocessing plant. Include also the considerations for offsite disposal of solid waste materials and contaminated equipment. The waste confinement objectives, equipment, and program should implement, in part, the considerations necessary for protection against radiation as described in Chapter 8.0, "Radiation Protection."

7.2 Radiological Wastes

Classify all anticipated radioactive wastes with respect to source, chemical and radiological composition, method and design for handling, and mode of storage (temporary or permanent). Identification may be by reference to previous flowsheets and diagrams.

7.3 Nonradiological Wastes

In like manner to Section 7.2, identify waste sources other than those containing radioactivity. Account for combustion products, as well as all chemicals leaving the plant. This information is to be included to assist the staff in their determination that no radioactivity will be added to such sources, particularly effluents.

7.4 Offgas Treatment and Ventilation

For all offgas and ventilation systems, indicate those radioactive wastes which will be produced as a result of removal from the gases cleaned by those systems. Such items as filters and scrubbers, which collect wastes, should be discussed to indicate the destination of the wastes upon regeneration or replacement. If the wastes enter other waste treatment systems, indicate how such transfers are made and any possible radiological effects of the transfer. Provide equipment and process flowsheets, tabular information (where clarity can be improved), and discussion in sufficient detail to demonstrate that:

1. "As low as practicable" radioactivity releases will be achieved during normal operation.

2. Capacity is sufficient to confine radioactivity during abnormal operations or under postulated accident conditions.

3. Provisions are incorporated to adequately monitor performance.

4. Satisfactory design features are incorporated to interface with other effluent and ventilation systems.

7.4.1 Operating Characteristics

Describe the function and performance objectives of each offgas treatment system. Present a discussion on the principles upon which each performs.

Include a discussion of the design limits selected for operation and the performance limits that must be met for safety. Also, discuss the program to determine the efficiencies of each treatment component during the operating life of the plant, including composition of the feed to the treatment system and the discharge from it. Give your estimates of the radioactivity contribution discharged by each system. Characterize the radioactivity in a manner to provide source terms used to develop the exposure data presented in Sections 8.5 and 8.6 as applicable.

7.4.2 Safety Criteria and Assurance

For each system, present the evaluation made to show that the system will be operable or noncontributory to release of radioactivity under all all credible circumstances.

7.5 Liquid Waste Treatment and Retention

Show how all liquid wastes are generated and enter liquid treatment systems. Include such items as laboratory wastes, liquid spills, and cleanup solutions. A statement should be made as part of the design objectives concerning the inventory levels expected, provisions for interim and long-term storage, and identification of those streams which will be processed to achieve volume reduction or solidification. Relate the discussion on process and equipment to the radioactivity level.

7.5.1 Design Objectives

Describe the design objectives for the system under discussion. Identify, in particular, criteria which incorporate backup and special features to ensure that the waste will be safely contained.

7.5.2 Equipment and Systems Description

Provide a description of the equipment and systems to be installed. Accompany the description with appropriate engineering drawings to show location of equipment, flow paths, piping, valves, instrumentation, and other physical features. Describe safety-related features, systems, or special handling techniques included in the systems to provide for the safety of the operation.

7.5.3 Operating Procedures

Describe the procedures associated with operation of the system(s). Include performance tests, action levels, action to be taken under normal and abnormal conditions, and methods for testability to ensure functional operation.

7.6 Liquid Waste Solidification

Provide a description of the process and equipment to be used for volume reduction and/or solidification of the liquid wastes identified in Section 7.5.

7.6.1 Design Objectives

Identify and state the means which will be used to meet the requirements in 10 CFR Part 50, Appendix F. Describe other objectives of the system(s) consistent with the processes selected.

7.6.2 Equipment and Systems Description

Provide a description of the equipment and systems to be installed. Accompany the description with appropriate engineering drawings to show location of the equipment and associated features which will be used for volume reduction, containment and/or packaging, cooling, and storage.

7.6.3 Operating Procedures

Describe the procedures associated with operation of the equipment, including performance tests, process limits, and means for controlling and monitoring to those limits.

7.6.4 Characteristics, Concentrations, and Volumes of Solid Wastes

Describe the physical, chemical, and thermal characteristics of the solid wastes, an estimate of concentrations, and volumes generated.

7.6.5 Packaging

Describe the means for packaging the solid wastes where required, and identify aspects which should be incorporated in the operating Quality Assurance Program. The package itself should be described in detail to show: (1) materials of construction, including welding information, (2) maximum temperatures for waste and container at the highest design heat loads, (3) homogeneity of the waste contents, (4) corrosive characteristics of the waste on the materials of construction, (5) means to prevent overpressurization of the package, and (6) containment provided by the package under abnormal conditions.

7.6.6 Storage Facilities

Describe the operation of the storage facilities which demonstrates that the likelihood of accidental puncture or other damage to a package from natural phenomena or other causes is very low. Discuss external corrosion of the package from storage surroundings, if applicable. Show how packages will be moved safely into and out of storage locations and how the packages will be monitored over their storage life.

7.7 Solid Wastes

List all solid wastes, other than the high-activity wastes, which are produced during plant operation. Describe the system used to treat, package, and contain them.

7.7.1 Design Objectives

Describe the objectives of the methods and the equipment selected for disposal of the solid wastes which are classified as containing less than high activity.

7.7.2 Equipment and Systems Description

Provide a description of the equipment and systems to be installed. Accompany the description with appropriate engineering drawings to show the location of the equipment and associated features which will be used for volume reduction, containment and/or packaging, cooling, and storage.

7.7.3 Operating Procedures

Describe the procedures associated with operation of the equipment, including performance tests, process limits, and means for monitoring and controlling to these limits.

7.7.4 Characteristics, Concentrations, and Volumes of Solid Wastes

Describe the physical, chemical, and thermal characteristics of the solid wastes, and provide estimates of concentrations and of volumes generated.

7.7.5 Packaging

Describe the means for packaging the solid wastes where required, and identify aspects which should be incorporated in the operating Quality Assurance Program.

7.7.6 Storage Facilities

For the solid wastes of the type of be retained onsite for the life of the plant, show in detail the containment methods used. Discuss corrosion aspects and monitoring of the containment. Show how the retrievability requirements of Appendix F to 10 CFR Part 50 with respect to decommissioning can be met.

7.8 Items Requiring Further Development

This section of the PSAR should present the safety aspects which require development of additional information or data. Identify and discuss each item, the projected schedule for obtaining the required information, and the alternatives which may be considered should the results obtained be unsatisfactory.

7.9 Changes from the PSAR

CHAPTER 8.0 RADIATION PROTECTION

This chapter of the SAR should provide information on methods for radiation protection and on estimated occupational radiation exposures to operating personnel during normal operation and anticipated operational occurrences (including radioactive material handling, use, storage, and disposal; maintenance; routine operational surveillance; inservice inspection; and calibration). It should provide information on facility and equipment design, the planning and procedures programs, and the techniques and practices employed by the applicant in meeting the standards for protection against radiation of 10 CFR Part 20 and the guidance given in the appropriate regulatory guides. Reference to other chapters for information needed in this chapter should be specifically made where required.

8.1 Assuring that Occupational Radiation Exposures Are As Low As Practicable (ALAP)

8.1.1 Policy Considerations

Describe the management policy and organizational structure related to assuring that occupational radiation exposures are as low as practicable. Describe the applicable activities to be conducted by the individuals having responsibility for radiation protection. In the PSAR, describe policy with respect to designing the plant, and in the FSAR, emphasize policy with respect to operation.

8.1.2 Design Considerations

In the PSAR, describe facility and equipment design considerations that are directed toward ensuring that occupational radiation exposures are as low as practicable. Describe how experience from any past designs is utilized to develop improved design for ensuring that occupational radiation exposures are as low as practicable. Include any design guidance (both general and specific) given to the individual designers. Describe how the design is directed toward reducing the need for maintenance of equipment and to reducing radiation levels and time spent where maintenance is required. These descriptions should be detailed in the PSAR.

Discuss the arrangements and plans for decontamination of the plant as referred to in 10 CFR Part 50, Appendix F, "Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities."

The detailed facility design practices regarding radiation protection are to be covered in Section 8.3.1.

8.1.3 Operational Considerations

In the PSAR, describe the methods used to develop the detailed plans and procedures for ensuring that occupational radiation exposures are as low as practicable. Describe how these plans and procedures will impact on the design of the facility and how such planning has incorporated information from other designs.

In the FSAR, identify and describe procedures and methods of operation that are used to ensure that occupational radiation exposures are as low as practicable. Describe how operational considerations are reflected in the design described in Section 8.1.2 and the radiation protection design features described in Section 8.3.1. Provide the criteria and/or conditions under which various procedures and techniques for ensuring that occupational radiation exposures are as low as practicable are implemented for all systems which contain, collect, store, or transport radioactive liquids, gases, and solids, including those from the radioactive waste treatment, handling, and storage systems.

8.2 Radiation Sources

8.2.1 Contained Sources

In the PSAR, the sources of radiation that are the basis for the radiation protection design should be described in the manner needed as input to the shield design calculation. The description should tabulate all sources by isotopic composition or gamma ray energy groups, strength (curie content), and geometry, as well as provide the basis for the values. In the FSAR, provide additional details (and any changes) of source descriptions that are used to develop the final shield design.

8.2.2 Airborne Radioactive Material Sources

In the PSAR, the sources of airborne radioactive material in areas easily accessible to or normally occupied by operating personnel should be described in the manner required for design of personnel protective measures and dose assessment. In the FSAR, the description should include a tabulation of the calculated concentrations of airborne radioactive material by nuclides expected during normal operation and anticipated operational occurrences in areas normally occupied by operating personnel. Provide the models and parameters for calculating airborne radioactivity concentrations. Describe any changes or additions to the source data since the PSAR.

8.3 Radiation Protection Design Features

8.3.1 Facility Design Features

In the PSAR, describe equipment and facility design features used for ensuring that occupational radiation exposures are as low as practicable.

Provide illustrative examples of the facility design features used in the PSAR design stage as applied to the systems addressed in Section

8.1.3. An illustrative example should be provided for components of each of the following systems: Fuel Receiving, Preparation, and Storage; Remote Process Cell; Process Offgas Treatment; Service Galleries; Waste Treatment and Storage; and Product (Uranium and Plutonium) Loadout and Storage. Refer to other chapters and sections as appropriate.

In the PSAR, provide scaled layout and arrangement drawings of the facility, showing the locations of all sources described in Section 8.2, including those contained in vaults, basins, process vessels, and storage containers or tanks throughout the plant. Include specific activity, physical and chemical characteristics, and expected concentrations of fission products and transuranic elements. Provide on the layouts the radiation zone designations, including zone boundaries. The layouts should show shield wall thicknesses, controlled access areas, personnel and equipment decontamination areas, contamination control areas, traffic patterns, location of the health physics facilities, location* of air-borne radioactivity and area radiation monitors, location of control panel(s) for radioactive waste equipment and components, location of the onsite laboratory for analysis of chemical and radioactivity samples, and location of the counting room. Summarize the design radiation dose rate for each area and activity. Specify the design basis radiation level in the counting room during normal operation and anticipated operational occurrences. Describe the facilities and equipment, such as hoods, gloveboxes, filters, and special handling equipment. In the FSAR, describe changes or additions to the radiation protection design since the PSAR was prepared.

8.3.2 Shielding

In the PSAR, provide information on the shielding for each of the radiation sources identified in Section 8.2, including the criteria for penetrations, the material, the method by which the shield parameters (such as attenuation coefficients, buildup factors, etc.) 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 radiation exposures will be ALAP in normally occupied areas. Describe the procedures that will be used to verify the integrity of the constructed shielding. In the FSAR, describe changes or additions in the shielding since the PSAR was prepared.

8.3.3 Ventilation

In the PSAR, the personnel protection features incorporated in the design of the ventilation system should be described by amplifying the discussions on building ventilation and offgas treatment in Chapters 5.0 and 6.0 to show that the designs selected will satisfy the ALAP provisions of 10 CFR Part 20 and appropriate guides.

* In the PSAR if available, and updated in the FSAR.

Refer to the discussion on building ventilation in Chapter 5.0, Section 5.4.1, and to appropriate engineering sketches and drawings to further discuss the interrelation of component parts and controls to:

1. Maintain internal exposure to as low as practicable.

2. Prevent spread of radioactivity in normal plant operations.

3. Minimize spread of radioactivity during abnormal operations or under accident conditions.

4. Control contamination between areas.

5. Control air contamination when personnel access doors or cell hatches are opened.

6. Interface with process offgases.

7. Limit the spread of radioactivity within the ventilation system.

8. Provide for ventilation exhaust in the event of stack failure.

9. Provide for power outages.

10. Limit radioactivity in the stack effluent.

Describe the function and performance objectives of the building ventilation system. Discuss the areas and equipment serviced and the criteria for providing continuity of service to the total system. Include in the description, with reference to drawings, the interface considerations between components of the systems and the offgas treatment systems. Include a discussion of the design limits selected for operation and the performance limits that must be met for safety. Also, discuss the program to determine the efficiencies of each component during the operating life of the plant.

Present a detailed discussion of the evaluations made that show that the system by itself and in conjunction with other ventilation systems will be operable. Also, show that sufficient margins exist so that a single component failure will not result in an uncontrolled release of radioactivity.

Describe how the system can cope with loss of electrical power.

Refer to the discussions of offgas treatment in Chapter 5.0, Section 5.2.3, and to appropriate equipment and process flow drawings, to further show that:

1. "As low as practicable" radioactivity releases will be achieved during normal operation.

2. Capacity is sufficient to confine radioactivity during abnormal operations or under postulated accident conditions.

3. Provisions are incorporated to adequately monitor performance.

4. Satisfactory design features are incorporated to interface with other effluent and ventilation systems.

Describe the function and performance objectives of each offgas treatment system. Present a discussion of the principles upon which each performs.

Include a discussion of the design limits selected for operation and the performance limits that must be met for safety. Also, discuss the program to determine the efficiencies of each treatment component during the operating life of the plant, including composition of the feed to the treatment system and the discharge from it.

For each system, present the evaluation made to show that the system will be operable or noncontributory to release of radioactivity under all credible circumstances.

In the FSAR, include any changes or additions in the ventilation system design protective features since the PSAR was prepared.

8.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

In the PSAR, describe the fixed area radiation and criticality monitors and the continuous airborne radioactivity monitoring instrumentation, as well as the criteria for placement.

In the FSAR, provide information on the auxiliary and/or emergency power supply, range, sensitivity, accuracy, calibration methods and frequency, alarm set points, recording devices, and location of detectors, readouts, and alarms for the monitoring instrumentation. Provide the location of the criticality detectors, and describe or refer to the readout system and neutron dose assessment technique to be used. In the FSAR, provide the location of airborne monitor sample collectors, and give details of the sampling lines pump location and criteria for obtaining representative samples from upstream effluent monitors.

8.4 Estimated Man-Rem Onsite Dose Assessment

In the PSAR, provide the estimated occupancy of the plant radiation areas during normal operation and anticipated operational occurrences. For areas with expected airborne radioactivity concentrations (as described in Section 8.2.2), provide estimated man-hours of occupancy. Provide the objectives and criteria for design dose rates in various areas and an estimate of the annual man-rem doses associated with major functions such as process operations and ancillary activities (e.g., offgas handling, volume reduction of wastes, etc.), maintenance, radwaste handling, decontamination, and inservice inspection. Provide the basis, models, and assumptions for the above values.

In the FSAR, tabulate the estimated annual occupancy for each radiation zone in the plant and provide the bases for the values. Provide updated estimates of annual man-rem doses for the functions listed above and the assumptions used in determining these values.

8.5 Health Physics Program

8.5.1 Organization

In the PSAR, describe the administrative organization of the health physics program, including the authority and responsibility of each position identified. In the FSAR, describe the experience and qualifications of the personnel responsible for the health physics program and for handling and monitoring radioactive materials.

8.5.2 Equipment, Instrumentation, and Facilities

In the PSAR, provide the criteria for selection of portable and laboratory technical equipment and instrumentation for performing radiation and contamination surveys, for airborne radioactivity sampling, for area radiation monitoring, and for personnel monitoring during normal operation, anticipated operational occurrences, and accident conditions. Describe the instrument storage, calibration, and maintenance facilities. Describe the health physics facilities, laboratory facilities for radioactivity analyses, protective clothing, respiratory protective equipment, decontamination facilities (for equipment and personnel), and other contamination control equipment and areas that will be available. In the FSAR, provide the locations of the respiratory protective equipment, protective clothing, and portable and laboratory technical equipment and instrumentation. Describe the type of detectors and monitors and the quantity, sensitivity, range, and frequency and methods of calibration for all of the technical equipment and instrumentation mentioned above.

8.5.3 Procedures

In the FSAR, describe the methods, frequencies, and procedures for conducting radiation surveys. Describe the health physics procedures that have been developed for assuring that occupational radiation exposures will be as low as practicable. Describe the physical and administrative measures for controlling access and stay time for radiation areas. Reference may be made to Section 8.1, as appropriate. Describe the bases and methods for monitoring and controlling personnel, equipment, and surface contamination. Describe radiation protection training programs.

Describe the methods and procedures for personnel monitoring (external and internal) for normal operations and criticality accidents, including methods of recording and reporting results. Describe how dosimetric results are used as a guide to operational planning. Provide the criteria for performing whole body counting and bioassays.

Describe the methods and procedures for evaluating and controlling potential airborne radioactivity concentrations, including any requirements for special air sampling and the issue and use of respiratory protective devices, including training and respiratory protective equipment fitting programs.

8.6 Estimated Man-Rem Offsite Dose Assessment

Describe the program and the analytical approach taken to monitor the radioactivity content of the effluent streams of the reprocessing plant. Relate the monitoring program to process flow diagrams and the discussions presented in Chapter 6.0, "Process Systems," and Chapter 7.0, "Waste Confinement and Management." Estimate the contribution by the reprocessing plant to the offsite radioactivity level.

8.6.1 Effluent and Environmental Monitoring Program

In the PSAR, describe the program for monitoring and estimating the contribution of radioactivity to the environment. Present the details of the approach and the results obtained for determining the background levels and the estimate of subsequent contribution of the plant.

8.6.1.1 Gas Effluent Monitoring. Describe the features of the sampling systems to be used, their locations, and the items to be monitored. For each, show the expected reliability and Ci-sec m^{-3} sensitivity in double the instrument response time and in one week for each device. Justify the selection of each system and instrument. Discuss the frequency of sampling, the limits for action, and the procedures to be used to maintain continued integrity of analyses.

8.6.1.2 Liquid Effluent Monitoring. As with gas effluent monitoring, describe the features of the liquid sampling systems to be used, their locations, and the items to be monitored. For each, show the expected reliability and Ci-sec m^{-3} sensitivity in double the instrument response time and in one week for each device. Justify the selection of each system and instrument. Discuss the frequency of sampling, the limits for action, and the procedures to be used to maintain continued integrity of analysis.

8.6.1.3 Solid Waste Monitoring. Describe the procedures, equipment, and instrumentation used to monitor all solid waste containing radioactivity.

8.6.1.4 Environmental Monitoring. Describe in detail the program which will monitor possible contribution of radiation to the site and environs. Identify the samples of atmosphere, soil, flora, and fauna that will be taken; the frequency the samples are obtained; the analyses to be performed; and the method of reporting. Include in this section the program for continuing meteorological data collection and evaluation to supplement the estimates previously developed.

8.6.2 Analysis of Multiple Contribution

Present an analysis of incremental and total exposures which would result from present or projected nuclear facilities in the vicinity (i.e., within a 50-mile radius), and compare with background man-rem of the same population.

8.6.3 Estimated Exposures

Present the man-rem annual exposures estimated to be attributable to plant effluents in each of 16 compass sectors about the plant between each of the arcs having the radii, 1, 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles. Provide details of assumptions, and give sample calculations with emphasis on critical pathways to man. Relate to the meteorological data presented in Chapter 3.0, "Site Characteristics," and the radioactivity release rates in Chapter 7.0, "Waste Confinement and Management." In addition to the man-rem whole body determinations, provide details on man-rem uptakes by critical organs.

8.6.3.1 Identification of Sources. For each radioisotope of biological significance, there should be included a description of the in-process inventory, the partitioning processes and decontamination factors, and the characteristics of the isotope pertinent to its release and eventual biological impact.

8.6.3.2 Analysis of Effects and Consequences. An analysis of effects and the attendant consequences should be supported by information, including, for example:

1. Joint stability-frequency and speed wind data.

2. Methods, assumptions, and conditions employed.

3. Biological pathways and critical organs.

4. Dose models.

The consequences shall be given for each significant isotope and critical organ in terms of maximum rem per year, average rem per year, and total man-rem per year for the population within a 50-mile radius.

The considerations of uncertainties in the calculational methods and equipment performance should be discussed. Conservatism existing in assumptions should also be described.

Reference to published data associated with the analysis should be made.

The mathematical or physical model employed, including any simplification or approximation to perform the analyses, should be discussed. The applicable parameters listed in Table 8.1 should be provided in tabular form. The table should have two columns, one indicating the conservative assumptions used in the analysis and the other indicating what are believed to be realistic assumptions.

Any digital computer programs or analog simulation used in the analysis should be identified. Adequate figures should be included on the analytical model, computer listing, and input data. Reference to computer models already available to the Commission should be made by summary only.

8.6.4 Liquid Release

Describe radioactive liquid effluents. Refer to Chapter 7.0 for discussion of how liquid wastes are treated and degree of safety. Describe the contribution that the liquid discharged to the atmosphere as water vapor has on the gaseous radioactive source terms. Describe the radioactive and nonradioactive wastes from the following sources, and include the same type of information (as applicable) as described in Section 8.6.3.2.

8.6.4.1 Treated Process Effluent.

8.6.4.2 Cooling Towers (Blowdown).

8.6.4.3 Sewage.

8.6.4.4 Drinking Water.

8.6.4.5 Rain Run-Off.

8.6.4.6 Laundry Waste.

8.7 Items Requiring Further Development

8.8 Changes from the PSAR

TABLE 8.1

Parameters to be Tabulated[a] for Postulated Chronic Releases

	Conservative Assumptions	Realistic Assumptions
I. Data and Assumptions Used to Estimate Radioactive Source		
A. Fission product inventory (burnup, cooling time, etc.)		
B. Partition mechanisms to offgas system		
C. Form (physical, chemical)		
D. Particle size		
E. Physical and chemical data related to transport or removal functions		
II. Data and Assumptions Used to Estimate Activity Released		
A. Partition fractions		
B. Leakage fractions		
C. Absorption and filtration efficiencies		
D. Release flow rates and pathways		
III. Dispersion Data		
A. Stack or building leakage source		
B. Building wake (ground source)		
C. Boundary distances		
D. χ/Q's (continuous annual release)		
E. Deposition, decay, and washout coefficients		
IV. Dose Data		
A. Method of dose calculation		

(Continued)

TABLE 8.1 (Continued)

	Conservative Assumptions	Realistic Assumptions
B. Dose conversion assumptions		
C. Biological pathways		
D. Doses		

[a] As applicable to event described.

CHAPTER 9.0 ACCIDENT SAFETY ANALYSIS

The evaluation of the safety of a nuclear fuel reprocessing plant is accomplished in part by analysis of the response of the plant to postulated accident events in terms of minimizing the causes of such events, the quantitative identification and mitigation of the consequences, and the ability to cope with each situation should it occur. These analyses are an important aspect of the reviews made by the Commission prior to issuing a construction permit and operating license.

The PSAR should present an in-depth discussion of accident analysis to the extent the technology and design is known or determined at the time of its submittal. The FSAR should additionally present details which have been revised or developed since the PSAR submittal. Those may result from changes in design and process or from development of additional information during the interim period.

In previous chapters, features important to safety have been identified and discussed. It is the purpose of this chapter to identify and analyze a range of credible accident occurrences (from minor accidents to 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.

9.1 Abnormal Operations

Present in this section events which could occur from malfunctions of systems, operating conditions, or operator error. In general, the magnitude of the events discussed in this section would not have a significant effect beyond the exclusion area. The following format should be used for the purpose of presenting the desired detail.

9.1.1 Event

Identify the occurrence, including the location of the event, type of failure or maloperation, and system or systems involved.

9.1.1.1 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.

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.

3. Identification of any operator actions necessary.

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

The analysis given should be such as to 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 functions, systems, interlocks, and controls are safety-related and what actions are required by the operator under anticipated operational occurrence and accident conditions.

9.1.1.2 Detection of the Event. Discuss the means or methods to be provided to detect the abnormal operation using visual or audible alarms or routine inspections performed at a stated frequency. Provide for each an assessment of response time.

9.1.1.3 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, activity, and release rate of fission products, or other transmissible radioactive materials within the confinement system that could escape to the environment,

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

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

9.2 Accidents

Provide in this section an analysis of situations where primary and/or secondary confinement may credibly be breached to the extent of releasing radioactive materials beyond the exclusion area or in such quantity as to seriously endanger personnel within the exclusion and restricted areas. Include consideration of industrial type accidents which would not result in a release of radioactivity but could endanger onsite personnel.

The following format should be used for the purpose of presenting the desired detail.

9.2.1 Accident Analyzed

Identify the accident, the location or portion of the facility involved, and the type of accident. Discuss each accident sequentially, e.g., 9.2.2, 9.2.3....

9.2.1.1 Cause of the 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.

9.2.1.2 Accident Analysis. Analyze the effects and, particularly, any radiological consequences of the accident. As with the abnormal event analysis, show the methods, assumptions, and conditions used in estimating the consequences, the recovery from the consequences, and steps used to mitigate the accident. Assess the consequence of the accident to persons and property offsite.

In addition to the assumptions and conditions employed in the course of events and consequences, support by sufficient information the following:

1. The mathematical or physical model employed, describing any simplification introduced to perform the analysis. Identify assumptions used that are known to differ from those normally used by the NRC staff.

2. Identification of any digital computer program or analog simulation used in the analysis with principal emphasis upon the input data and the extent or range of variables investigated. This information should include figures showing the analytical model, 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 available reference with only summaries provided in the PSAR text.

3. A description of 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 fission product inventory assumed to be released from the source material into offgas systems,

b. The concentrations of radioactive or fission product inventory airborne in the confinement atmosphere and buildup on filters during the post-accident time intervals analyzed,

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

4. Identification of the time-dependent characteristics, activity, and release rate of the fission products or other 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, in equipment performance, in instrumentation response characteristics, or other indeterminate effects taken into account in the evaluation of the results.

6. Explanation of 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. A discussion of the extent of system interdependency (confinement system and other engineered safety features) contributing directly or indirectly to controlling or limiting leakages from the confinement systems, or other sources (e.g., from spent fuel areas) as the contribution of: (a) confinement air systems, (b) air purification and cleanup systems, etc.

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

9. For the accidents, discussion of the results of calculations of potential integrated whole body and critical organs doses from exposure to radiation as a function of distance and time after the accident (presented in terms of a lifetime dose commitment).

Discuss the results and consequences derived from the analysis and the margin of protection provided by whatever system is depended upon to limit the extent or magnitude of the consequences.

CHAPTER 10.0 CONDUCT OF OPERATIONS

Every applicant should include a description of the Quality Assurance Program (Chapter 12.0) to be applied to the design, fabrication, construction, and testing of structures, systems, and components of the plant. Therefore, sufficient detail should be provided to indicate how the applicant intends to conduct all operations to ensure that the licensee will maintain a technically competent staff to provide continued implementation of administrative and operating procedures and programs necessary to ensure safe operation.

The information contained in this chapter should respond to the requirements of the following sections and appendices:

1. 10 CFR Part 50, §50.34, "Contents of Application — Technical Information"

2. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

3. 10 CFR Part 50, Appendix E, "Emergency Plans for Production and Utilization Plants"

4. 10 CFR Part 50, Appendix F, "Policy Relating to Siting of Fuel Reprocessing Plants and Related Waste Management Facilities"

5. 10 CFR Part 50, Appendix P, "General Design Criteria for Fuel Reprocessing Plants"

6. 10 CFR Part 55, "Operators' Licenses"

10.1 Organizational Structure

The following format should be used to present the organizational structure as it will be at the time the PSAR is submitted through construction. The organization as it will function through preoperational testing, startup, and plant operation should be provided in the FSAR.

10.1.1 Corporate Organization

Describe the corporate arrangement or organization related to the fuel reprocessing activity. If the corporation is made up from two or more existing entities, the relationship and responsibilities between them should be explained. As required in §50.33(f), "Contents of Applications," provide sufficient information to demonstrate the financial capabilities for construction, operation, and decommissioning of the reprocessing plant.

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

10.1.1.2 Applicant's In-House Organization. A description should be provided of the applicant's corporate management and technical support staffing and in-house organizational relationships established for the design and construction, review, and quality assurance functions, and the responsibilities and authorities of personnel and organizations described in Section 10.1.1.1 above. Establish the extent of dependence on corporate or offsite personnel.

10.1.1.3 Interrelationships with Contractors and Suppliers. The working interrelationships and organizational interfaces among the applicant, the architect-engineer, and other suppliers and contractors should be described.

10.1.1.4 Applicant's Technical Staff. Include a description of the applicant's corporate (home office) technical staff specifically supporting the engineering, construction, and operation of the reprocessing plant, including description of the duties, responsibilities, and authority of the engineering technical staff, including numbers of personnel, qualifications, educational backgrounds (disciplines), and technical experience. Indicate technical support to the corporate technical staff to be provided by the use of 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.

10.1.2 Operating Organization

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

10.1.2.1 Plant Organization. Provide a comprehensive description of the plant organizational arrangement to show the title of each position, the flow of responsibility as depicted by an organization chart, the number of personnel in each unit, and an identification of those positions requiring licenses in accordance with 10 CFR Part 55, "Operators' Licenses." Describe the organizational arrangement for assuring safe operation, the personnel assigned to the safety committee, its mode of operation, and its responsibilities.

10.1.2.2 Personnel Functions, Responsibilities, and Authorities. Describe the functions, responsibilities, and authorities of all personnel positions, including a discussion of specific succession to responsibility for overall operation of the plant in the event of absences, incapacitation, or other emergencies.

10.1.3 Personnel Qualification Requirements

Describe in this section the proposed minimum requirements for onsite plant personnel. The PSAR should specify the minimum qualification requirements and, as known, the qualifications of assigned plant personnel. The FSAR should present any changes in required qualifications and the description of staff personnel finally selected.

The following specific information should be included.

10.1.3.1 Minimum Qualification Requirements. The minimum qualification requirements should be stated for all plant operating, technical, and maintenance support personnel.

10.1.3.2 Qualifications of Plant Personnel. The qualifications of the individuals assigned to the managerial and technical positions described should be presented in resumé form. The resumés should identify individuals by position title and, as a minimum, should describe the formal education, the training, and the experience of the individuals. Complete staff qualifications should be provided in the FSAR.

10.1.4 Liaison with Outside Organizations

Discuss arrangements made with outside organizations, including those providing expertise on technical facets of details concerning site selection and evaluation, facility design and construction, process and equipment selection or development, and safety evaluations. Additionally, any arrangements made with other government agencies should be presented, as well as the method or system used to monitor the interfaces between participants.

10.2 Preoperational Testing and Operation (FSAR)

In the FSAR, describe the preoperational testing and operating startup plans. Emphasize those plans which demonstrate that the facility, equipment, and processes meet safety and design criteria discussed in previous chapters. Test plans should be presented to verify the integrity of the facility, equipment, and process and to substantiate the safety analysis. Results obtained from carrying out the plans are reported as an appendix to the FSAR submittal.

10.2.1 Administrative Procedures for Conducting the Test Program

Describe the system used for preparing, reviewing, approving, and executing all testing procedures an' instructions and for evaluating, documenting, and approving the test results, including the organizational responsibilities and personnel qualifications for the applicant and his contractors.

The administrative procedures should be described 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).

10.2.2 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, and the general prerequisites for performing the tests, including special conditions to simulate normal and abnormal operating conditions of the tests listed.

10.2.2.1 Physical Facilities. For the physical facilities, components, and equipment, summarize the following: items tested, type test, response, and validation.

10.2.2.2 Process Operations. In similar manner to the above, itemize those operations to be tested, together with the additional information indicated.

10.2.3 Test Discussion

10.2.3.1 Test Name or System Under Test. For each preoperational test, provide the following information:

Purpose. Describe the purpose of the test.

Response and Acceptance Criteria. 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. When the results of the preoperational test do not confirm the expected response, discuss in detail the changes required and provide a justification that the change will correct the problem.

10.3 Training Programs

10.3.1 Program Description

Describe the proposed training program, including the scope of training in plant operations and design, instrumentation and control, methods of dealing with process malfunctions, decontamination procedures, and emergency procedures; in health physics, subjects such as nature and sources of radiation, methods of controlling contamination, interactions of radiation with matter, biological effects of radiation, and use of monitoring equipment. Identify personnel classification with level of instruction.

10.3.2 Retraining Program

Describe the program for continued training through presentation of additional materials and refresher training.

10.3.3 Administration and Records

Identify personnel in the organization responsible for the training programs and for maintaining up-to-date records on the status of trained personnel, training for new employees, and refresher or upgrading training of present personnel.

10.4 Normal Operations

10.4.1 Plant Procedures

The PSAR should include a commitment to conduct safety-related operations by detailed written procedures. In addition, the FSAR should include a list of titles of procedures (that indicate clearly their purpose and applicability), and a description of the review, change, and approval procedures for all plant operating, maintenance, and testing procedures through use of quality assurance and safety manuals.

10.4.2 Plant Records

The FSAR should present the detailed management system for maintaining records relating to the historical operation of the plant: the quality assurance records required in 10 CFR Part 50, Appendix B, Section XVII; the operating records including principal maintenance, alteration, or additions made; records of abnormal occurrences and events associated with radioactive releases; and environmental surveys.

10.5 Emergency Planning

Describe the applicant's plans for coping with emergencies. The information to be included is described in 10 CFR Part 50, Paragraph 50.34(a)(10). The minimum items to be discussed in the PSAR are set forth in 10 CFR Part 50, Appendix E, "Emergency Plans for Production and Utilization Facilities," Section II.

The information to be included in the FSAR is described in 10 CFR Part 50, Paragraph 50.34(b)(6)(v). The minimum items to be discussed are set forth and detailed in 10 CFR Part 50, Appendix E, Sections III and IV.

10.6 Decomissioning

Provide information in the PSAR and FSAR to respond to the requirements of 10 CFR Part 50, Appendix F, Section 4, "Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities," which requires that adequate provisions be made for decommissioning the reprocessing plant.

10.6.1 Decommissioning Program

Present the planned program for decommissioning the plant.

10.6.2 Decontamination

Discuss the procedures and arrangements to decontaminate the facility so that it will not present a hazard for an interminable period.

10.6.3 Agreements with Outside Organizations

Present the arrangements and agreements with other organizations which will ensure the continued safe decommissioning of the plant.

10.6.4 Arrangements for Funding

Discuss the means for funding the decommissioning and maintaining isolation from the public, where necessary, in perpetuity.

CHAPTER 11.0 TECHNICAL SPECIFICATIONS

11.1 Preliminary Technical Specifications (PSAR)

In accordance with §50.34 of 10 CFR Part 50, an application for a construction permit for a production or utilization facility is required to include an identification and justification for the selection of those variable conditions or other items which are determined as a result of preliminary safety analysis and evaluation to be probable subjects of technical specifications for the plant. Special attention should be given to those items which may significantly influence the final design. The objective in selecting probable technical specification subjects is to identify those items that would require special attention at the construction permit stage to avoid the necessity for any significant change in design to support final technical specifications, e.g., particularly those specifications that include technical operating limits, conditions, and requirements imposed upon plant operation in the interest of the health and safety of the public.

Throughout the previous sections of the Standard Format, the necessity for identification of safety limits, limiting conditions, and surveillance requirements has been indicated. It is from such information that the Technical Specifications and supporting bases are developed.

The preliminary Technical Specifications and bases proposed by an applicant for its plant should be included in Chapter 11.0 of the PSAR. The preliminary Technical Specifications should be complete, i.e., to the fullest extent possible, numerical values and other pertinent data should be provided. For each specification, the applicable sections that develop, through analysis and evaluation, the details and bases for the specification should be referenced.

11.2 Proposed Technical Specifications (FSARs)

In accordance with §50.36 of 10 CFR Part 50, each operating license for a production or utilization facility issued by the Commission must contain technical operating limits, conditions, and requirements imposed upon plant operation in the interest of the health and safety of the public. The Technical Specifications are proposed by the applicant for an operating license. After review by the staff, they are modified as necessary before becoming part of the operating license. A statement of the bases or reasons for all specifications, other than those dealing with administrative controls, must be included in the application, but this statement does not become part of the Technical Specifications. Technical Specifications may not be changed without prior Commission approval.

The Technical Specifications and bases proposed by an applicant for its plant should be included as Chapter 11.0 of the FSAR. Except for the specifications covering design features and administrative controls, each specification selected should be provided in the FSAR with bases in the form of a summary statement of the technical and operational considerations which justify the selection. For each specification, the applicable sections of the FSAR which fully develop, through analysis and evaluation, the details and bases for the specification should be referenced.

Additional guidance on the contents of the Technical Specifications is provided in a document entitled "Guide to Content of Technical Specifications for Nuclear Reactors," prepared by the staff and available from the Commission.

11.3 Content of Technical Specifications

Technical Specifications should include both technical and administrative matters. Technical Specifications related to technical matters should consist of those features (process variables, systems, or components) of the facility that are of controlling importance to safety. In addition, Technical Specifications related to technical matters should include effluent and environmental monitoring and specifications addressed to the attainment of "as low as practicable" levels of releases and exposures. Technical Specifications related to administrative matters should be addressed to those organizational and functional requirements that are important to the achievement and maintenance of safe operation of the facility.

11.4 Bases for Technical Specifications

When a technical specification 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 which justify the selection. The Safety Analysis Report (SAR) should fully develop, through analysis and evaluation, the details of these bases. The physical format for Technical Specifications therefore assumes importance, since the collection of specifications and their written bases form a document which delineates facility features that are important to safety of operation, the reasons for their importance, and their relations to each other.

11.5 Development of Technical Specifications

The five categories for which Technical Specifications are defined in §50.36 of 10 CFR Part 50 have been derived from a consideration of factors that bear on the use and maintenance of physical barriers in the operation of a facility. Additional categories may be designated by the applicant.

11.5.1 Safety Limits and Limiting Control Settings

Specifications of this category apply to safety-related process variables which are observable and measurable (e.g., pressures, temperatures, flow rates, concentrations, volumes, and quantities). Control of such variables is directly related to the performance and integrity of equipment and confinement barriers.

11.5.2 Limiting Conditions for Operation

This category of technical specification covers two general classes, (a) equipment and (b) technical conditions and characteristics of the plant necessary for continued operation, as discussed below:

11.5.2.1 Equipment. Technical Specifications must 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 must be operable or available.

11.5.2.2 Technical Conditions and Characteristics. Technical conditions and characteristics should be stated in terms of allowable quantities, e.g., temperature, pressure, mass of fissionable material in certain systems, concentration of radioactive material in certain systems, volume of fluid required in a system, chemical constitution of certain fluids, or allowable configurations of equipment.

11.5.3 Surveillance Requirements

Major emphasis in surveillance specifications should be placed on those systems and components which are essential to safety during all modes of operation or are necessary to prevent or mitigate the consequences of accidents. Tests, calibrations, or inspections are necessary to verify performance and availability of important equipment and to detect incipient deficiencies.

11.5.4 Design Features

These Technical Specifications 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 category is to control changes in design of vital equipment.

11.5.5 Administrative Controls

The Safety Analysis Report should contain a full description and discussion of organization and administrative systems and procedures for operation of the facility.

11.5.6 Suggested Format for Technical Specifications

Title (e.g., Temperature Control of Waste Evaporators)

Applicability. System(s) or portion(s) of the facility to which the specification applies should be clearly defined.

Objective. The reason(s) for the specification and the specific unsafe condition(s) it is intended to prevent.

Specification. Safety limits and limiting control setting(s) for the important variable(s) or the condition or surveillance requirement imposed.

Bases. The Safety Analysis Report 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 specification should contain a summary of the information in the Safety Analysis Report in enough depth to indicate the completeness and validity of the source material and to provide justification for the specification. Subjects which may be appropriate for discussion in the bases are:

1. 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 analyses and evaluations should be summarized.

2. Equipment

A safety limit often is protected by or closely related to certain equipment. Such relation should be noted, and the means by which the variable is monitored and controlled should be briefly mentioned.

For specifications in categories referred to in Sections 11.5.2 through 11.5.4, 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 frequency of required action should be given.

3. Operation

The margins and the bases that relate to the safety limit(s) and the normal operating zone(s) should be mentioned. The roles of operating procedures and of protective systems in guarding against exceeding a limit or condition should be stated. A brief discussion should be included of such factors as system response(s), process or operational transients, malfunctions, and procedural errors. Reference should be made to related specifications.

4. Assessment of Risk

The degree of confidence in the value of the variable or the condition specified or the uncertainties associated therewith should be stated as precisely as is possible. The potential results and effects of exceeding the limit should be mentioned, and the risk resulting therefrom should be evaluated.

CHAPTER 12.0 QUALITY ASSURANCE

In 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," the regulations for quality assurance (QA) programs to be established by the applicant for use during design, construction, and subsequent operation are specified. The PSAR should provide a description of the Quality Assurance Program to be established and executed during the design and construction of the reprocessing plant. Additionally, the provisions for smooth transition of the program from construction to operation should be discussed. The FSAR should describe the Quality Assurance Program to be used during operation of the plant.

Where some portions of the Quality Assurance Program have not yet been established at the time the Safety Analysis Report is prepared because the activity will be performed in the future, the description should include a schedule for implementation.

Where a portion of the Quality Assurance Program to be implemented will conform to a particular quality assurance standard, such as those adopted by the American National Standards Institute (ANSI), the description, to the extent described in the standard, may consist of a statement that the particular standard will be followed.

12.1 Organization

Provide organization charts for the construction project that denote the lines and areas of responsibility, authority, and communication within each major organization involved, such as applicant, architect-engineer, and construction company, when different. Additionally, supply a discussion of the relationship of responsibility and authority between the organizations, clearly indicating the organizational location of, organizational freedom of, and authority of the individual or groups for checking, auditing, inspecting, or otherwise verifying that an activity has been correctly performed. The charts and discussions should indicate the degree of involvement, on the part of the applicant, in the verification of the Quality Assurance Programs implemented by the applicant's contractors and suppliers. The data should cover those cases where the applicant has delegated to other organizations the work of establishing and implementing the project Quality Assurance Program, or any part thereof.

12.2 Quality Assurance Program Plan

The structures, systems, and components to be covered by the Quality Assurance Program should be identified, along with the major organizations participating in the program and the designated functions of these organizations. The written policies, procedures, or instructions which implement or will implement the Quality Assurance Program should be described. Where these written policies, procedures, or instructions are not yet effective, a schedule for their implementation should be provided.

A positive audit plan for monitoring the implementation of the QA Program should be included.

12.2.1 Design Control

A description of the design control measures should be provided. Included should be (1) measures to ensure that appropriate quality standards are specified in design documents and that deviations from such standards are controlled, (2) measures for the selection and review of suitability of application of materials, parts, equipment, and processes, (3) measures for the identification and control of design interfaces and for coordination among participating organizations, (4) measures for verifying or checking adequacy of design such as by design reviews, alternative or simplified calculational methods, or suitable testing programs, and (5) measures to ensure that design changes, including field changes, will be subject to design control measures commensurate with those applied to the original design and will be reflected in accurate "as built" drawings and specifications.

12.2.2 Procurement Document Control

A description of the procurement document control measures should be provided. Included should be measures to ensure that applicable Commission requirements, design bases, and other requirements such as quality assurance program requirements which are necessary to obtain adequate quality are included or referenced in procurement documents.

12.2.3 Instructions, Procedures, and Drawings

Provide a description of the measures to ensure that activities affecting quality will be prescribed by documented instructions, procedures, or drawings and will be accomplished in accordance with these instructions, procedures, or drawings.

12.2.4 Control and Identification of Purchased Material, Equipment, and Services

Describe the measures for the control of purchased material, equipment, and services. Included should be measures for source evaluation and selection; for assessing the adequacy by means of objective evidence of quality furnished by the contractor; for inspection at the contractor source; and for examination of products upon delivery. A description should also be provided of the measures taken to ensure that documentary evidence that the material and equipment conform to the procurement requirements is available at the plant site prior to installation or use of such material or equipment.

Describe the measures for the identification and control of materials, parts, and components to ensure that incorrect or defective items will not be used.

12.2.5 Inspection, Surveillance, and Testing

Provide a description of the program for the inspection and surveillance of items and activities affecting quality, indicating specifically the items and activities to be covered. Included should be an organizational description of the individuals or groups performing inspections and their qualifications to perform inspections. Also, indicate the independence of the inspection group from the group performing the activity being inspected, and describe how the inspection and surveillance program for the involved organizations has been or will be established.

Also, discuss the test program to ensure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service. Included should be an outline of the test program; procedures to be developed; means for documenting and evaluating test results of the item tested; and designation of the responsibility for performing the various phases of the program. Where a test program is used to verify the adequacy of a specific design feature, a description of the qualification testing of a prototype unit should be included.

12.2.6 Nonconforming Materials, Components, and Fabrication and Construction Features

Describe the measures to be taken to control nonconforming materials, parts, or components to prevent their inadvertent use or installation. Included should be the means for identification, documentation, segregation, and disposition of nonconforming material and notification to affected organizations. Also, include means of control of nonconforming construction practices as related to the plant-approved drawings and specifications.

12.2.7 Corrective Action

Describe the corrective action measures established to ensure that conditions adverse to quality are identified and corrected and that the cause of significant conditions adverse to quality is determined and corrective action taken to preclude repetition.

12.2.8 Quality Assurance Records

Discuss the program for the maintenance of records to furnish evidence of activities affecting quality. Include the means for identifying the records and the retention requirements for the records, including duration, location, assigned responsibility and means for retrieving the records when needed.

12.2.9 Audits

A description of the system of audits to verify compliance with all aspects of the Quality Assurance Program and to determine the effectiveness of the Quality Assurance Program should be provided. Included should be means for documenting responsibilities and procedures for auditing; required frequency of audits; audit results; designation of management levels to which audit results are reported; and a system of followup on deficiencies.

12.3 Quality Assurance Program for Plant Operation (FSAR)

Provide in the FSAR a description of the proposed Quality Assurance Program that will govern the quality of all safety-related items during operation of the plant. These activities include operating, maintaining, repairing, and modifying subsequent to the preoperational phase. Follow the format of Section 12.2 to provide this information, indicating procedures used in the repair, modification, or replacement to ensure that such changes are subject to the same control as the original approved designs and procedures.

U.S. GOVERNMENT PRINTING OFFICE 1980 -0-620-269/252

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
UNITED STATES NUCLEAR
REGULATORY COMMISSION

U.S.MAIL