

USNRC REGULATORY GUIDE SERIES

REGULATORY GUIDE 3.39

**STANDARD FORMAT
AND CONTENT OF
LICENSE APPLICATIONS FOR
PLUTONIUM PROCESSING
AND
FUEL FABRICATION PLANTS**

JANUARY 1976

UNITED STATES NUCLEAR REGULATORY COMMISSION

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REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 3.39

STANDARD FORMAT AND CONTENT OF LICENSE APPLICATIONS FOR PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS

FOR COMMENT

USNRC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public methods acceptable to the NRC staff of implementing specific parts of the Commission's regulations, to delineate techniques used by the staff in evaluating specific problems or postulated accidents, or to provide guidance to applicants. Regulatory Guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission.

Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience. However, comments on this guide, if received within about two months after its issuance, will be particularly useful in evaluating the need for an early revision.

Comments should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Section.

The guides are issued in the following ten broad divisions:

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|-----------------------------------|------------------------|
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| 2. Research and Test Reactors | 7. Transportation |
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INTRODUCTION

10 CFR Part 70 specifies the information to be supplied in applications for licenses to possess and use special nuclear materials in plutonium processing and fuel fabrication plants. However, Part 70 does not specify the format for presentation of that information. The NRC staff suggests the use of this standard format for license applications to present the required information.

There are important functional differences between plutonium processing and fuel fabrication plants and fuel reprocessing plants, and even greater differences between plutonium processing and fuel fabrication plants and nuclear power reactors. As a result, the emphasis on certain safety features in the license application for plutonium processing and fuel fabrication plants will differ somewhat from that required in a safety analysis report (SAR) for fuel reprocessing plants, and even more markedly from that required in a safety analysis report for nuclear power reactors. The applicant should develop the safety assessment of the design bases of plutonium processing and fuel fabrication plants in a manner consistent with the safety considerations applicable to such plants.

To obtain guidance as to the depth of analysis required in the license applications, the applicant is invited to confer with the NRC staff prior to preparing the license application.

The "Standard Format and Content of License Applications for Plutonium Processing and Fuel Fabrication Plants" (hereinafter "standard format") was prepared to supply guidance in the preparation of license applications for plutonium processing and fuel fabrication plants.

The standard format represents a format that is acceptable to the NRC staff. Conformance with this standard format, however, is not required. Thus, while license applications with differing formats will be acceptable to the staff if they provide an adequate basis for the findings required for the issuance of a license, delays may result because there is a greater likelihood that all subjects necessary for a license review will not be covered.

1. Purpose and Applicability

This standard format has been prepared to identify for applicants the type of information needed in the license application.

Certain requirements need not and cannot be met until the construction phase has begun or has been completed. This standard format identifies those items in the license application that should be submitted to the Commission 9 months ahead of the proposed start of construction. The remaining items must be submitted as part of the completed license application prior to the granting of a license. This standard format is designed to facilitate an orderly review. The information identified herein represents a minimum which the license application should provide.

Additional information may be requested if needed for the staff review. If, after the submittal of the application and prior to the issuance of license, any changes or additions to the plant are made, the application must be corrected. This ensures that the completed copy of the license application reflects the actual conditions of the plant. As further guidance, the NRC staff is also issuing guides describing recommended information and acceptable methods for implementing specific details outlined by this standard format. Specific requirements for control of special nuclear material are contained in 10 CFR Part 70. Additional guidance will be provided to applicants regarding the information to be submitted for the physical protection of special nuclear material in transit and also for the special nuclear material and plant physical security plans.

The license application serves as the principal technical communication between the applicant and the Nuclear Regulatory Commission. It establishes the nature of the plutonium processing and fuel fabrication plant and the plans for its use. Each applicant must show in the license application that the process to be performed, the operating procedures, the plant and equipment, and the applicant's capability collectively provide reasonable assurance of protection of the health and safety of the public and plant personnel.

In the license application the applicant analyzes the plant in terms of potential hazards and the means employed to protect against the hazards, including the associated margins of safety. This includes evaluating (1) the site and its relation to accidents from natural phenomena, (2) radiation shielding, (3) confinement and control of radioactive material, (4) effluent treatment, (5) projected effluent quantities and concentrations, (6) reliability of the systems essential to safety, and (7) the radiological impact associated with normal operations, abnormal conditions, and accidents.

The license application demonstrates the degree of skill, care, and effort used by the applicant in all aspects of the project. To this end, the applicant should provide for certain selected areas a complete, in-depth analysis, which may be presented in supplemental reports and incorporated in the license application by reference.

The application should contain, as a minimum, the information required pursuant to 10 CFR §70.22(f) to support the determination required by 10 CFR §70.23(b). The application should set forth a description and safety assessment of the design bases of the principal structure, systems, and components of the plant in sufficient detail so that the staff can make an independent determination that there is reasonable assurance that safe operation will be achieved. A detailed description of the quality assurance program associated with the plant

construction is required with the application. With respect to certain information which may not yet be available at the time of initial submission of the application, the following should be included:

- a. The development work which is yet to be completed,
- b. The criteria and bases being used to develop the required information,
- c. The concepts and/or alternatives under consideration,
- d. The schedule for completion of obtaining the required information.

The completed license application should contain all technical information required by 10 CFR §70.22 and should describe in detail the final plant design and present the final safety assessment. Modifications from criteria, designs, and bases previously included in the application, as well as any new criteria, designs, and bases, should be identified and justified. The safety significance of each change should be discussed. A detailed presentation on the conduct of operations should be included in the application covering:

- a. Plans for preoperational testing,
- b. Startup and normal operation,
- c. Emergency plans,
- d. Organizational structure,
- e. Personnel qualifications,
- f. Operating training,
- g. Quality assurance,
- h. Decommissioning plan,
- i. Proposed license conditions.

2. Use of the Standard Format

The application should follow the numbering systems of this standard format at least down to the level of subsections.

Due to the wide diversity of process and design possibilities for a plutonium processing and fuel fabrication plant, the applicant may

wish to include appendices to the application to provide detailed supplemental information not explicitly identified in this format. The following are examples:

- a. A glossary of unusual terms or abbreviations used by the applicant,
- b. Supplementary information regarding assumed analytical models, calculational methods, or design alternates used by the applicant or its agents with particular emphasis on rationale and detailed examples used to develop the bases for criticality safety,
- c. Reports furnished the applicant by consultants.

3. 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, "Rules of Practice," §2.790, "Public inspections, exemptions, requests for withholding."

4. Style and Composition

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

The applicant should strive for clear, concise presentation of the information provided in the application.

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 application 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 when first appearing in the application.

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

References used should appear either as footnotes to the page where referenced or at the end of each chapter.

5. Physical Specifications

a. Paper size.

(1) Textual pages: 8-1/2 x 11 inches

(2) 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.

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

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

d. Printing.

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

(2) Type face and style: should be suitable for micro-filming or image-copying equipment.

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

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

f. Page numbering. Pages should be numbered with the two digits corresponding to the chapter and first-level section numbers followed by a hyphen and a sequential number within the section, i.e., the third page in Section 4.1 of Chapter 4 should be numbered 4.1-3. Do not number the entire report sequentially. (Note that because of the small number of pages in many sections, this standard format is numbered sequentially within each chapter.)

6. Procedures for Updating or Revising Pages

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

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

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

7. Status of the Standard Format

This standard format guide is issued for comment and interim use. It is the responsibility of the applicant to comply with the existing Federal Regulations to ensure that its plant design and operating practices will result in the degree of safety required.

As the nuclear industry develops, the Commission's requirements for information needed in its review of applications for licenses to process and use special nuclear material in plutonium and fuel fabrication plants may change. The contents of this standard format will be revised to reflect modifications in the regulations. Revisions of the Commission's needs for the information in connection with the licensing of special nuclear material for use in plutonium processing and fuel fabrication plants will be conveyed to the industry and the public in the following principal ways: (1) by amendments to this 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 NRC staff as needed.

1. INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT

Provide introductory information, and the purpose for and the general description of the plant. The information in this chapter and Chapter 2, "Summary Safety Analysis," should enable the reader to obtain a basic understanding of the plant 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. The following should be included: a general description of the activity for which a license is requested; a brief description of the proposed location of the plant; the plant's nominal capacity; the type, form, and quantities (possession limits) of the special nuclear material to be possessed; the types of fuel to be fabricated; the waste products; the corporate entities involved; and the estimated time schedules for construction and operation. The period of time for which the license is requested should be identified.

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 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

A summary description of the process to be used in the plant including process origin and background should be included. Identify reactants and products as well as 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 agents or contractors for the design, construction, and operation of the plant. All principal consultants and outside service organizations (including those providing audits of the quality assurance program) should be identified. The division of responsibility between the process designer, architect-engineer, constructor, and plant operator should be delineated.

1.5 Requirements for Further Technical Information

For the initial application submittal, 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 in the plant prior to or during construction. Reference this information to the appropriate sections in Chapters 5, 6, 7, and 8 and any appendices or topical reports filed with the Nuclear Regulatory Commission. The discussion may be presented in summary form and should include the following:

- An identification of and differentiation between those systems 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,
- A summary description of the technical information that must be obtained to demonstrate acceptable resolution of the problems,
- A summary description to show how the information will be obtained,
- The estimated time schedule for commencing and completing each program,
- An identification of design alternatives or operational restrictions available in the event that the results of the program do not demonstrate acceptable resolution of the problems.

1.6 Identification of Changes and Additions to the License Application

The completed license application should describe, with details, the changes adopted since submittal of the initial application. Summarize the (1) results obtained from 1.5 above, (2) changes resulting from additional considerations, and (3) 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 plant design since submittal of the initial application.

2. SUMMARY SAFETY ASSESSMENT

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. Also, include a summary of the information presented in Chapter 9, "Accident Safety Analysis."

2.1 Site Analysis

2.1.1 Natural Phenomena

From information presented in Chapter 3, "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, tornado- or hurricane-type winds, missiles, inundation by water from possible sources, loss of water supply, and ice and/or 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 Assessment

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

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. Section 3.1.4 identifies typical activities to be analyzed. The following are typical considerations to be evaluated:

1. The effects of explosion of chemicals, flammable gases, or munitions,
2. The effects of explosions of large natural gas pipelines that cross, or pass close to the plant,
3. The effect of detonation of the maximum amount of explosives that are permitted to be stored at mines or stone quarries near the site,
4. The potential effects (1) of fires in adjacent oil and gasoline plants or storage facilities, (2) of fires in adjacent industries, (3) of fires from transportation accidents, and (4) from brush and forest fires,
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. The potential effects of aircraft impacts on the plant and stack, taking into account aircraft size, velocity, weight, and fuel loading for sites in the vicinity of airports.

If tall structures, such as discharge stacks, are used onsite, evaluate the potential for damage to equipment or structures important to safety should these structures collapse.

2.2 Radiological Impact of Normal Operations

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

1. A summary identifying each waste,
2. Amount generated per metric ton (MT) of fuel fabricated and/or per kilogram of plutonium processed,
3. Quantity and concentration of each radionuclide in each stream,
4. Identification of the locations that are beyond the restricted areas [as defined in 10 CFR §20.3(a)(14)] and beyond the exclusion area, which are most impacted by radioactive effluents; the exclusion area is that area surrounding the plant in which the licensee has the authority to control all activities, including exclusion or removal of personnel and property from the area,
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. Explanation by a discussion and sample calculations or reference of the reliability of the estimated values presented,
7. For each effluent, the constraints imposed on process systems and equipment to ensure a safe operation,
8. Discussion of how the "as low as is reasonably achievable" concept is met and the alternatives considered.

2.3 Radiological Impact from Abnormal Operations

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

1. Estimated man-rem exposure,
2. Method or means available for detecting the respective situations,

3. Causes of the particular situation,
4. Corrective actions,
5. Effects and consequences.

A summary of the information presented in Chapter 9, "Accident Safety Analysis," should be included.

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, and state the estimated radiological consequences.

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.

3. SITE CHARACTERISTICS

Provide information on the location of the plant and a description of the geographical, demographical, 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. Identify any assumptions that need to be applied in making the safety appraisal and further related by cross-reference both to the criteria developed in Chapter 4, "Principal Design Criteria," and to the design bases selected in subsequent chapters to meet these criteria.

3.1 Geography and Demography of Site Selected

Information concerning the site, geography, population, and land usage should be provided in support of the safety evaluation.

3.1.1 Site Location

The location of the plant site should be described with sufficient clarity to avoid any 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 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 man-made features such as rivers and lakes. To facilitate presenting this information, maps and aerial photographs should be provided. The general location map should encompass at least a 50-mile radius. 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 referenced 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 applicant's legal rights with respect to the properties described (ownership, lease, easements, etc.).

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

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

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 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, §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 to which access will be actively controlled for purposes of protection of individuals from exposure to radiation and radioactive materials. The degree of access control required is that which enables the licensee to comply with the requirements of 10 CFR Part 20. The site map (discussed in Section 3.1.2) 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 that identifies places of significant population grouping, such as cities and towns within the 50-mile radius, concentric circles should be drawn using the plant as 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 (e.g., 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. The basis for the projection should be described. Significant transient or seasonal population variations should also 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 recreation activities should be presented to permit estimates to be made of potential population radiation dose commitments resulting from plant effluents. The localized population 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.

Identify nearby industrial, transportation, and military installations 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 plant.

Consideration should be given in Chapter 2 of the license application 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 that influence the design and operation of the facility must be identified. Sufficient information should be included to permit an independent evaluation by the NRC 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 the intensity and frequency of severe cold and acute thaws;
3. On occurrence and intensity of heavy rain, snow, and ice storms;
4. On occurrence and intensity of thunderstorms and lightning strike frequencies; and
5. On occurrence and intensity of strong winds and tornadoes.

Those data should be reported in sufficient detail to indicate impacts on plant design and operation.

*All activities within 5 miles of the site should be considered. Activities at greater distances should be described and evaluated as appropriate to their significance.

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 license 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). The daily high, low, and mean joint temperature and specific humidity throughout the year should also be provided.

3.3.2.3 Topography. A detailed topographic description of the site should be provided 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 point 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 that will be used during operations to estimate offsite concentrations of monitored stack or other 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. Consideration of any influence local topography may have should be included.

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

Sufficient information should be provided to allow an independent review 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 water course flow for streams, rivers, lakes, and reservoirs. Provide water course 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. Reference 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. A topographic map of the site should be provided indicating any proposed changes to natural drainage features.

3.4.1.2 Hydrosphere. A description should be provided of 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 frequency, intensity, and cause information for past flooding and other water inundation occurrences such as tidal or wind blown flood waters 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, tsunamis, 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, floodwaves, and wave action erosion. The design flood protection level for safety-related components and structures and facilities necessary to protect the plant from floods, erosion, and wave action should be based on the highest calculated floodwater level elevations and floodwave 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 are to 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) is that which may cause the highest water level. Other possibilities are the flood level resulting from the most severe floodwave 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 are to be evaluated both statically and dynamically to determine the design flood protection level and dynamically induced loadings. The topical information required 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 probable local 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 to (1) allow an independent review of rainfall and runoff effects on safety-related facilities and (2) 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 thus 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. Finally, 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. A summary should be included of 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. Also involved are certain modifications and extrapolations of historical data to reflect more severe rainfall-runoff relations than actually recorded, insofar as those relations are deemed "reasonably possible" based on hydrometeorological logic.

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. The selected maximized storm precipitation distribution (time and space) should be presented.

3.4.3.2 Precipitation Losses. Describe the absorption capability of the basin including consideration of initial losses, infiltration rates, and antecedent precipitation. Verification should be provided 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. Provide a description of subbasin drainage areas (including a map), their sizes, and topographic features of watersheds. Include a tabulation of all drainage areas, runoff, and reservoir and channel routing coefficients.

3.4.3.4 Probable Maximum Flood Flow (PMF). Present the PMF runoff hydrograph (as defined) that results from the probable maximum precipitation (and snowmelt, if pertinent) considering 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 (see 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.

3.4.3.5 Water Level Determinations. Describe the translation of the estimated peak PMF discharge to elevation using (when applicable) cross-sectional 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 that may occur coincidentally 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 floodwaves, 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 should not be 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 a 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 (see 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 (see 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 Wind 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 windstorm should move along a critical path at optimum rate of movement. Present in detail 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" based on meteorological reasoning. The probable maximum conditions are the most severe combinations of hydrometeorological parameters considered reasonably possible that would produce a surge or seiche which has virtually no risk of being exceeded (e.g., 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). 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 ensure 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 for 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 wind storms), 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 wind storms, moving squall lines, and surge mechanisms which are possible and applicable to the site. Include (1) the antecedent water level (with reference to the spring tide for coastal locations, the average monthly recorded high water for

* 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.

lakes, and a forerunner or ambient water level where applicable), (2) the determination of the controlling storm surge or seiche (consider the probable maximum meteorological parameters such as the storm track, wind fields, the fetch or direction of approach, bottom effects, and verification with historic events), (3) the method used, and (4) 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. Give specific data 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 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 (e.g., fractures, faults, landslide potential, and volcanism). 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 in the analysis.

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. Include 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. Also include a discussion of the analysis used to translate tsunami waves from offshore generator locations, or in deep water, to the site, with antecedent conditions. Provide, where possible, verification of the techniques and coefficients used by reconstituting tsunami of record.

3.4.7 Ice Flooding

Design criteria should be presented for protection of safety-related facilities from the most severe ice jam floods, 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. Include 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 component. Present the design bases required to ensure that safety-related components will be capable of surviving all design flood conditions. Reference appropriate discussions in other sections of the application where these design bases are implemented.

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 water supply is safety related.

3.4.11.2 Low Water Resulting from Surges, Seiches or Tsunami. Determine the low water level resulting from surges, seiches, or tsunami that could occur from probable maximum meteorological or geoseismic conditions. A description should be included 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, since 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 water-groundwater 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 groundwater resources. Describe any safety-related effects of normal or accidental releases of radionuclides and heated water on surface waters and groundwaters, e.g., any potential for recirculation, sediment concentration, and hydraulic short circuiting of cooling ponds.

3.4.13 Chemical and Biological Composition of Adjacent Watercourses

Provide details of the prevailing chemical and biological composition of water courses which may be affected by location of the plant. This information, together with other hydrological data, should 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 groundwater aquifers, formations, sources, and sinks in relation to the site location. Discuss the flow directions, gradients, potential for reversibility of groundwater flow, and effects of potential

future use on groundwater recharge areas within influence of the plant. Provide a survey of uses, users (amounts, water levels, location, and draw-down) 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 groundwater levels, flow, permeability, porosity, flow, and gradients at the site, as well as chemical analysis of the groundwater. The proposed sources and usage anticipated by the plant facility should also be given. 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, a model should be developed that will allow evaluation of the extent to which contamination from the plant operation could migrate in groundwater. Include in the model the time required to reach the nearest existing or potential future user.

3.6 Geology and Seismology

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

3.6.1 Basic Geologic and Seismic Information

The basic geologic and seismic information for the region and the site should be presented. 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 have been analyzed and selected as a source to develop design criteria and bases and accident safety 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. Include a regional physiographic map showing site location.

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, e.g., folds, faults, basins, and domes. Include a discussion of the geologic history of the tectonic features and a regional tectonic map showing the site location.

a. Provide detailed discussions of the regional tectonic structures significant 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 the following:

(1) Natural features such as tectonic depressions, cavernous conditions or karst terrains, and potential landslides;

(2) Man's activities, such as withdrawal or addition of subsurface fluids, or mineral extraction;

(3) Regional warping.

7. Provide a discussion of the regional groundwater conditions. Cross-reference to Section 3.5.1.

3.6.1.2 Site Geology. Material in 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 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 should be evaluated.

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, e.g., folds, faults, synclines, anticlines, domes, and basins. 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 that shows surface geology and includes the locations of major structures of the plant. Areas of direct observations of bedrock outcrop should be distinguished from areas which are covered and about 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 to a regional geologic history. A local geologic stratigraphic column should be included.

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

7. Provide geologic profiles that show the relationship of the major foundations of the plant to subsurface materials, including groundwater, 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 that 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 previous 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 groundwater conditions and cross-reference to Section 3.6.4.6.

11. Provide profiles and tables showing the results of any geophysical surveys (e.g., seismic refraction, seismic reflection, acoustic and aeromagnetic) conducted to evaluate the stratigraphic structure and bedrock, and subsurface material characteristics of the site. Results of compressional and shear wave velocity surveys, and crosshole and uphole velocity surveys, where performed, should be provided.

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 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 cross-referenced 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 Previous Earthquakes. Describe physical evidence concerning the behavior during previous 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, e.g., 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 (1) the material underlying the epicentral location or region of highest intensity and (2) 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, where possible, of epicenters or regions of highest intensity of historically reported earthquakes with tectonic structures, any part of which is located within 200 miles of the site. Epicenters or regions of highest intensity that 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 Capable 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 is within 200 miles of the site and which may be of significance in establishing the earthquake criteria and considered as capable faults, the following should be determined: 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 cross-referenced 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 data 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 (1) the length of the fault, (2) the relationship of the fault to regional tectonic structures, (3) the nature, amount, and geologic history of displacements along the fault, and (4) 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, details and results of this investigation should be presented to determine the need to consider surface faulting in the design of the plant. Where it is determined that surface faulting need not be taken into account, sufficient data to justify the determination clearly should be provided.

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. Evaluate the following geologic features that could affect the foundations. (Information presented in other sections may be cross-referenced 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, thixotropy, 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 plant structures. Furnish profiles showing the relationship of the foundations of structures to subsurface materials, including groundwater 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 Sections 3.6.4.3 or 3.6.4.4.)

3.6.4.6 Groundwater Conditions. Provide a history of groundwater fluctuations beneath the site and a discussion of groundwater conditions during construction of the plant and during plant life.

3.6.4.7 Response of Soil and Rock to Dynamic Loading. Furnish analyses of the response 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 groundwater 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), and lateral pressures (with backup data).

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, vibroflotation, dental work, rock bolting, and anchors.

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. Include factors of safety, along with the adverse conditions considered in the analyses, such as sudden drawdown, earthquake, and steady seepage at anticipated pool levels.

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

3.6.5.4 Compaction Specifications. Provide compaction specifications along with representative lab 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 selection of design bases for the plant and associated facilities.

4. PRINCIPAL DESIGN CRITERIA

The contents of this chapter will partially fulfill the requirements found in 10 CFR Part 70, Section 70.22, "Contents of Applications." Principal design criteria are established by the applicant in the license application. The NRC staff analyzes the plutonium processing and fuel fabrication plant design criteria for adequacy before the application is approved. Changes in the criteria are not anticipated after that approval is granted. Therefore, the criteria selected should encompass all considerations for alternatives that the applicant may choose.

. 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

A detailed description of the physical, chemical, and radiological characteristics of the feed materials to be processed in the plant should be provided. Include feed specifications such as fissile material limits, plutonium isotopic composition limits, forms of the material, and packaging.

4.1.2 Plant Products and Byproducts

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

4.1.3 General Plant Functions

Provide information related to the overall functioning of the plant as a manufacturing operation. This should 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 that 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 that 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 that 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 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 factored loads are used, the basis for selection of the load factor used for tornado loading should be furnished.

4.2.2.3 Ability of Plant Structures to Perform Despite Failure of Structures not Designed for Tornado Loads. Information to show that the failure of any structure 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. By reference relate 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 (e.g., 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. Describe the flood protection measures for vital systems and components that are located below grade or below flood level.

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 and required in 10 CFR Part 100, Appendix A, present the design criteria to be used in construction of the plant and associated equipment. Sufficient detail must be presented to allow an independent evaluation of the criteria selected. For clarity cross-reference 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 should be provided for the safe shutdown earthquake (SSE). If applicable, design response spectra should be submitted for the operating basis earthquake (OBE). A discussion of 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 envelopes the design response spectra derived from the actual or synthetic earthquake time motion records, should be provided. For all the damping values that are used in the design submit a comparison of the response spectra derived from the time history and the design response spectra. The system period intervals at which the spectra values were calculated should be identified.

3. Critical Damping Values. The specific percentage of critical damping values used for identified structures, systems, components, and soil should be provided. For example, 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, then these assumptions as well as the influence of 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 (e.g., modal analysis response spectra, modal analysis time history, and equivalent static load) should be identified in the application. 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 in the application. All seismic methods of analyses used should also be described in the application.

2. Natural Frequencies and Response Loads. 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. Provide a description of the procedure used to lump masses for the seismic system analyses (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).

4. Rocking and Translational Response Summary. 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. Describe the methods and procedures used to couple the soil and 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 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 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. Where applicable, the responses obtained from both modal analysis response spectrum and time history methods at selected points in the 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 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 a coupled system model 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 (e.g., 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 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 in the application. A summary of typical results comparing the simplified dynamic methods and response spectra modal analysis methods should be submitted in the application. 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, provide 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.

10. Modal Period Variation. The procedures used to account for modal period variation in the mathematical models for the 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 Plant Structure. With respect to piping designated to withstand the earthquake and buried or otherwise located outside of the confinement structure, describe 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.

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 earthquake designed.

14. Field Location of Supports and Restraints. 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 should be provided.

4.2.6 Snow and/or Ice Loadings

Describe design load criteria used to ensure that a maximum snow and/or ice 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 and seismic loads 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. Describe the loads acting on the structures such as dead loads, live loads, and earth pressure loads, as well as the design basis accident loads, and loads resulting from natural phenomena such as earthquakes, floods, tornadoes, hurricanes, and missile effects unique for the site. The design loading combinations used 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, should be provided together with time-dependent loading such as the thermal effects, effects of creep, 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 groundwater-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 groundwater 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, and

3. Delineation 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 release 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 ensured continuity of operation under accident conditions and special control instrumentation.

Establish the criteria for the design of the ventilation and offgas systems including (1) airflow 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 control, 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

Supply all pertinent criteria relating to the appropriate safety margins 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 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 under 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 for limiting 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 Materials Handling and Storage

4.3.7.1 Fuel Handling and Storage. Describe the design criteria for fuel materials and storage. Include the criteria for cooling requirements, criticality, and contamination control.

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 and/or shipment to a disposal or storage site, (5) safe confinement during onsite storage, (6) monitoring during onsite storage to demonstrate safe confinement, and (7) final decontamination, retrieval, and disposal of stored wastes 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 the 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

(e.g., fire and explosion) and hazardous chemical reactions (e.g., vigorous chemical reactions and hydrogen explosions) should be presented.

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 in Chapter 5, "Plant Design" and Chapter 6, "Process Systems."

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

4.5 Decommissioning

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 for allowing ease of plant decontamination and future isolation of all radioactive materials from the public while maximizing the land area returned to the public domain.

5. PLANT DESIGN

In support of the license application, provide descriptive information on the buildings and other installed features of the plant and their locations on the site. Use drawings and maps as appropriate. Describe and evaluate each part of the plant with emphasis on those features that 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. Reference those features which require inclusion in the quality assurance program. For the completed application, identify areas which have been changed or added, the reasons for the changes, and the safety implications of the changes to the initial submittal. Also present the results of research and development activities that relate to the construction and/or operating criteria.

5.1 Summary Description

5.1.1 Location and Plant Layout

Identify the location of the plant buildings and other installed plant facilities 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 that 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 described in Section 2.2.

5.1.2.3 Restricted Area. Show the restricted area as defined in 10 CFR Part 20, "Standards for Protection Against Radiation," §20.3(a)(14), "Definitions."

5.1.2.4 Site Utility Supplies and Systems. Identify the utility supplies and systems as well as the source(s) of water. Include the location of test wells and cooling towers.

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 (1) analysis and design procedures for tornado, earthquake, missile, fire, and explosion

effects, (2) the general analysis and design procedures for normal, abnormal and special loadings and load combinations, (3) allowable foundation loads and deflections and deformation stresses for structures, and (4) 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, 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 previously discussed in Section 5.2. Also include 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 that 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. Include in the discussion 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 ventilations operation should be presented in Chapter 8, "Radiation Protection."

5.2.3 Individual Facility Description

List each facility sequentially from the receiving facility through the various operations. The following are typical items: Feed materials receiving and storage, chemical process area(s), mechanical process area(s), product load-out and storage, process offgas treatment, control locations, service galleries, miscellaneous waste treatment and waste packaging, waste storage and shipment, 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 developed design codes used and additional specifications necessary to provide a sufficient margin of safety between normal and accident conditions to ensure that a single failure will not result in the release of significant radioactivity. Detail on backup provisions and interface with other areas should be included. Also include a discussion of the features used to ensure radiation protection and that criticality will not occur.

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 to ensure that a single failure within a support system will not result in the release of radioactivity.

5.3.1 Development of Support Requirements

For certain auxiliary systems involving building ventilation, electric, 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 detail 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 present additional details to identify the

detailed physical arrangement. For each support facility, 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, and filter and fan housing arrangements. Identify each of the areas serviced and the interfaces between areas in the following sections.

5.4.1.1 Major Components and Operating Characteristics. Present the design bases selected for the building ventilation system. Present detailed discussions justifying these bases, the system design, and its operating provisions in Chapter 8, "Radiation Protection."

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 reference in the discussion appropriate engineering drawings and sketches.

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.

Emphasize the design features to ensure 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.

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. Provide a description of 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 for each.

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, and 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 use for 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 plant 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, alternate 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 used 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 process requirements and air conditioning loads. Also provide information on cooling ponds or towers and the 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 that 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) for external and internal communications 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 Bases.

1. Identify in the license application the fires that could indirectly or directly affect safety-related structures, systems, and components. Describe and discuss those fires that provide the bases for the design of the fire protection system, i.e., fires considered to be the maximum fire that may develop in local areas assuming that no manual, automatic, or other firefighting 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 in the initial submittal fire characteristics, 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 that 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. In the completed application, provide a list of the dangerous and hazardous combustibles and the maximum amounts estimated to be present. State where these will be located in the plant in relation to safety systems.

3. Discuss and list in the initial submittal the features of building and plant 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, fire walls, and the isolation and containment features provided for flame, heat, hot gases, smoke, and other contaminants.

4. Specify the seismic design requirements for each type of fire protection system incorporated in the plant and the 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 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 the fire hazards and potentials during construction of separately identifiable 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 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 the protection and suppression systems provided in the control room and other operating areas containing safety-related equipment.

3. Describe 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 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. The completed application should include drawings and a list of equipment and devices which adequately define the principal and auxiliary fire protection systems.

5. Describe electrical cable fire protection and detection and the fire containment, control, and extinguishing systems provided. Define the 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 to demonstrate 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. The completed application should describe the operational checks, inspection, and servicing required to maintain this integrity. The completed application should also discuss the testing necessary to maintain a highly reliable alarm detection system.

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. The completed application should 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.

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 ensuring confinement of process materials and radioactive wastes as necessary.

5.4.11 Cold Chemical Systems

Describe the major components and operating characteristics of facilities that will be used in association with cold chemical operations. Where hazardous chemicals or materials are involved, discuss the provisions that will be made to mitigate accidents. Itemize the chemicals and materials

that will be used, their quantities, and where they will be used; and codify with respect to hazard.

5.5 Items Requiring Further Development

This section of the initial submittal should identify, describe, and discuss those safety features or components for which further technical information will be required before the Commission will approve construction of the plant, but which have not been supplied in the application. 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 for 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 that will be considered will be an acceptable substitute.)

5.6 Changes in the Application

This section will appear in the completed license application. Describe the results of any development work identified in the initial submittal. Present an evaluation of the results and the application made of them; identify and justify the changes made. Each item should be cross-referenced to the appropriate section in the completed application 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. Also provide 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.

6. 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 process safety features to ensure against a hazard should be so designated in the details presented. The latter information should include, but not be limited to, listing systems necessary for safe shutdown under normal and abnormal conditions, 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 that will require attention for the quality assurance program while under construction. For each system describe the considerations used to achieve as low as is reasonably achievable levels of radioactivity in the plant effluents and to ensure nuclear safe conditions at all times. The completed application should show changes made in the application since the initial submittal, reasons for the changes, and a final definition of limits and parameters for developing the Technical License Conditions.

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, and 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, "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

Provide identification of areas or items for safety analysis. Reference this part of the chapter, as applicable, in subsequent discussions

of design and operating features and items discussed in Chapter 2, "Summary Safety Analysis."

6.1.3.1 Criticality Prevention. Provide a summary description of the principal design guidance, procedures, 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 and the approaches used to preclude associated accidents. (Refer to Section 6.2.)

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. Provide 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 areas where specific 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 Fissile Materials Receiving, Storage, Handling, and Transfer

Describe the systems associated with fissile materials receipt, storage, and transfer. From the design criteria present the provisions for cooling, when used, maintaining fissile materials 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 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 Fuel Manufacturing

Describe the processes used for fuel pellet manufacture and rod loading as they relate to the type of fuels to be fabricated. Also describe fuel rod and assembly handling and storage.

6.3.2.1 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

Each process system should be related 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, "Waste Confinement and Management" and Chapter 8, "Radiation Protection." Reference should be made to physical layout presentations found in Chapter 5, "Plant Design." Use subsections to present the information on each process system.

6.4.1 Process System

Name the actual process system described in this section. 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, its function, and how the function 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 10, "Conduct of Operations" and Chapter 12, "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 10 or Chapter 12.

6.4.1.4 Safety Criteria and Assurance. From the parameters discussed in the preceding sections, summarize the criteria for 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 that can be characterized as being process safety features which are considered additionally necessary beyond normal process operation and control. Emphasis should be placed on criticality control and radiological 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 License Condition 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 alternate equipment to provide continuity of safety under normal and abnormal conditions. This may include vessels, jets, pumps, spool pieces, heaters or coolers, valves, and standby blanket gas supplies. 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, "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 should be discussed in Chapter 5, "Plant Description."

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, "Principal Design Criteria."

Discuss how instrumentation and control systems monitor safety-related variables and operating systems over anticipated ranges for normal operation, abnormal operation, accident conditions, and safe shutdown. Describe the redundancy of process 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 and/or Control Areas

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 Analytical Sampling

Provisions for obtaining samples for process analysis and controls necessary to ensure that operations are within prescribed limits should be discussed. 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(s) resulting from operation of the plant, provide the details of the system and methods which will be used for their handling and storage.

6.9 Items Requiring Further Development

As described in Chapter 5, Section 5.5, in the initial submittal the details should be presented for each item requiring the development of additional information or data. Identify the item, what is needed, how and when the information will be obtained. Indicate times when data are expected to be available and options that are available in event satisfactory results are not obtained. Reference this information to Chapter 1, Section 1.6.

6.10 Changes in the License Application

In the completed license application, describe with details the results of the development work identified in the initial submittal. Present an evaluation of the results and the application made of them, and identify and justify the changes made.

7. WASTE CONFINEMENT AND MANAGEMENT

7.1 Waste Management Criteria

By reference to Chapter 4, "Principal Design Criteria," provide the primary design bases and supporting analysis for demonstrating that all radioactive waste materials will be contained safely over the life of the plant. The considerations for offsite disposal of solid waste materials and contaminated equipment should also be included. The waste confinement objectives, equipment, and program should implement, in part, the considerations necessary for protection against radiation as described in Chapter 8, "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

Similar to 7.2, waste sources other than those containing radioactivity should be identified. Account for combustion products as well as all chemicals leaving the plant. This information is to be included to assist the NRC 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 that 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. The actual operation of the gas-cleaning equipment and its minimum expected performance should be discussed and included in this section.

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

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 should be provided.

7.6.1 Design Objectives

Describe 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 that will be used for volume reduction, containment and/or packaging, storage, and disposal.

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 and provide an estimate of concentrations and volumes generated.

7.6.5 Packaging

Describe the means for packaging the solid wastes where required, and identify aspects that 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 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 and characterize all solid wastes that are produced during plant operation. Describe the system(s) used to treat, package, and contain these solid wastes.

7.7.1 Design Objectives

Describe the objectives of the methods and the equipment selected for minimizing the generation of solid wastes and for safe management of that solid waste which is generated.

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 location of the equipment and associated features that will be used for volume reduction, containment and/or packaging, storage, and disposal.

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 an estimate of concentrations and 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 solid wastes of the type to 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 these wastes will be handled at the time the plant is permanently decommissioned.

7.8 Items Requiring Further Development

This section of the initial submittal 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 that may be considered should the results obtained be unsatisfactory.

7.9 Changes in the License Application

In the completed license application, describe with details the results of the development work identified in the initial submittal. Present an evaluation of the results, the application made of them, and identify and justify the changes made.

8. RADIATION PROTECTION

This chapter of the license application 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; in-service inspection; and calibration). This chapter should also provide information on plant 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 Ensuring That Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)

8.1.1 Policy Considerations

Describe the management policy and organizational structure related to ensuring that occupational radiation exposures are ALARA. Describe the applicable activities to be conducted by the individuals having responsibility for radiation protection. In the initial license application, describe policy with respect to designing the plant. In the completed license application, emphasize policy with respect to the operation of the plant. In the initial submittal indicate whether, and if so how, the guidance given in Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposure As Low As Is Reasonably Achievable (Nuclear Power Reactors)," and, where appropriate, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," will be followed. If the guidance will not be followed, indicate the specific alternative approaches to be used.

8.1.2 Design Considerations

In the application, describe plant and equipment design considerations that are directed toward ensuring that occupational radiation exposures are ALARA. Describe how experience from any past designs is utilized to develop improved design for ensuring that occupational radiation exposures are ALARA and that plutonium contamination incidents are negated. Include any design guidance (both general and specific) given to the individual designers. Describe how the design is directed toward reducing the (1) need for maintenance of equipment, (2) radiation levels and time spent where maintenance is required, and (3) contamination control in handling, transfer, and storage of plutonium and mixed oxides. These descriptions should be detailed in the application, including an indication of whether, and if so how, the applicable design consideration guidance provided in Regulatory Guide 8.8, Section C.3, will be followed. If it will not be followed, indicate the specific alternative approaches to be used. The application

should also state whether, and if so how, relevant design experience from existing facilities is being used.

Discuss the arrangements and plans for decontamination of the plant.

8.1.3 Operational Considerations

In the application, describe the methods used to develop the detailed plans and procedures for ensuring that occupational radiation exposures are ALARA and that operational safeguards are provided to ensure that contamination levels are as low as achievable. Describe how these plans, procedures, and safeguards will impact on the design of the plant and how such planning has incorporated information from other designs and follows the applicable guidance given in Regulatory Guide 8.8, regulatory position 4. If the guidance will not be followed, describe the specific alternative approaches to be used.

In the completed application, identify and describe procedures and methods of operation that are used to ensure that occupational radiation exposures are ALARA, such as those pertinent procedures in Regulatory Guide 8.8, regulatory position 4, and Regulatory Guide 8.10. Describe how operational requirements are reflected in the design considerations 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 are implemented for ensuring that occupational radiation exposures are ALARA and residual contamination levels are as low as achievable for all systems which contain, collect, store, or transport radioactive solids and liquids, including those from the radioactive waste treatment, handling, and storage systems.

8.2 Radiation Sources

8.2.1 Contained Sources

In the application, 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 includes a tabulation of all sources by isotopic composition, x-ray and gamma ray energy groups, strength (curie content), and geometry, as well as provides the basis for the values. The sources should include those contained in vaults, process conveyors, process equipment, and storage containers or tanks throughout the plant. Indicate the physical and chemical forms of all sources. The completed application should provide additional details (any changes) of source descriptions that are used to develop the final shield design.

8.2.2 Airborne Radioactive Material Sources

In the application, 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 commitment. The description in the completed application 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.

8.3 Radiation Protection Design Features

8.3.1 Plant Design Features

In the application, describe equipment and plant design features used for ensuring that occupational radiation exposures are ALARA and confinement of radioactive material is maintained as high as achievable. Indicate whether, and if so how, the applicable design feature guidance given in Regulatory Guide 8.8, regulatory position 3, has been followed. If it was not followed, describe the specific alternative approaches used.

Provide illustrative examples of the plant design features used in the initial design 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: feed material receiving preparation and storage, chemical process areas, mechanical process areas, service galleries, waste treatment packaging, storage, and shipment, and product loadout and storage. Reference other chapters and sections as appropriate.

In the application, provide scaled layout and arrangement drawings of the plant 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. Provide on the layouts the radiation zone designations including zone boundaries and type interface (e.g., air lock, barrier).

The layouts should show shield wall thicknesses, controlled access areas, personnel and equipment decontamination areas, contamination control areas and type controls, traffic patterns, location of the health physics facilities, location* of airborne radioactivity and area radiation monitors, location of control panel(s) for radiological 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. Describe the facilities and equipment such as hoods, glove boxes, filters and special handling equipment. The completed application should describe changes or additions to the radiation protection design since the initial submittal. Discuss the arrangements and plans for final decommissioning of the plant.

*In the initial submittal, if available, and update in the completed application.

8.3.2 Shielding

In the application, provide information on the shielding for each of the radiation sources identified in Section 8.2. Include the criteria for penetrations, material, the method by which the shield parameters (e.g., attenuation coefficients, buildup factors) were determined, and the assumptions, codes, and techniques used in the calculations. Describe special protective features that use shielding, geometric arrangement (including equipment separation), or remote handling to ensure that occupational radiation exposures will be ALARA in normally occupied areas. The completed application should describe changes or additions in the shielding since the initial submittal.

8.3.3 Ventilation

In the application, 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 and 6 to show that the designs selected will satisfy the ALARA provisions of 10 CFR Part 20, "Standards for Protection Against Radiation," Section 20.1(c), "Purpose," and appropriate guides. The discussion should also show that expenditures for design work and equipment will not result in concomitant reduction of released radioactivity.

Reference the discussion on building ventilation in Chapter 5, Section 5.4.1, and appropriate engineering sketches and drawings to further discuss the interrelation of component parts and controls to the following:

1. Maintain internal exposure to ALARA.
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 or windows, bags, or gloves are breached.
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 for measuring the efficiency of filters, adsorbers, scrubbers, and other gaseous effluent treatment devices over the lifetime of the plant.

Estimate 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 8.5. Present a detailed discussion of the evaluations made to show that the ventilation 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 typical ventilation operating upsets as well as fire, explosives, high winds and tornadoes, and loss of electrical power.

Reference the discussions of offgas treatment in Chapter 5, Section 5.2.3, and appropriate equipment and process flow drawings to further discuss that

1. "As low as is reasonably achievable" 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, and
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 and discuss 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 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.

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.

The completed application should include any changes or additions in the ventilation system design protective features since the initial submittal.

8.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

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

The completed application should 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 reference the readout system and neutron dose assessment technique to be used. The completed application should also provide the location of the continuous airborne monitor sample collectors, and give details of sampling lines pump location and criteria for obtaining representative samples of effluent monitors.

Indicate whether, and if so how, the guidance provided by Regulatory Guides 8.2, "Guide for Administrative Practices in Radiation Monitoring," and 8.6, "Standard Test Procedure for Geiger-Müller Counters," and ANSI N13.1-1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities," has been followed. If the guidance was not followed, describe the specific alternative methods used.

8.4 Estimated Man-Rem Onsite Dose Assessment

In the application, provide the estimated occupancy of the plant radiation areas during normal operation and anticipated operational occurrences. For areas with expected airborne radioactivity concentrations (as required by Section 8.2.2), provide estimated man-hours of occupancy. Also 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), maintenance, radwaste handling, decontamination and inservice inspection. Supply the basis, models, and assumptions for the above values.

In the completed application, the estimated annual occupancy for each radiation zone in the plant should be tabulated and the bases for the values provided. 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 application describe the administrative organization of the health physics program including the authority and responsibility of

each position identified. Indicate whether, and if so how, the applicable guidance of Regulatory Guide 8.8, regulatory position 2, and Regulatory Guide 8.10, has been followed. If it was not followed, describe the specific alternative approaches used. The completed application should describe the experience and qualification 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 application, provide the criteria for selection of portable and laboratory technical equipment and instrumentation for (1) performing radiation and contamination surveys, (2) airborne radioactivity sampling, (3) area radiation monitoring, and (4) personnel monitoring during normal operation, anticipated operational occurrences, and accident conditions. Describe the instrument storage, calibration, and maintenance facilities. Also 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. Indicate whether, and if so how, the guidance provided by Regulatory Guides 8.3, "Film Badge Performance Criteria," 8.4, "Direct-Reading and Indirect-Reading Pocket Dosimeters," and 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program," has been followed. If it was not followed, describe the specific alternative methods used.

The completed application should provide the location 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

The completed application should describe the methods, frequencies, and plans for conducting radiation surveys. Describe the health physics plans that have been developed for ensuring that occupational radiation exposures will be ALARA. 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. Indicate whether, and if so how, the guidance given in Regulatory Guides 8.7, "Occupational Radiation Exposure Records Systems," 8.9, and 8.10 will be followed. If it will not be followed, describe the specific alternative approaches to be used.

Describe the methods and plans for neutron, gamma, and x-ray personnel dosimetry for normal operations and criticality accidents including methods for recording and reporting results. Describe how dosimetric

results are used as a guide to operational planning. The criteria for performing whole body and/or lung counting and bioassays should be provided. Describe the methods and procedures for evaluating and controlling potential airborne radioactivity concentrations, including any requirements for special air sampling. Discuss the use of respiratory protective devices including the respiratory protective equipment fitting programs and training of personnel.

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 plutonium processing and fuel fabrication plants. Relate the monitoring program to process flow diagrams and the discussions presented in Chapter 6, "Chemical Process Systems," and Chapter 7, "Waste Confinement and Management." An estimate of the contribution by the plutonium processing and fuel fabrication plant to the offsite radioactivity level should be provided.

8.6.1 Effluent and Environmental Monitoring Program

In the initial application, the program for monitoring and estimating the contribution of radioactivity to the environment should be described. 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. The selection of each system and instrument should be justified. The frequency of sampling, the limits for action, and the plans to be used to maintain continued integrity of analyses should also be discussed.

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. The selection of each system and instrument should be justified. The frequency of sampling, the limits for action, and the plans to be used to maintain continued integrity of analysis should also be discussed.

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

8.6.1.4 Environmental Monitoring. Describe in detail the program that 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 at which the samples are obtained; the analyses to be performed; and the method of reporting. This section should include the program for continuing meteorological data collection and evaluation to supplement the estimates previously developed.

8.6.2 Analysis of Multiple Contribution

An analysis should be presented of incremental and total exposures that 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, "Site Characteristics," and the radio-activity release rates in Chapter 7, "Waste Confinement and Management." In addition to the man-rem whole body determinations, details on man-rem uptakes by critical organs should be provided.

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 the following:

1. Joint frequency distribution of wind speed, wind direction, and atmospheric stability;
2. Methods, assumptions, and conditions employed;
3. Biological pathways and critical organs;
4. Dose models.

The consequences should 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 parameters for postulated chronic releases should be tabulated. The tabulation should include both a conservative value as well as the realistic values for each assumption used. List the parameters in a table similar to Table 8.1.

Any digital computer programs or analog simulation used in the analysis should also 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 for a 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 (From Recycle Area).

8.6.4.2 Cooling Water Streams.

8.6.4.3 Sewage.

8.6.4.4 Drinking Water.

8.6.4.5 Rain Runoff.

8.6.4.6 Laundry Waste.

8.7 Items Requiring Further Development

8.8 Changes Since Initial Submittal

TABLE 8.1

Parameters to be Tabulated* for Postulated Chronic Releases

	<u>Conservative Assumptions</u>	<u>Realistic Assumptions</u>
I. <u>Data and Assumptions Used to Estimate Radioactive Source</u>		
A. Form (physical, chemical)		
B. Particle size		
C. Physical and chemical data related to transport or removal functions		
II. <u>Data and Assumptions Used to Estimate</u>		
A. Leakage fractions		
B. Absorption and filtration effi- ciencies		
C. Release flow rates and pathways		
III. <u>Dispersion Data</u>		
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. <u>Dose Data</u>		
A. Method of dose calculation		
B. Dose conversion assumptions		
C. Biological pathways		
D. Doses		

*As applicable to event described

9. ACCIDENT SAFETY ANALYSES

The evaluation of the safety of a plutonium processing and fuel fabrication plant is accomplished in part by analyzing the response of the plant to postulated accident events in terms of minimizing (1) the causes of such events, (2) the quantitative identification and mitigation of the consequences, and (3) 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 license to possess and use special nuclear material in a plutonium processing and fuel fabrication plant.

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

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

9.1 Abnormal Operations

In this section events which could occur from malfunctions of systems, operating conditions, or operator error should be presented. 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 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, and

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 process safety features, and the performance of backup protection 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 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 on 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, radioactivity and release rate of fission products, or other transmissible radioactive materials within the confinement system that could escape to the environment; and

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

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 analyses 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 area. Include consideration of industrial-type accidents that would not result in a release of radioactivity but could endanger onsite personnel.

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

9.2.1 Accident Analyzed

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

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

9.2.1.2 Accident Analysis. Analyze the effects and particularly any radiological consequences of each 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 each accident. Assess the consequences of the accident to persons and property offsite.

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

1. The mathematical or physical models employed, describing any simplification introduced to perform the analyses. Identify assumptions used 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 models, flow path identification, actual computer listing, and complete listing of input data. The detailed description of mathematical models and digital computer programs or listings may be included by available reference with only summaries provided in the application.

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

- a. The distribution and fractions of plutonium and transplutonium isotopes and of fission product inventory assumed to be released from the source material into offgas systems,

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

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

4. Identify the time-dependent characteristics, activity, and release rate of the plutonium and transplutonium isotopes and 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, equipment performance, instrumentation response characteristics, or other indeterminate effects taken into account in the evaluation of the results.

6. Explain 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. Discuss 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 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 on to limit the extent or magnitude of the consequences.

9. For the accidents, provide and discuss the results of calculations of potential integrated whole body and critical organ doses from exposure to radiation as a function of distance and time after the accident. Present in terms of a 50-year dose commitment. Discuss the results and consequences derived from the analysis and the margin of protection provided by whatever system is depended on to limit the extent or magnitude of the consequences.

10. CONDUCT OF OPERATIONS

The framework for conducting the operation of the plant should be described. Quality assurance (QA) applies to all safety aspects of nuclear activities: design, fabrication, construction, operation, maintenance, modifications, and decommissioning. 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:

1. 10 CFR Part 70, §70.22, "Content of Applications"
2. 10 CFR Part 70, §70.23, "Requirements for the Approval of Applications"
3. 10 CFR Part 70, Appendix A, "General Design Criteria for Plutonium Processing and Fuel Fabrication Plants" (proposed)
4. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
5. 10 CFR Part 50, Appendix E, "Emergency Plans for Production and Utilization Facilities."

10.1 Organizational Structure

The following format should be used to present the organizational structure as it will be at the time the initial application submittal is made through the construction phase. The organization as it will function through preoperational testing, startup, and plant operation should be updated in the completed license application.

10.1.1 Corporate Organization

Describe the corporate arrangement or organization related to the processing and fabrication activity. Indicate the information required by §70.22(a)(1) if the corporation is made up from two or more existing identities, the relationship and responsibilities between each should be explained. As required in §70.22, provide sufficient information to demonstrate the financial capabilities for construction, operation, and decommissioning of the 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 Inhouse Organization. A description should be provided of the applicant's corporate management and technical staffing and inhouse organizational relationships established for the design and construction review and quality assurance functions, and the responsibilities and authorities of personnel and organizations described in 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. Describe the applicant's corporate (home office) technical staff specifically supporting the engineering, construction, and operation of the plutonium processing and fuel fabrication plant. Include a description of the duties, responsibilities, and authority of the engineering technical staff; state numbers of personnel, qualifications, educational backgrounds (disciplines), and technical experience. Indicate technical support for 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 organizational arrangement of the plant showing the title of each position, the flow of responsibility as depicted by an organization chart, and the number of personnel in each unit. Describe the organizational arrangement for ensuring 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 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 application should specify the minimum qualification requirements and, as known, the qualifications of assigned plant personnel. The completed application 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 resumé should identify individuals by position title and, as a minimum, should describe the formal education, training, and experience of the individuals. Complete staff qualifications should be provided in the completed license application.

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, plant design and construction, process and equipment selection or development, and safety evaluations. Additionally, any arrangements made with other government agencies should be presented and the method or system used to monitor the interfaces between each participant.

10.2 Preoperational Testing and Operation

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

10.2.1 Administrative Procedures for Conducting the Test Program

Describe the system used for (1) preparing, reviewing, approving, and executing all testing procedures and instructions and (2) 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 of 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:

1. Describe the purpose of the test (Purpose).
2. 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 (Response and Acceptance Criteria).

10.3 Training Programs

10.3.1 Program Description

Describe the proposed training program including the scope of training in (1) plant operations and design, instrumentation and control, methods of dealing with process malfunctions, decontamination procedures, and emergency procedures and (2) in health physics subjects such as nature and sources of radiation, methods of controlling contamination, interactions of radiation with matter, biological effects of radiation, use of monitoring equipment, and principles of criticality hazards control. Identify personnel classification with level of instruction.

10.3.2 Retraining Program

Describe the program for continued training that provides additional materials and refresher training.

10.3.3 Administration and Records

Identify personnel in the organization responsible for the training programs and 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 application should include a commitment to conduct safety-related operations by providing detailed written procedures. The completed application should include a list of procedures that, by title or subject, clearly indicates their purpose and applicability. The completed application should include a description of the review, change, and approval practices for all plant operating, maintenance, and testing procedures.

10.4.2 Plant Records

The completed application 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; operating records including principal maintenance, alteration, or additions made; records of abnormal occurrences and events associated with radioactive releases; and environmental survey records.

10.5 Emergency Planning

The application should describe the applicant's preliminary plans for coping with emergencies. The applicant should refer to 10 CFR Part 50, Appendix E, "Emergency Plans for Production and Utilization Facilities," Section II, for a description of the kind of information to be provided. The completed application should contain the plans for coping with emergencies. The applicant should refer to 10 CFR Part 50, Appendix E, Sections III and IV, for a description of the minimum information to be included in the emergency plan.

10.6 Decommissioning

The license application should describe provisions for decommissioning the 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 Arrangements with Outside Organizations

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

10.6.4 Arrangements for Funding

Discuss the means for funding the decommissioning of the plant and maintaining its continued isolation from the public.

11. OPERATING CONTROLS AND LIMITS

The operating controls and limits for plutonium processing and fuel fabrication plants are derived from the safety assessment of the plant and process and include all important safety, environmental, and materials and plant protection aspects of plant operation.

The safety and environmental analyses should lead to the conclusion that the health and safety of the public and operating personnel and the environmental values will be protected during plant operation if all operations are performed within certain prescribed limits. These limits are defined and established in the operating controls and limits.

Except for safety questions that have not been reviewed, changes can be made without amending the license unless a change in operating controls and limits is involved. Such changes would require NRC staff review and approval before being instituted.

The operating controls and limits will be proposed by the applicant and reviewed and issued by NRC.

11.1 Preliminary Operating Controls and Limits

An application for a license to possess and use special nuclear material in a plutonium processing and fuel fabrication plant should include an identification and justification for the selection of those variable conditions or other items determined, as a result of safety assessment and evaluation, to be probable subjects of operating controls and limits for the plant. Special attention should be given to those items which may significantly influence the final design. The objective in selecting probable operating controls and limits is to identify those items that would require special attention at the construction authorization stage. This would avoid the necessity for any significant change in design to support final operating controls and limits, e.g., particularly those controls or limits 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 this guide the need to identify safety limits, limiting conditions, and surveillance requirements has been indicated. It is from such information that the operating controls and limits and supporting bases are developed.

The preliminary operating controls and limits and bases proposed by an applicant for a plant should be included in Chapter 11 of the application. The preliminary operating controls and limits should be complete, i.e., to the fullest extent possible, numerical values and other pertinent data should be provided. For each control or limit the applicable sections that develop, through analysis and evaluation, the details and bases for the control or limit should be referenced.

11.2 Proposed Operating Controls and Limits

Each operating license to possess and use special nuclear material in a plutonium processing and fuel fabrication plant issued by the Nuclear Regulatory Commission should contain technical operating limits, conditions, and requirements imposed upon plant operation in the interest of the health and safety of the public. The operating controls and limits are proposed by the applicant. After review by the NRC staff, they are modified as necessary before becoming part of the license. A statement of the bases or reasons for all controls or limits, other than those dealing with administrative controls, should be included in the application but does not become part of the operating controls and limits. Operating controls and limits may not be changed without prior Commission approval.

The operating controls and limits and bases proposed by an applicant for its plant should be included as Chapter 11 of the completed license application. Except for the controls and limits covering design features and administrative controls, each control or limit selected should be provided in the completed application with bases in the form of a summary statement of the technical and operational considerations justifying the selection. For each control or limit the sections of the application that fully develop, through analysis and evaluation, the details and bases for the control or limit should be referenced.

11.3 Content of Operating Controls and Limits

Operating controls and limits should include both technical and administrative matters. Operating controls and limits related to technical matters should consist of those features of the plant that are of controlling importance to safety (process variables, systems, or components). In addition, operating controls and limits related to technical matters should include effluent and environmental monitoring and controls or limits addressed to the attainment of "as low as is reasonably achievable" levels of releases and exposures. Operating controls and limits 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 plant.

11.4 Bases for Operating Controls and Limits

When an operating control and limit has been selected, the bases for its selection and its significance to safety of operation should be defined. This can be done by the provision of a summary statement of the technical and operational considerations justifying the selection. The license application should fully develop, through analysis and evaluation, the details of these bases. Therefore, the physical format for operating controls and limits assumes importance, since the collection of controls or limits and their written bases form a document which delineates plant features that are important to safety of operation, the reasons for their importance, and their relations to each other.

11.5 Development of Operating Controls and Limits

The applicant should refer to §50.36, "Technical Specifications," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," for a description of the categories of technical specifications applicable to operating controls and limits. Additional categories may be designated by the applicant.

11.5.1 Safety Limits and Limiting Control Settings

Controls or limits 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 operating controls and limits 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. Operating controls and limits 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 detect incipient deficiencies.

11.5.4 Design Features

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

11.5.5 Administrative Controls

The license application should contain a full description and discussion of organization and administrative systems and procedures for operation of the plant.

11.5.6 Suggested Format for Operating Controls and Limits

1. Title: (e.g., Pressure Control of Glove Boxes).
 2. Applicability: System(s) or portion(s) of the plant to which the control or limit applies should be clearly defined.
 3. Objective: The reason(s) for the control or limit and the specific unsafe condition(s) it is intended to prevent.
 4. Operating Control or Limit: Safety limits and limiting control setting(s) for the important variable(s), or the condition or surveillance requirement imposed.
 5. Bases: The license application should contain all pertinent information and an explicit detailed analysis and assessment supporting the choice of the item and its specific value or characteristics. The basis for each control or limit should contain a summary of the information within the application in enough depth to indicate the completeness and validity of the supporting information and to provide justification for the control or limit. The following subjects may be appropriate for discussion in the bases section:
 - a. Technical Basis. The technical basis is derived from technical knowledge of the process and its characteristics and should support the choice of the particular variable as well as the value of the variable. The results of computations, experiments, or judgments should be stated and analysis and evaluation should be summarized.
 - b. Equipment. A safety limit often is protected by or closely related to certain equipment. Such a relationship should be noted, and the means by which the variable is monitored and controlled should be briefly mentioned.
- For controls or limits in categories referenced in 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.
- c. 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. Include a brief discussion of such factors as system response(s), process or operational transients, malfunctions, and procedural errors. Reference to related controls or limits should be made.

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

12. QUALITY ASSURANCE

To provide assurance that the design, construction, and operation of the proposed plutonium processing and fuel fabrication plant are in conformance with (a) applicable regulatory requirements and (b) the design bases specified in the license application, a quality assurance program (QA program) should be established by the applicant. The applicant should provide a description of the QA program to be established and executed during the design, construction, and operation of the plutonium processing and fuel fabrication plant. The operational QA program need not be described until the completed application is submitted. However, the QA program must be established at the earliest practical time consistent with the schedule for accomplishing the activity. Where some portions of the QA program have not yet been established at the time the initial application is submitted, because the activity either is not yet defined or will be performed in the future, the description should also provide a schedule for implementation. The QA program must meet the requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50.

The QA program for each of the major organizations involved in executing the total program should include the information described (either separately for each organization or integrally for all organizations) in accordance with the outline presented below. It is not the intent of the NRC staff to dictate the format of any QA program manual; that is left to the discretion of the applicant. However, the license application should describe, at a minimum, each of the criteria in Appendix B in sufficient detail to enable the reviewer to determine whether and how all the requirements of the appendix will be satisfied. Reference to appropriate portions of other sections of the application may suffice.

12.1 Quality Assurance During Design Construction

12.1.1 Organization

The initial application should describe clearly the authority and duties of persons and organizations performing quality assurance (QA) functions for ensuring that the QA program is established and executed or for verifying that an activity has been correctly performed. Organization charts and functional responsibility descriptions should be provided that denote the lines of responsibility and areas of authority within each of the major organizations in the project, including those of the applicant, the architect-engineer, the constructor, and construction manager (if other than the contractor). These charts and descriptions should present the structure of QA organizations involved as well as other functional organizations performing activities affecting quality in design, procurement, manufacturing, construction and installation, testing, inspection, and auditing with clear delineation of their responsibility, authority, and

relationship to corporate management. In addition, a single overall project organization chart should be included showing how the major organizations or companies working directly for the applicant on the project interrelate with one another.

The initial application should describe those measures to ensure that persons and organizations performing QA functions have sufficient authority and organizational freedom to (1) identify quality problems; (2) initiate, recommend, or provide solutions; and (3) verify implementation of solutions. Describe the measures to ensure that persons and organizations assigned the responsibility for checking, auditing, inspecting, or otherwise verifying that an activity has been correctly performed report to a management level, so that the required authority and organizational freedom, including sufficient independence from the pressures of production, are provided.

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

The initial application should describe how requirements will be imposed on contractors and subcontractors to ensure that individuals or groups within their organizations performing QA functions have sufficient authority and organizational freedom to effectively implement their respective QA programs. The initial application should describe the extent to which the applicant will delegate to other contractors the work of establishing and executing the QA program or any part thereof. A clear delineation of those QA functions which are implemented within the applicant's QA organization(s) and those which are delegated to other organizations should be provided in the initial application. The applicant should describe the method that will ensure the retention of responsibility for and maintenance of control over those portions of the QA program delegated to other organizations and identify the organization responsible for verifying that the delegated QA functions are carried out. The application should identify major work interfaces for activities affecting quality and describe how clear and effective lines of communication exist between the applicant and his principal contractors to ensure necessary coordination and control of the QA program.

12.1.2 Quality Assurance Program

The QA program, in the initial application, should cover each of the criteria in Appendix B to 10 CFR Part 50 in sufficient detail to permit a determination as to whether and how all of the requirements of Appendix B will be satisfied. The applicant should identify the safety-related structures, systems, and components to be controlled by the QA program.

The initial application should describe the measures to ensure that the QA program is being established at the earliest practicable time consistent with the schedule for accomplishing activities affecting quality for the project. That is, the applicant should describe how the QA program is being established in advance of the activity to be controlled and how it will be implemented as the activity proceeds. Those activities affecting quality initiated prior to the submittal of the initial application, such as establishing information required to be included in the application, design and procurement, and safety-related site preparation activities should be identified in the initial application.

The initial application should describe how the QA program is documented by written policies, procedures, or instructions and how it will be implemented in accordance with these policies, procedures, or instructions. The applicant should include a listing of QA program procedures or instructions that will be used to implement each major activity of the program, such as design, procurement, and construction. The procedure list should identify which criteria of Appendix B to 10 CFR Part 50 are implemented by each procedure. In the event certain required procedures are not yet established, a schedule for their preparation should be provided in the application.

The initial application should describe the program providing adequate indoctrination and training of the personnel performing activities that affect quality so that suitable proficiency is achieved and maintained. The applicant should describe how the indoctrination and training program will assure that

1. Personnel performing activities affecting quality are appropriately trained in the principles and techniques of the activity being performed;
2. Personnel performing activities affecting quality are instructed as to purpose, scope, and implementation of governing manuals, policies, and procedures; and
3. Appropriate training procedures are established.

The initial application should describe the qualification requirements for the position(s) responsible for ensuring effective implementation of the QA program of the applicant and his major contractors.

The applicant should describe the measures which ensure that activities affecting quality will be accomplished under suitable controlled conditions, including (1) the use of appropriate equipment; (2) a suitable environment for accomplishing the activity, e.g., adequate cleanliness; and (3) compliance with necessary prerequisites for the given activity.

The initial application should describe the measures to ensure that there is regular management review of the QA program to assess the adequacy of its scope, implementation, and effectiveness. The applicant should describe the provisions for reviews by management above or outside the QA organization to ensure achieving an objective program assessment.

The initial application should describe the measures to ensure that the QA organization of the applicant will (1) review and document agreement with the QA program of his principal contractors and (2) conduct or have conducted audits of the contractors' QA program activities.

12.1.3 Design Control

The initial application should describe the design control measures to ensure that (1) applicable regulatory requirements and design bases for safety-related structures, systems, and components are correctly translated into specifications, drawings, procedures, and instructions; (2) appropriate quality standards are specified in design documents; and (3) deviations from such standards are controlled.

The initial application should describe measures that ensure that adequate review and selection for application suitability is conducted for materials, parts, equipment, and processes that are essential to safety-related functions of the structures, systems, and components. The applicant should describe provisions that ensure that standard commercial or so-called "off the shelf" materials, parts, and equipment also receive adequate application review and selection.

The initial application should describe measures that ensure verification or checking of design adequacy, such as design reviews, use of alternative calculational methods, or performance of a qualification testing program under the most adverse design conditions. The applicant should identify the positions or organizations responsible for design verification or checking and should describe measures to ensure that the verifying or checking process is performed by individuals or groups other than those who performed the original design, but who may be from the same organization.

The initial application should describe measures for identifying and controlling design interfaces, both internal and external, and for coordinating among participating design organizations. The applicant should describe measures in effect among participating design organizations for review, approval, release, distribution, collection,

and storage of documents involving design interfaces and changes thereto. The applicant should describe how these measures will ensure that these design documents are controlled in a timely manner to prevent inadvertent use of superseded design information.

The initial application should describe the measures that will be employed to ensure that design changes, including field changes, are subject to the same design controls that were applied to the original design and are reviewed and approved by the organization that performed the original design unless the originating organization designates another responsible organization.

12.1.4 Procurement Document Control

The initial application should describe measures to ensure that documents (and changes thereto) for procurement of material, equipment, and services purchased by the applicant, his contractors, or subcontractors, correctly include or reference the following, as necessary, to achieve required quality:

1. Applicable regulatory, code, and design requirements;
2. Quality assurance program requirements;
3. Requirements for supplier documents such as instructions, procedures, drawings, specifications, inspection and test records, and supplier QA records to be prepared, submitted, or made available for purchaser review or approval;
4. Requirements for the retention, control, and maintenance of supplier QA records;
5. Provision for purchaser's right of access to suppliers' facilities and work documents for inspection and audit; and
6. Provision for supplier reporting and disposition of non-conformances from procurement requirements.

The initial application should describe (1) measures to clearly delineate the control responsibilities and action sequence to be followed in the preparation, review, approval, and issuance by competent personnel of procurement documents and (2) measures to ensure that the changes or revisions to procurement documents are subject to the same review and approval requirements as the original documents.

The initial submittal should describe measures to ensure (1) that procurement documents require suppliers to have and implement a documented QA program for purchased materials, equipment, and services to an extent consistent with their importance to safety; (2) that the purchaser has evaluated the supplier before the award of the procurement order or contract to ensure that the supplier can meet the procurement requirements;

and (3) that procurement documents for spare or replacement items will be subject to controls at least equivalent to those used for the original equipment.

12.1.5 Instructions, Procedures, and Drawings

The initial application should describe measures to ensure that activities affecting quality such as design, procurement, manufacturing, construction and installation, testing, inspection, and auditing are prescribed by appropriately documented instructions, procedures, or drawings and that these activities will be conducted in accordance with the documented instructions and procedures.

The applicant should describe the system whereby the documented instructions and procedures will include appropriate quantitative (e.g., dimensions, tolerances, and operating limits) and qualitative (e.g., workmanship samples and weld radiographic acceptance standards) acceptance criteria for determining that prescribed activities have been satisfactorily accomplished.

12.1.6 Document Control

The initial application should describe those measures established to control the issuance of documents, e.g., instructions, procedures, and drawings, including changes thereto, which prescribe all activities affecting quality. The description should cover control measures that ensure the following:

1. Documents are reviewed for adequacy (i.e., information is clearly and accurately stated) and are approved by authorized personnel for issuance and use at locations where the prescribed activity will be performed before the activity is started;
2. Means such as use of updated master document lists exist to ensure that obsolete or superseded documents are replaced in a timely manner by updated applicable document revisions; and
3. Document changes are reviewed and approved by the same organizations that performed the original review and approval unless delegated by the originating organization to another responsible organization. The applicant should identify the types of documents to be controlled and the group responsible for review, approval, and issuance of documents and changes thereto.

12.1.7 Control of Purchased Material, Equipment, and Services

The initial application should describe those measures to ensure that material, equipment, and services purchased directly by the applicant or by his contractors and subcontractors will conform to procurement document requirements. The application should describe the measures that provide, as appropriate, for the following:

1. Evaluation and selection of sources of supply,
2. Surveillance at the supplier's facility by the purchaser or his representative in accordance with written procedures during design, manufacture, inspection, and test of the procured item or service to verify compliance with quality requirements, and
3. Source and/or receipt inspection in accordance with written procedures and acceptance criteria of procured items furnished by the supplier. The initial application should describe measures whereby the applicant or his designated representative will audit and evaluate the effectiveness of the control of quality-related activities of contractors and subcontractors at a frequency or to an extent consistent with importance to the safety, complexity, and quantity of the item or service being furnished.

12.1.8 Identification and Control of Materials, Parts, and Components

The initial application should describe measures established to identify and control items such as materials, parts, and components, including partially fabricated assemblies, to prevent use of incorrect or defective items. The application should describe measures to ensure that (1) identification of the item, (i.e., heat number, part number, serial number, or other appropriate marking) is maintained either on the item or on records traceable to the item and verified, as required, throughout fabrication, erection, installation, and use of the item and (2) the method and location of the identification does not affect the function or quality of the item being identified.

12.1.9 Control of Special Processes

The initial application should describe measures established to control special processes such as welding, heat treating, nondestructive testing, and electrochemical machining to ensure that they are accomplished by qualified personnel using written procedures qualified in accordance with applicable codes, standards, specifications, or other special requirements. The application should describe those measures to ensure that qualifications of special processes, personnel performing special processes, and equipment are kept current and that record files thereof are maintained.

12.1.10 Inspection

The initial application should describe the measures to ensure that a program for inspection is established and implemented by or for the organization performing the activities to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity. The application should describe measures to ensure that (1) inspection personnel are appropriately qualified and are independent of the individual or group performing the activity being inspected; (2) inspections or tests are performed for each work operation as necessary

to verify quality; (3) indirect control by monitoring processing methods, equipment, and personnel is used if direct inspection of processed material or products is impossible or disadvantageous, and (4) both inspection and process monitoring are used when control is inadequate without both.

The initial application should describe measures to ensure that (1) inspection procedures and instructions are made available with necessary drawings and specifications for use prior to performing the inspections; (2) inspectors' qualifications or certifications are kept current; and (3) replaced or reworked items are inspected in accordance with original inspection requirements and modified or repaired items are inspected by methods that are equivalent to the original inspection method.

The application should describe the system whereby appropriate documents will identify any mandatory inspection hold points that require witnessing or inspecting by the applicants' designated representative and beyond which work may not proceed without the consent of its designated representatives.

12.1.11 Test Control

The initial application should describe the measures that establish a test program which (1) identifies all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service and (2) is conducted by trained or appropriately qualified personnel in accordance with written test procedures which incorporate or reference the requirements and acceptance limits contained in applicable design documents.

The application should describe the measures to ascertain that test procedures have provisions for ensuring the following:

1. All prerequisites for the given test have been met,
2. Adequate test instrumentation and equipment are available,
3. The test is performed under suitable environmental conditions and with adequate test methods, and
4. All test results are documented and evaluated to make sure test requirements have been satisfied.

12.1.12 Control of Measuring and Test Equipment

The initial application should describe the measures established to ensure that tools, gages, instruments, and other measuring and testing devices used in activities affecting quality are properly identified,

controlled, adjusted, and calibrated at specified periods to maintain accuracy within necessary limits. The application should describe measures to ensure that (1) these devices are adjusted and calibrated against certified equipment or reference or transfer standards having known valid relationships to nationally recognized standards or (2) if no national standards exist, the basis for calibration is documented. The applicant should describe the measures to ensure that the error of calibration standards is less than the error of production measuring and test equipment.

The application should describe provisions that will apply if measuring and test equipment is found out of calibration (1) for evaluating the validity of previous inspection of test results and the acceptability of items inspected or tested since the last calibration check and (2) where necessary to establish acceptability of suspect items, for repeating original inspections or tests using calibrated equipment. The application should also describe measures to ensure the maintenance of records that indicate the calibration status of all items under the calibration system and that identify the measuring and test equipment.

12.1.13 Handling, Storage, and Shipping

The initial application should describe the measures established to control the handling, storage, shipping, cleaning, and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration. The application should describe the measures for specifying and providing, when necessary for particular products, special protective environments such as inert gas atmosphere, specific moisture content levels, and temperature levels.

12.1.14 Inspection, Test, and Operating Status

The initial application should describe measures established to indicate by the use of marking such as stamps, tags, labels, routing cards, or other suitable means the status of inspections and tests performed on individual items of the plant throughout fabrication, installation, and test. The application should describe the measures which provide for the identification of items that have satisfactorily passed required inspections and tests, where necessary, to preclude inadvertent bypassing of such inspections and tests. The application should describe the measures established for indicating the operating status of structures, systems, and components of the plant such as tagging valves and switches to prevent inadvertent operation.

12.1.15 Nonconforming Materials, Parts, or Components

The initial application should describe the measures established to control materials, parts, or components that do not conform to requirements in order to prevent their inadvertent use or installation. Describe

measures that provide for identification, documentation, segregation, disposition, and notification to affected organizations, as appropriate. The application should describe measures to ensure that nonconforming items are reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures. Also describe measures that control further processing, delivery, or installation pending proper disposition of the deficiency.

The application should describe measures established by the applicant (1) for contractors to report to him those nonconformances concerning departures from procurement requirements that are dispositioned "use as is" or "repair" and (2) to make such nonconformance reports part of the documentation required at the plant site or to include a description of the nonconformance and its disposition on certificates of conformance that are provided to the plant prior to installation or use of material or equipment at the plant. The application should state whether periodic analyses of nonconformance reports are performed to show quality trends and whether such analyses are forwarded to management.

12.1.16 Corrective Action

The initial application should describe the measures to ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. The application should describe how, in the event of significant conditions adverse to quality, the cause(s) of the condition is determined, corrective action is taken to preclude repetition, and the problem with its determined cause(s) and corrective action is documented and reported to appropriate levels of management.

12.1.17 Quality Assurance Records

The initial application should describe the measures to ensure that sufficient records are maintained for furnishing evidence of activities affecting quality. Describe how the content of such records (1) includes at a minimum the following: test logs, results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses; and such data as qualifications of personnel, procedures, and equipment; (2) identifies the type of operation, the inspector or data recorder, the results, the acceptability, and action taken in connection with any deficiencies noted; and (3) provides sufficient information to permit identification of the record with the item(s) or activity to which it applies.

The application should also describe the system to ensure that records will be identifiable and retrievable. The initial application should describe the measures that establish requirements, consistent with regulatory requirements and responsibilities, concerning record submittal and retention, security, and storage facilities for protecting

records from destruction by fire, flooding, tornadoes, insects, and rodents and from deterioration by extremes in temperature and humidity.

12.1.18 Audits

The initial application should describe the program of the applicant and of his principal contractors for conducting comprehensive planned and periodic audits to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program.

The application should describe the program features that cover the functions listed below and should identify the positions or organizations which perform these functions.

1. External audits to be performed by the applicant and his principal contractors on their respective suppliers.
2. Internal audits to be performed by the applicant and his principal contractors within their respective organizations.
3. The planning and scheduling of audits to ensure that they are regularly scheduled on the basis of the status and safety importance of the activities being performed and are initiated early enough to ensure effective quality assurance during design, procurement, manufacturing, construction and installation, inspection, and test.
4. Conduct of audits in accordance with written procedures or check lists by appropriately trained and qualified personnel not having direct responsibility in the area being audited.
5. Documentation of audit results with review by management responsible for the area audited and, where indicated, followup action taken, including re-audit of deficient areas.

12.2 Quality Assurance During the Operation Phase

The completed license applications should describe the QA program that will ensure the quality of all safety-related items and activities during the operations phase. These activities include plant operation, maintenance, repair, inservice inspection, modifications, testing, and inspections under the materials license. The description of the QA program in the completed application should include the applicable information requirements outlined in Section 12.1, except those activities applicable only to the construction phase.

All employee positions and groups responsible for defining the content and changes to the QA program should be identified. The completed application should describe the advance planning for the management of technical and QA interfaces between the constructor, architect-engineer,

and applicant during the phaseout of design and construction and during preoperational testing and plant turnover. The completed application should also describe the program for the transfer and control of QA-related activities and records from the principal contractors to the applicant during the preoperational testing phase up to "hot" operation. This description should include:

1. Identification of those significant QA-related activities for which the applicant will assume responsibility,
2. The means of tagging and identifying structures, systems, and components in a manner that ensures continuity of indicators of the status of inspections and tests, and
3. The procedures established to ensure the effective transfer, storage, and control of records.

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