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OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 3.8

PREPARATION OF ENVIRONMENTAL REPORTS FOR URANIUM MILLS

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USNRC REGULATORY GUIDES

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This guide was issued after consideration of comments received from the public. 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.

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INTRODUCTION

1. National Environmental Goals

Prior to the issuance of a license authorizing uranium milling activities, the Nuclear Regulatory Commission (NRC) is required to assess the potential environmental effects of the proposed activities in order to ensure that issuance of the license will be consistent with the national environmental goals. In order to obtain information essential for this assessment, the Commission requires each applicant for a license to submit a report on the potential environmental impact of the proposed uranium mill and related activities.

The national environmental goals are expressed by the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 83 Stat. 852), as follows:

"...it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may--

"(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

"(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

"(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

"(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

"(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

"(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

In addition to NEPA, the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974, numerous other pieces of legislation and implementing regulations, both Federal and State, may affect the siting and operation of uranium mills. Some of these laws, such as the Endangered Species Act of 1973, require the NRC to determine acceptability of the mill site and operation. Compliance with other laws such as the Federal Water Pollution Control Act must be merely reported to the NRC.

No attempt is made in this guide to discuss any of these requirements in detail. The applicant should make an independent determination of those statutes and regulations that may affect the proposed mill. Early consultation with the NRC staff is encouraged to determine the applicability of environmental requirements in specific instances.

2. Applicant's Environmental Reports

10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," § 51.40, "Environmental Reports," requires that each applicant for a license authorizing uranium milling submit 15 copies of a separate document, "The Applicant's Environmental Report," with the license application. The applicant must retain an additional 110 copies of the environmental report for distribution to Federal, State, and local officials in accordance with written instructions issued by the NRC's Director of the Office of Nuclear Material Safety and Safeguards. The applicant's environmental reports are important documents of public record. Therefore, the applicant is urged to give full attention to their accuracy and completeness.

The environmental report must discuss the following environmental considerations:

- a. The environmental impact of the proposed action,
- b. Any adverse environmental effects that cannot be avoided should the proposal be implemented,
- c. Alternatives to the proposed action,
- d. The relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and
- e. Any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented.

The discussion of alternatives to the proposed action in the environmental report must be sufficiently complete to aid the Commission in developing and exploring, pursuant to Section 102(2)(D) of the National Environmental Policy Act, "...appropriate alternatives...in any proposal which involves unresolved conflicts concerning alternative uses of available resources."

Under § 51.20, "Applicant's Environmental Report -- Construction Permit Stage," the environmental report must also include a benefit-cost analysis that considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental, economic, technical, and other benefits of the facility. The benefit-cost analysis must, to the fullest extent practicable, quantify the various factors considered. To the extent that such factors cannot be quantified, they must be discussed in qualitative terms. The environmental report should contain sufficient data to aid the Commission in its development of an independent benefit-cost analysis covering the factors specified.

The environmental report must further include a discussion of the status of compliance of the facility with applicable environmental quality standards and requirements that have been imposed by Federal, State, and regional agencies having responsibility for environmental protection. In addition, the environmental impact of the facility should be fully discussed with respect to matters covered by such standards and requirements irrespective of whether a certification from the appropriate authority has been obtained (including, but not limited to, any certification obtained pursuant to Section 401 and any discharge permit obtained pursuant to Section 402 of the Federal Water Pollution Control Act, as amended). While compliance with NRC standards and criteria pertaining to radiological effects will be necessary to meet the licensing requirements of the Atomic Energy Act, the benefit-cost analysis for the purposes of the National Environmental Policy Act must consider the radiological effects together with a broad range of other environmental effects of the facility.

3. Preparation of Environmental Reports

a. Purpose of This Guide

The Commission's regulations in 10 CFR Part 51 provide only general information concerning the content of an applicant's environmental report. This guide has been prepared to provide specific and detailed guidance for the preparation of environmental reports for uranium mills. Where appropriate, similar information should also be provided for support or ancillary facilities (e.g., heap leach and ion exchange facilities) both within and outside the mill site boundary.

The guide identifies information needed by the NRC staff to assess the potential environmental effects of the proposed uranium mill and directly associated mining activities and establishes a format acceptable to the staff for its presentation. Conformance with this standard format, however, is not required. Use of the format of this guide will help ensure the completeness of the information provided, will assist the NRC staff and others in locating the information, and will aid in shortening the time needed for the review process.

The environmental report and the application, as discussed in Regulatory Guide 3.5, "Standard Format and Content of License Applications for Uranium Mills," should be submitted together. These documents provide the basis for the licensing action on the facility.

b. Scope of This Guide

In order to cover a wide variety of anticipated situations, the scope of this guide is comprehensive. In some instances, requests for specific information may not be applicable to a particular mill or site. The applicant should identify those areas where the information requested is not relevant to the particular mill under consideration. If any topics in this guide relate to information not available at the time the report is prepared, the applicant should indicate when the information will be available.

c. Presentation of Information

The applicant should strive for clear, concise presentation of the information provided in the environmental report. Each subject should be treated in sufficient depth and with sufficient documentation* to permit the Commission to evaluate the extent of the environmental impact independent of the applicant's analysis.

When an evaluation of information or data is necessary to show compliance with a regulation, the applicant should clearly state the conclusion of the evaluation and present the analyses and supporting data in sufficient detail to permit an independent reviewer to verify this result. Tables, line drawings, and photographs should be used wherever they contribute to the clarity and brevity of the report. The number of significant figures stated in numerical data should reflect the accuracy of the data. Descriptive and narrative passages should be concise. In cases where test results are needed to support conclusions, test data, procedures, techniques, and equipment used to perform tests should be included.

Pertinent published information relating to the site, the mill, and its surroundings should be referenced. Where published information or assumptions are essential to evaluate specific environmental effects of the proposed activities, they should be included in summary or verbatim form in the environmental report or as an appendix to the report.**

Some of the information that should be included in the environmental report may have already been prepared by the applicant during preparation of the license application for the proposed mill. In such cases, this information (whether in the form of text, tables, or figures) should be incorporated in the environmental report, where appropriate, to provide a complete document.

The site for the mill may also be the site of the mine. If there is a proposed mine adjacent to or in the vicinity of the mill site, the applicant should consider the cumulative or synergistic effects of directly associated mining activities when preparing the environmental report relating to such a mill.

* Documentation as used in this guide means information, supporting data, and statements and includes (1) references to published information, (2) citations from the applicant's experience, and (3) reference to unpublished information developed by the applicant or the applicant's consultants. Statements not supported by documentation should be identified either as information for which documentation is not available or as expressions of belief or judgment.

** The distinction between pertinent and essential hinges on the effect that the information may have in the review of potential impacts to public health and safety and the environment. Useful information that is not likely to impact public health and safety or the environment is pertinent. However, information that may reasonably be necessary for the review to ensure protection of public health and safety and the environment is essential.

CHAPTER 1. PROPOSED ACTIVITIES

This chapter of the environmental report should discuss the proposed project and the activities to be conducted as a result of the project. For example, the applicant should address such matters as ore reserves, ore-body locations, anticipated quantity of ore to be mined and milled, mining methods, plans for overburden storage and disposal, ore transport, milling processes, plans for tailings disposal and management, transport of product, operating plans and schedules, expected longevity of the project, U_3O_8 content of the ore, ore processing rate, concentrate yield, planned end use of the project areas, and surety arrangements for the eventual decommissioning of the mill and reclamation of the areas impacted.

CHAPTER 2. THE SITE

This chapter should present the basic relevant information concerning those physical, biological, human, and social characteristics of the area potentially affected by the proposed project that might be affected by the construction and operation of a uranium milling project and its associated activities in the region. To the extent possible, the information presented should reflect observations and measurements made over periods of time sufficient to allow defensible conclusions to be reached.

2.1 Site Location and Layout

A map should be provided that shows the site and its location with respect to State, county, and other political subdivisions. On detailed maps, show the location of the boundary of the proposed restricted area (10 CFR Part 20); the applicant's property; adjacent properties, including water bodies, wooded areas, and farms; nearby settlements; industrial plants, parks, and other public facilities; and transportation links (railroads, highways, waterways). Indicate total acreage owned or leased by the applicant and that part occupied by or which will be modified for the mine and mill. Indicate other existing and proposed uses of applicant's property and the acreage devoted to these uses.

Describe any plans for site modifications such as a visitors' center. A contour map of the site should also be supplied with elevation contours of an interval suitable to show significant variations of the site environs and drainage gradients. In addition, indicate if the site is in the vicinity of a flood plain. This information should be supplied as separate maps, if required, for clarity.

2.2 Uses of Adjacent Lands and Waters

Indicate, within an 8-km (5-mi) radius, the nature and extent of present and projected land use (e.g., agriculture, livestock raising, dairies, pasturelands, residences, wildlife preserves, sanctuaries, hunting areas, industries, recreation, transportation) and any recent trends such as major or unexpected changes in population or industrial patterns. Note whether any other nuclear fuel cycle facilities are located or are proposed within an 80-km (50-mi) radius of the site.

Provide in tabular form for each of the 22-1/2-degree sectors centered on one of the 16 compass points, i.e., north, north northeast, etc., the distances [to a distance of 8 km (5 mi)] from the center of the site to the following:

1. Nearest cattle (or other meat animals) grazing on natural forage, with types and numbers of animals specified.
2. Nearest game animals consumed by sportsmen.
3. Nearest residence.

4. Nearest site boundary.
5. Nearest vegetable garden larger than 50 m² (60 yd²) in area. The type of crop and amounts produced should be noted.

Where possible, the applicant should provide specific information on actual consumption of the meat from cattle and game animals.

Provide data on annual production and distribution of meat (kg) and truck farming produce (kg) within an 80-km (50-mi) radius from the proposed facility. Provide information on grazing season (months of year) and feeding regimens for cattle. Agricultural production, crop yield, grazing, and feeding data may be obtained from sources such as local, State, and Federal agricultural agencies, agricultural agents, and other reliable sources.

Identify the location, nature, and amounts of present and projected surface and ground-water use (e.g., water supplies, irrigation, reservoirs, recreation, and transportation) within 16 km (10 mi) of the site and the present and projected population (during the active life of the mill) associated with each use point, where appropriate.

Data on both present and projected future water use should be summarized and tabulated; users should be located on maps of legible scale. Tabulations should include:

1. Location: Include symbols shown on maps identifying the location of water users. Provide map coordinates if appropriate.

2. Distance from mill.

3. Withdrawal rate: Provide present and projected withdrawal rate (in liters per second or cubic meters per second) for each water use.

4. Return rates: Provide present and projected return rates (in liters per second or cubic meters per second), if appropriate.

5. Type of water use: Provide type of water use for each location, e.g., municipal, industrial, irrigation, stock/game watering.

6. In addition, for ground-water use: Indicate depth of wells, ground-water elevation, and drawdown rates and characterize the use of each aquifer.

7. Source and projection of water-use estimates: Where use rates are anticipated to change over the life of the project and beyond, indicate projections and the source of the projection information. Sources for such projections may be available from users or planning agencies at different levels of government.

For items 3 and 4 above, if use varies significantly seasonally, indicate monthly values.

Provide data on the annual recreational and commercial fish catch from waters within an 8-km (5-mi) radius of the site. Report the catch by principal

species, location, and amount used for human consumption (note amounts consumed locally).

2.3 Population Distribution

Population data presented should be based on the most recent census data. On a map of suitable scale that identifies places of significant population grouping, such as cities and towns, within an 80-km (50-mi) radius, concentric circles should be drawn with the mill at the center point, at distances of 0.1, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 70.0 and 80.0 kilometers. The circles should be divided into 22-1/2-degree sectors with each sector centered on one of the 16 compass points (with reference to true north, i.e., north-northeast, northeast, etc.). A table (see table in Appendix A) appropriately keyed to the map should provide the current residential population within each area for the expected first year of mill operation and census years through the anticipated life of the mill. The tables should provide separate and cumulative population totals for each sector and annular ring. Distance to the nearest residence should be noted for each sector. The basis for population projections should be described.

Descriptive material should include tables giving the population of neighboring schools, plants, hospitals and residential areas within 8 km (5 mi). Visitor statistics for such areas as sports facilities, residential areas, and parks within 8 km (5 mi) of the project site(s) should also be included.

2.4 Regional Historic, Archeological, Architectural, Scenic, Cultural, and Natural Landmarks

Areas valued for their historic, archeological, architectural, scenic, cultural, or natural significance may be affected. The environmental report should include a brief discussion of the historic, scenic, archeological, architectural, cultural, and natural significance, if any, of the mill site and nearby areas with specific attention to the sites and areas listed in the National Registry of Natural Landmarks and properties included in or eligible for inclusion in the National Register of Historic Places.

The National Registry of Natural Landmarks appears in 37 FR 1496. The National Register of Historic Places is published annually in the Federal Register. General guidance on the treatment of historic, archeological, architectural, and cultural features can be obtained by reference to the Advisory Council on Historic Preservation Regulations, 36 CFR Part 800, "Protection of Historic and Cultural Property," and by consulting the Cultural Programs Division of the nearest regional office of the National Park Service and the relevant State Historic Society or its equivalent.

The applicant should submit a copy of the report on the archeological and historical artifact survey of the proposed site and of any areas to be disturbed by mill related activities. With respect to Indian lands, this survey should be performed with special attention to sacred areas and other special features uncovered from the oral history of the appropriate Indian tribe(s).

The environmental report should identify those properties included in or eligible for inclusion in the National Register of Historic Places located within the area of the project's potential environmental impact. Also, the

applicant should discuss its consultation with the appropriate State Historic Preservation Officer concerning the identification of properties included in or eligible for inclusion in the National Register of Historic Places. The environmental report should contain evidence of this contact with the Historic Preservation Officer for the State involved, including a copy of the Officer's comments concerning the effect of the undertaking on historic, archeological, architectural, and cultural resources.

State whether new roads, pipelines, and utilities connected with the proposed mill will pass through or near any area or location of known historic, scenic, cultural, natural, archeological, or architectural significance.

2.5 Geology and Soils

Describe the major geological and soils aspects of the site and its environs. The discussion should note the stratigraphy, structure, and tectonic history. Comment on regional continuity, faulting, dip, and strikes of water-bearing formations that will be affected. An inventory of economically important minerals and energy-related deposits, in addition to the uranium ore, should be included. Any unique mineralogical or paleontological deposits of particular scientific interest should also be noted. Any effect that planned operations might have on the future availability of other mineral resources should be noted.

Detailed geological data at building sites and in the vicinity of tailings or other effluent impoundments, sanitary landfills, spoil disposal areas, and sewage disposal facilities should be included. These data should include strike and dip and lateral and vertical distribution of permeable layers, shales, and clays, and data on any fault, fracture, or joint pattern that may exist. Locations of local outcroppings where seepage from landfills, dumps, impoundments, and sewage facilities is likely to occur should be noted.

The location of ground water with respect to tailings disposal areas, spoil dumps, liquid impoundments, sanitary landfills, and sewage disposal facilities is important for the assessment of possible ground-water contamination. The discussion should include a statement concerning the hydraulic properties (such as permeability and porosity) of the materials between the ground water and these facilities.

2.6 Seismology

Discuss the seismicity (including history) of the region. Where possible, associate seismic events with tectonic features identified in the geology discussion. Furnish a regional earthquake epicenter map showing site location.

2.7 Hydrology

The effects of mine, mill, and other project facilities construction and operation on adjacent surface and ground waters are of prime importance. The applicant should describe, in quantitative terms, the physical, chemical, biological, radiological and hydrological characteristics, the typical seasonal ranges and averages, and the historical extremes for surface- and ground-water bodies. Information relating to water quality characteristics should include measurements made on or in close proximity to the site.

Information should be presented in sufficient detail to allow an independent staff review of the effects of construction and operation on both resources. Data should be presented in metric units as specified by the U.S. Geological Survey.*

2.7.1 Ground Water

Describe the hydrology of the region that affects the local ground-water aquifers, formations, sources, and sinks. Describe the recharge potential of the immediate plant area, including vertical and horizontal permeabilities of the natural and modified terrain, as well as that of tailing disposal areas. Indicate gradients and seasonal variations in ground-water levels beneath the site. Furnish sufficient site-specific data for the evaluation of the effects of construction and operation of the facility on established ground-water tables and usage. This is especially important for consideration of dewatering operations in associated mines.

Descriptions of the major aquifers in the area should include piezometric contour maps, hydraulic gradients, permeabilities for representative geologic features, total and effective porosities, bulk density estimates, storage coefficients, dispersion and distribution (sorption) coefficients, descriptions of pertinent geologic formations and soil types, including formation depth throughout the site and to the nearest downgradient well or water body, chemical and radiological properties, and time histories of ground-water fluctuations.

The applicant should provide data concerning any drawdown of ground water that may be caused by withdrawals from neighboring major industrial, agricultural, or municipal wells.

2.7.2 Surface Water

Describe the location, size, shape, and other hydrologic characteristics of water bodies in the environs of the site. Surface-water descriptions for receiving streams should include the channel shape, slope, roughness coefficient, sediment concentrations (suspended), flow records (at nearest gauges), and dispersion coefficients; for ponds and lakes the geometry of the bed, wind currents, and suspended solids (sediment) concentration.

Include a description of upstream and downstream river control structures, and provide a topographic map showing the major hydrologic features.

2.8 Meteorology

This section should provide a description of the meteorological diffusion characteristics of the site and its surrounding area. The description should include the use of data collected for at least one annual cycle from an onsite or nearby local meteorological station, plus examination of additional regional meteorological information. Sufficient data should be included to permit

*A. M. Orellana and S. M. Lang, "Conversion Factors: SI Metric and U.S. Customary Units," U.S. Geological Survey, Branch of Distribution, 1200 S. Eads St., Arlington, Virginia 22202.

independent staff evaluation and assessment of atmospheric diffusion characteristics.

The following data concerning site meteorology from meteorological measurements taken onsite and at nearby representative stations should be presented:

1. Quarterly and annual wind rose presentation for the 16 compass directions.
2. Quarterly and annual wind speed, wind direction, and atmospheric stability data in joint frequency form at heights representative of effluent releases.
3. Total precipitation and evaporation by month.

This information should be fully documented as to validity of its representation of expected long-term conditions at and near the site.

Present the joint wind speed-stability-direction frequencies (in item 2 above) in tabular form, giving the frequencies as fractions when using 5-year National Weather Service summaries or as number of occurrences when using only 1 or 2 years of onsite data. The data should be presented for each of the 16 compass directions, and the stability categories should be established to conform as closely as possible with those of Pasquill.* In addition, the annual average inversion height should be provided from other nearby weather stations.

Guidance on acceptable onsite meteorological measurements and data format for nuclear reactors is presented in Regulatory Guide 1.23, "Onsite Meteorological Programs." Staff guidance should be requested for adaptation of relevant portions of this document to the specific mill project. See Appendix A of this regulatory guide for appropriate format for meteorological data.

In addition, this section should provide a discussion of general climatology, the existing levels of air pollution and their effects on site operations, the relationship of the meteorological data gathered on a regional basis to local data, the impact of the local terrain and large lakes and other bodies of water on meteorological conditions in the area, and the occurrence of severe weather in the area and its effects. Data on diurnal and monthly averages and extremes of temperature and humidity should also be provided.

2.9 Ecology

In this section, the applicant should describe the biota (both flora and fauna) in the vicinity of the site, their habitats, and their distribution. This initial inventory should reveal certain organisms which, because of their importance to the community, should be given specific attention. A species is "important" (for the purposes of this guide) if a specific link exists between the facility and the species and if one or more of the following criteria applies: (a) the species is commercially or recreationally valuable, (b) the

*F. Pasquill, "The Estimation of Windborne Material," Meteorological Magazine, Vol. 90, pp. 33-49, 1961.

species is threatened or endangered,* (c) the species affects the well-being of some important species within criteria (a) or (b), or (d) the species is critical to the structure and function of the ecological system or is a biological indicator of radionuclides or chemical pollutants in the environment.

The information should be presented in two separate subsections: "Terrestrial Ecology" and "Aquatic Ecology." The sources of information should be identified. As part of this identification, present a list of pertinent published material dealing with the ecology of the region. Locate and describe any ecological or biological studies of the site or its environs currently in progress.

The initial inventory should establish the identity of the majority of terrestrial and aquatic organisms on or near the site and their relative (qualitative) abundances. The applicant should identify the "important" species from this list and discuss in detail their number and geographic distribution. The discussion should include species that migrate through the area or use it for breeding grounds. Special attention should be given to the relative importance of the site area as compared to the total regional ecosystem (potential or exploited). Any additional inventories should be reserved for those species identified as critical.

The applicant should provide data on the count and distribution of important domestic fauna, in particular, cattle, sheep, and other meat animals that may be included in the biological pathway that ultimately could involve the exposure of humans to radionuclides. Important game animals should receive similar treatment. A description of marketing or consumption patterns for livestock or game should also be submitted, including livestock consumed by families with grazing rights in the mill vicinity and the extent of sales to local or national markets. A map that shows the distribution of the principal flora communities should be provided. These plant communities should be characterized by predominant species, successional stage, percent ground cover and annual yield (in animal unit months or other acceptable units).

The discussion of species-environment relationships should include descriptions of area usage (e.g., habitat, breeding, etc.) for important species; it should include life histories of important regional animals and aquatic organisms, their normal seasonal population fluctuations, and their habitat requirements; and it should include identification of food chains and other interspecies relationships, particularly when these may contribute to predictions or evaluations of the impact of the facility on the regional biota.

Information on the soils of the project area(s) should include soil map(s), details of the physical and chemical characteristics of typical soil profiles with respect to potentially toxic elements and compounds, and land capacity

* In the writing and reviewing of environmental reports, specific consideration should be given to possible impact on any species (or its habitat) that has been determined by the Secretary of the Interior and the Secretary of Commerce to be endangered or threatened with endangerment. New terminology defining "endangered or threatened with endangerment" has been promulgated in Public Law 93-205, 87 Stat. 884.

classification. The site(s) soils should be evaluated with respect to suitability as sources of topsoil materials during the period of interim stabilization and final reclamation.

Identify any definable preexisting environmental stresses from sources such as pollutants, as well as pertinent ecological conditions suggestive of such stresses. The status of ecological succession should be described. Discuss the histories of any infestations, epidemics, or catastrophes that have had a significant impact on regional biota.

2.10 Background Radiological Characteristics

Regional radiological data should be reported, including both natural background radiation levels and results of measurements of concentrations of radioactive materials occurring in important biota, in soil and rocks, in air, and in regional surface and local ground waters. These data, whether determined during the applicant's preoperational surveillance program (see Section 6.1.5) or obtained from other sources, should be referenced.

2.11 Background Nonradiological Characteristics

Regional nonradiological characteristics, particularly those that are similar to expected site-related effluents, should be reported. Data should include such parameters as heavy metals and other potentially toxic substances, atmospheric pollutants, and dusts that could affect water or air quality. Other regional sources of these same materials should be noted along with a discussion of the possible contribution to levels found at the facility site.

2.12 Other Environmental Features

For certain sites, some relevant information on the mill or mine environs may not clearly fall within the scope of the preceding topics. Submission of additional information may be appropriate with respect to some environmental features in order to reflect the value of the site and site environs to important segments of the population. Such information should be included here.

CHAPTER 3. THE MILL AND MINE(S)

The operating mill and any directly associated mine(s) adjacent to or in the vicinity of the mill should be described in this chapter. The mill and mine effluents and related systems that interact with the environment should be described in detail sufficient to allow the reviewer to independently assess the combined environmental effects presented in this chapter of the environmental report.

3.1 Site* Area

A map of the site area should be included; it should clearly show the following:

1. The location of the site boundary.
2. The location and orientation of principal structures within the site area. Principal structures should be identified as to function, e.g., mines, ore crushing structures, chemical separation and storage, ore stock piles, waste rock dumps, tailings disposal areas, retention and settling ponds, explosive magazines, housing areas, administration buildings, yellowcake storage areas, parking lots.
3. The boundary lines of any restricted areas, access to which are to be controlled by fences or other means.
4. A scale that will permit the measurement of distances with reasonable accuracy.
5. True north.

3.2 External Appearance of Mill

The building layout and plant profile should be shown to scale by line drawings or other illustrative techniques. The architectural design and efforts to make the structures and grounds esthetically pleasing should be noted.

3.3 Mill Circuit

The entire mill process or circuit should be quantitatively and qualitatively described in sufficient depth to permit confirmation of the quantities and constituents of all gaseous, liquid, and solid wastes and effluents generated in the process. The following should be included:

1. A flow diagram of the process or circuit.
2. A material balance diagram.

* Site means the contiguous real estate on which the mine and mill are located.

3. Description of any water recycle systems.
4. Water balance diagram for the entire mining/milling project.

3.4 Sources of Mill Wastes and Effluents

Clearly identify the location of release points for all gaseous (include stack heights), liquid, and solid wastes and effluents, including bulk storage locations, i.e., piles of ore or tailings or overburden dumps. Specify quantities, concentrations, and physical, chemical, and radiological characteristics of all materials released. Average and maximum release rates should be included plus all pertinent supporting information such as assumptions and computational methods used. The quantities and concentrations of radioactive and nonradioactive materials that will be released into the environs should be compared with State and other applicable standards.

Suggested formats for supplying this material on radioactive emissions are included as Appendix B of this guide. The tables supplied by the applicant should not be limited to the examples listed, however.

3.5 Controls of Mill Wastes and Effluents

Provide a description of mill waste and effluent control systems and equipment for minimizing to as low as is reasonably achievable the quantities of materials released into the environment. Identify the operating efficiency of such systems and equipment in relation to current best methods for controlling milling wastes and effluents. Also, identify the factors that affect these efficiencies, and describe the operating practices to be pursued during the life of the proposed project.

For waste retention systems, a design analysis of the integrity of the proposed systems should be provided. This should include:

1. Drawings showing the layout in plan, typical cross sections of all embankments showing proposed design and, if applicable, anticipated future extensions, and other pertinent design details. Embankment designs should include information on heights, top width, side slopes, freeboard, seepage control, and protection of embankment surfaces as well as foundation design. See Regulatory Guide 3.11, "Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills."
2. The results of soil tests, geologic exploration, foundation materials stability investigations, as well as characteristics of fill material and a description of the construction methods and specifications.

3.6 Sanitary and Other Mill Waste Systems

Describe any other nonradioactive solid or liquid waste materials, such as sanitary, laundry, and chemical laboratory wastes that may be generated during operation. Describe the manner in which they will be treated and controlled, and describe procedures for disposal.

Means for control and treatment of all systems subject to effluent limitation guidelines and standards of performance under the Federal Water Pollution Control Act (FWPCA) should be described.

The applicant should (a) describe any other airborne effluents (e.g., from diesel engines, gas turbines, heating plants, incinerators) created during project operation, (b) estimate the frequency of release and describe how they will be treated before release to the environment, and (c) estimate the total quantity of pollutants to be discharged annually.

3.7 Mining Activities

This portion of the report should contain a thorough description of the interrelated mining activities including:

1. Topographical maps showing locations and areas to be mined and haulage and access roads.
2. A description of the mining method(s) to be employed, including any dewatering activities and associated effluents.
3. A description of the method(s) for accumulating and storing wastes in order to minimize esthetic and other effects.
4. Identification and source terms of all sources of effluents associated with mining activities (e.g., radon and particulate emissions, dust from haulage, storage activities), including release rates and concentrations and their physical and chemical characteristics.
5. A description of methods to minimize and control releases of effluents into the environs.
6. Any other information that might be helpful in assessing the environmental effects connected with the mining project.

CHAPTER 4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION, MILL CONSTRUCTION, AND MINE OPENING

The construction of a uranium mill and the opening of related mines will inevitably affect the environment; some of the effects will be adverse and some may be beneficial. Effects are considered adverse (1) if environmental change or stress causes a valuable or otherwise important biotic population or natural resource to be less safe, less healthy, less abundant, less productive, or less esthetically or culturally pleasing; (2) if the change or stress reduces the diversity and variety of individual choice, the standard of living, or the extent of sharing of life's amenities; or (3) if the change or stress tends to lower the quality of renewable resources or to impair the recycling of depletable resources.

In the applicant's discussion of adverse environmental effects, it should be made clear which of these adverse effects are considered unavoidable and subject to later amelioration and which are regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should receive detailed consideration in Section 4.2. In the context of this discussion, "irretrievable commitment of resources" alludes to natural resources and means a permanent impairment of these, e.g., loss of wildlife habitat; destruction of nesting, breeding, or nursing areas; interference with migratory routes; loss of valuable or esthetically treasured natural areas; and use of nonrenewable resources.

4.1 Site Preparation and Construction

The applicant should organize the discussion in terms of the effects of site preparation (including mine opening) and mill construction on both land use and water use. The applicant should consider consequences to both human and wildlife populations and indicate which are unavoidable and irreversible according to the categorization set forth above.

In the land-use discussion, describe how construction activities may disturb the existing terrain and wildlife habitats. Consider the effects of such activities as creating building material supply areas; building temporary or permanent roads, bridges, or service lines; disposing of trash; excavating; and land filling. Provide information bearing on such questions as what is the total number of acres disturbed, at which locations, over what time periods, will there be dust or smoke problems, what type and amount of explosives will be used, where, and how often.

Indicate proximity of human populations and identify undesirable impacts on their environment arising from noise, disruption of stock grazing patterns, inconvenience because of the movement of people, material, machines, including activities associated with any provision of housing, transportation, and educational facilities for workers and their families. Describe any expected changes in accessibility of historical and archeological sites in the region. Discuss measures designed to mitigate or reverse undesirable effects, such as erosion control, dust stabilization, landscape restoration, control of truck traffic, and restoration of affected habitats.

The discussion should also include any effects of site preparation and construction activities whose consequences may be beneficial to the region.

The discussion of water use should describe the impact of site preparation and construction activities on area water sources. Such activities would include mine dewatering, diversion of streams, and placement of fill material in water. The applicant should describe the effects of these activities on fish and wildlife resources, water quality, water supply, downstream use of water, and esthetics, as applicable. Describe measures to control pollution to mitigate undesirable effects and improve habitats.

4.2 Resources Committed

Discuss any irreversible and irretrievable commitments of resources (e.g., commitment of land, consumptive water use, and destruction of biota) that are expected should site preparation and mine opening and mill construction proceed. Such use should be evaluated in terms of its relative and long-term net impacts, as well as its absolute impacts. (See Section 5.6 of this guide for more detailed consideration.)

CHAPTER 5. ENVIRONMENTAL EFFECTS OF MILLS AND MINE OPERATION

This chapter should describe the interaction of the mill and mine (discussed in Chapter 3) and the environment (discussed in Chapter 2) during the operating phase of the project. To the extent possible, material presented in Chapters 2 and 3 does not need to be repeated. Measures planned to reduce any undesirable effects of the total project on the environment should be described in detail.

In the discussion of environmental effects, as in Chapter 4, effects that are considered unavoidable but either inherently temporary or subject to later amelioration should be clearly distinguished from those regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should receive detailed consideration in Section 5.6.

The impacts of operation of the proposed activity should be, to the fullest extent practicable, quantified and systematically presented. In the discussion of each impact, the applicant should make clear whether the supporting evidence is based on theoretical, laboratory, onsite, or field studies undertaken on this or on previous occasions. The source of each impact (the plant subsystem, waste effluent) and the population or resource affected should be made clear in each case. The impacts should be distinguished in terms of their effects on surface water bodies, ground water, air, land, land use, ecological systems, and important plants and animals.

Finally, the applicant should discuss the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity. As used in this guide, "short-term" refers to the operating life of the proposed facility and "long-term" refers to time periods extending beyond this life. The applicant should assess the action for cumulative and projected long-term effects from the point of view that each generation is trustee of the environment for each succeeding generation.

Principal parameters for the assessment of radiological impacts from proposed activities should be presented in the format of Appendix B.

5.1 Radiological Impact on Biota Other Than Humans

In this section the applicant should consider the impact on biota other than humans attributable to the release of radioactive or chemical materials from the facility. The biota to be considered are those species of local flora and local and migratory fauna defined as "important" in Section 2.9. Since the region may contain many important species, the applicant should concentrate any efforts on those important species whose terrestrial and aquatic habitats provide the highest potential for radiation exposure.

5.1.1 Exposure Pathways

The various possible pathways for radiation exposure of the important local flora and local and migratory fauna should be identified and described in textual and flow-chart format. The pathways should include the important

routes of radionuclide translocation (including food chains leading to important species) to organisms or sites.

5.1.2 Effluents in the Environment

In Sections 3.4 and 3.7, the radionuclide and chemical concentrations in the liquid and gaseous effluents discharged from the site are listed. In this section, the applicant should consider how these effluents are quantitatively distributed in the environment. Specifically, estimates should be provided for the concentration (a) in any water sources, (b) on land areas, and (c) on vegetation (on a per unit area basis) in the environs.

If there are other components of the physical environment that may become contaminated and thus result in the exposure of living organisms to radiation, they should be identified and their radioactivity burden estimated. In addition, information concerning any cumulative buildup of radionuclides in the environment should be presented and discussed. A summary of data, assumptions, and models used in determining radioactivity concentrations and burdens should be provided.

From considerations of the exposure pathways and the distribution of radioactivity released into the environs, the applicant should estimate the maximum radionuclide concentrations that may be present in important local flora and local and migratory fauna. Values of bioaccumulation factors used in preparing the estimates should be based on site-specific data if available; otherwise, values from the literature may be used. The applicant should tabulate and reference the values of bioaccumulation factors used in the calculations.

5.2 Radiological Impact on Humans

In this section the applicant should consider the radiological effects of operations and transportation of radioactive materials on human beings. Estimates of the radiological impact on humans via various exposure pathways should be provided.

5.2.1 Exposure Pathways

The various possible pathways for radiation exposure of humans should be identified and described in textual and flow chart format.

Discuss any exposure pathways, if they exist, involving radionuclide accumulation in specific components of the environment.

5.2.2 Liquid Effluents

Estimate the expected annual average concentrations of radioactive nuclides (listed in Sections 3.4 and 3.7) in receiving water at locations where water is consumed or otherwise used by human beings or where it is inhabited by biota of significance to human food chains. Specify the dilution factors used in preparing the estimates and the locations where the dilution factors are applicable. Consideration should be given to the absence of mixing and dilution because of factors such as channeling.

Determine the expected radionuclide concentrations in aquatic and terrestrial organisms significant to human food chains. Use the bioaccumulation factors given in Section 5.1.2 or supply others as necessary.

Using the above information and any other necessary supporting data, calculate the total annual body and significant organ doses (millirems) to individuals in the population (discussed in Section 2.3) from all exposure pathways related to receiving water, i.e., all sources of internal and external exposure. Provide, as an appendix, details of the models and assumptions used in these calculations.

5.2.3 Airborne Effluents

From release rates of airborne radioactivity and meteorological data (Sections 3.4, 3.7, and 2.8), estimate total annual body and significant organ doses (millirems) to individuals exposed at the point of maximum ground-level concentrations offsite, individuals exposed at the site boundary in the direction of the prevailing wind, individuals exposed at the site boundary nearest to the sources of emission, and individuals exposed at the residence expected to receive the highest dose commitments. Assume annual average meteorological conditions. Identify locations of points of release (e.g., stacks, roof vents, tailings ponds and beach areas, and ore storage areas) used in calculations.

Estimate deposition of radioactive materials on food crops and pasture grass and any bioaccumulation in the human food chain. Estimate total annual body doses (millirems) and significant annual doses received by other organs via such potential pathways.

Provide an appendix describing the models used in these calculations.

5.2.4 Direct Radiation

The applicant should provide an estimate of the maximum annual external dose (millirems) that would be received by an individual at the nearest site boundary from direct radiation. Provide an appendix describing the models and assumptions used in these calculations.

5.2.5 Summary of Annual Radiation Doses

The applicant should provide estimates of the maximum annual doses (millirems) that could be received via all pathways by an individual at the site boundary and at the nearest residence.

The applicant should also present a table that summarizes the estimated radiation dose to the regional population (within 80-km) from mill- and mine-related sources using values calculated in previous sections. The tabulation should include (a) the total annual doses (man-rems) to the population (discussed in Section 2.3) from all water-related pathways and (b) the total annual doses (man-rems) to the population attributable to airborne effluents.

5.3 Chemical Impacts on Humans

In this section, the specific concentrations of nonradioactive wastes in effluents at the points of discharge should be compared with natural ambient

concentrations without the discharge and also compared with applicable standards. The projected effects of the effluents for both acute and chronic exposure of human beings (including those resulting from any long-term buildup in soils and sediments and in the biota) should be identified and discussed. Dilution and mixing of discharges into the receiving environs should be discussed in detail, and estimates of concentrations at various relevant distances from the point of discharge should be provided that relate to factors such as dilution, habitations, wells, and water intakes. The effects on humans from changes in terrestrial and aquatic environments from chemicals that contaminate ground water should be included.

5.4 Effects of Sanitary and Other Waste Discharges

Describe and discuss the environmental impact associated with sanitary and other mill waste systems discussed in Section 3.6.

5.5 Other Effects

The applicant should discuss any effects of operation that do not clearly fall under any single topic of Sections 5.1 through 5.4. These may include changes in land and water use at the project site, interaction of the facility with other existing or projected neighboring facilities, effect of ground-water withdrawal on ground-water resources in the vicinity of the mine and mill, effects of construction and operation of roads, transmission corridors, and railroads, effects on fish and wildlife resource usage, effects of changes in surface-water availability on biotic populations, and disposal of solid and liquid wastes other than those already discussed.

5.6 Resources Committed

Any irreversible and irretrievable commitment of resources resulting from mine and mill operation should be discussed. This discussion should include both direct commitments, such as depletion of uranium resources; irreversible environmental losses, such as destruction of wildlife habitat, and consumptive water use.

In this discussion, the applicant should consider resources used from the viewpoints of both relative impacts and long-term net effects. As an example of relative impact assessment, the loss of a few animals of a given species could represent quite different degrees of significance, depending on the total population in the immediate region. Such a loss in the case of a small local population, however, could be less serious if the same species were abundant in neighboring regions. Similarly, land use that precludes other highly desirable land uses should be evaluated in terms of the total amount of such land in the environs. These relative assessments should accordingly include statements expressed in percentage terms (a) in which the amount of expected resource loss is related to the total resource in the immediate region and (b) in which the total resource in the immediate region is related to that resource in surrounding regions. The latter should be specified in terms of areas and distances from the site.

CHAPTER 6. EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

The purpose of this chapter is to describe in detail the means by which the applicant collected the baseline data presented in other chapters and to describe the applicant's plans and programs for monitoring the impacts of the proposed activities on the environment.*

Section 6.1 addresses the measurement of preexisting characteristics of the site and the surrounding region. This program should establish a reference framework for assessing subsequent environmental effects attributable to the proposed activity and for use as baseline reference data at the time of site decommissioning.

The applicant's attention is directed to two considerations pertinent to Section 6.1. First, the term "preexisting" refers to the characteristics of the site prior to any mining-related activities. A given characteristic or parameter may or may not require assessment prior to site disturbance and mill construction, depending on whether that particular characteristic may be altered at these stages. Second, in most instances this guide indicates the specific environmental effects to be evaluated; consequently, the parameters to be measured will be apparent. In some cases, it may be advisable to establish a monitoring program based on the applicant's own identification of potential or possible effects and to provide the underlying rationale for such a program. Accordingly, the applicant should carefully review the plans for measurement of preexisting conditions to ensure that these plans include all factors that must be subsequently monitored as discussed in Section 6.2.

Sampling design, frequency, methods (including calibration and checks with standards), and instrumentation for both collection and analysis should be discussed as applicable.**

In all cases, the applicant should estimate the statistical validity of any proposed sampling program. Information should be provided on instrument accuracy, sensitivity, and (especially for highly automated systems) reliability. Where standard analytical or sampling techniques can be identified, they should be so identified and referenced.

For quantitative descriptions of samples collected within areas and for periods of interest, descriptive statistics should include, unless justifiably omitted, the mean, standard deviation, standard error, and a confidence interval for the mean. In each case, the sample size should be clearly indicated. If diversity indices are used to describe a collection of organisms, the specific diversity indices used should be stated.

* See Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills."

** See Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment."

6.1 Applicant's Preoperational Environmental Programs

The programs for collection of initial or baseline environmental data prior to submittal of the license application should be described in sufficient detail to make it clear that the applicant has established a thorough and comprehensive approach to environmental assessment. The description of these programs should be confined principally to technical descriptions of instrumentation, frequency and duration, technique, and procedures.

Where information from the literature has been used by the applicant, it should be concisely summarized and documented by reference to original data sources. Where the availability of original sources that support important conclusions is limited, the applicant should provide either extensive quotations or references to accessible secondary sources.* In all cases, information derived from published results should be clearly distinguished from information derived from the applicant's field measurements.

6.1.1 Surface Water

If a body of surface water may be affected by the proposed activities, the applicant should describe the programs by which the background condition of the water and the related ecology were determined. If a natural water body has already been subjected to environmental stress from pollutant sources, the nature of this stress and its consequences should be evaluated. The applicant should estimate the potential quality of the affected water body.

6.1.2 Ground Water

In those cases in which the proposed activities may potentially affect quality or quantity of local ground water, the program leading to assessment of potential effects should be described.

6.1.2.1 Physical and Chemical Parameters. The properties and configuration of the local aquifer will have been defined in sufficient detail (in Section 2.7) to permit a reasonable projection of effects of proposed activities on the ground water. Methods for obtaining information on ground-water levels and ground-water quality should be described.

6.1.2.2 Models. Models may be used to predict such effects as changes in ground-water levels, dispersion of contaminants, and eventual transport through aquifers to surface water bodies and downgradient wells. The models should be described and supporting evidence for their reliability and validity presented.

6.1.3 Air

The applicant should describe the program and identify sources for obtaining information on local air quality and local and regional meteorology.

* Any reports of work (e.g., ecological surveys) supported by the applicant that are of significant value in assessing the environmental impact of the facility should be included as appendices or supplements to the environmental report unless these reports are otherwise generally available.

6.1.3.1 Meteorology. The applicant should identify sources of meteorological data used in the atmospheric transport models and reported in Section 2.8. Locations and elevations of observation stations, instrumentation, and frequency and duration of measurements should be specified both for the applicant's measuring activities and for activities of governmental agencies or other organizations on whose information the applicant intends to rely. Guidance for an acceptable meteorological measurement program for nuclear reactors is presented in Regulatory Guide 1.23 (Safety Guide 23), "Onsite Meteorological Programs." See Appendix C for the format for reporting meteorological data. The applicant's description should show the basis for predicting such effects as the dispersion of airborne effluents and should present the methodology for gathering baseline data.

6.1.3.2 Models. Any models used by the applicant, either to derive estimates of basic meteorological information or to estimate the effects of effluents, should be described in detail and their validity and accuracy discussed. Staff guidance should be sought in adapting existing guidance to the particular effluents from uranium mines and mills.*

6.1.4 Land

Data collection and evaluation programs concerning the terrestrial environment of the proposed mill should be described and justified with regard to both scope and methodology.

6.1.4.1 Geology and Soils. Those geological and soil studies designed to determine the environmental impact of the construction or operation of the mine/mill should be described. The description should include identification of the sampling pattern and the justification for its selection, the sampling method, holding periods, preanalysis treatment, and analytic techniques. Other geological and soil studies (e.g., those conducted in support of safety analyses) should be briefly summarized and reference made to the relevant reports for a more detailed presentation.

6.1.4.2 Land Use and Demographic Surveys. The applicant should describe its program for identifying the actual land use in the site environs and for acquiring demographic data for the region as reported in Section 2.3.

Sources of information should be identified. Methods used to forecast probable changes in land use and demographic trends should be described.

6.1.4.3 Ecological Parameters. In this section, the applicant should discuss the program used to assess the ecological characteristics of the site, with primary reference to important biota identified in Section 2.9.

* For example, see Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

6.1.5 Radiological Surveys*

This section of the environmental report should discuss the methods used to determine the preoperational radiation levels at the site and environs and the concentrations of radionuclides in important local and regional biota, soil, sediment, vegetation, air, and surface and ground waters.

6.2 Applicant's Proposed Operational Monitoring Programs

The applicant should present the proposed operational monitoring program for planned operations. Review of this description will be facilitated if the applicant includes maps of proposed observation sites and tabular presentation of summary descriptors of such factors as sample collection and analysis frequency, type of sampling, method of collection, analytic method, preanalysis treatment, instrumentation, and minimum sensitivities. The discussion should include the justification for the choice of sampling sites, analyses, and sampling frequencies. The program description should be explicit with respect to the parameter limits that are not to be exceeded under normal operating conditions and with regard to the actions planned in the event the limits are exceeded.

6.2.1 Radiological Monitoring*

The applicant's operational monitoring program for radiological effects should be described both for the mine and mill effluent monitoring program and for the environmental monitoring program.

6.2.1.1 Mill Effluent Monitoring. Describe the proposed effluent monitoring program for liquid and airborne effluents. Discuss the sensitivity limits for detecting radioactivity corresponding to routinely expected release rates. List the effluent streams, if any, that will not be monitored and provide a brief rationale for the absence of monitoring. Also, provide criteria for setting threshold levels for corrective action and describe the actions to be taken if these levels are exceeded.

6.2.1.2 Environmental Radiological Monitoring. The operational monitoring program should be described in detail, with specific attention given to the organisms and other types of samples to be collected, sampling locations and frequency, the analyses to be performed on each sample, the analytical sensitivity (detection threshold) for each analysis, and the criteria for investigating increases of concentration of material detected in the environs.

6.2.2 Chemical Effluent Monitoring

The proposed measurement program, including instrumentation, locations, frequencies, and analytical techniques, should be fully described. The description of the program should include instrumentation sensitivity and reliability. Monitoring procedures prescribed by local, State, or Federal agencies as conditions placed on operation should be so identified.

* Regulatory Guide 4.14 should be reviewed in connection with this section.

The criteria for setting threshold levels for corrective action should be presented. In the case of prescribed quantitative standards set by agencies, the applicable regulation should be cited. In the case of quantitative limits set by the applicant to conform to qualitative standards or restrictions, the applicant's rationale should be presented. In either case, if measurements exceed thresholds, the action to be taken should be specified.

6.2.3 Meteorological Monitoring

The applicant's program for monitoring meteorological phenomena should be described.

6.2.4 Ecological Monitoring

In the preoperational surveillance program, the applicant will have established methodology for determining the ecological characteristics of the region. The applicant should describe any additional ecological monitoring to be conducted during plant operation.

6.3 Related Environmental Measurement and Monitoring Programs

When the applicant's site lies within a region for which environmental measurement or monitoring programs are carried out by public agencies or other agencies or groups not directly supported by the applicant, any such related programs known to the applicant should be identified and discussed. Relevance of such independent findings to the proposed facility's effects should be described, and plans for exchange of information, if any, should be presented. Agencies responsible for the programs should be identified, and, to the extent possible, the procedures and methodology employed should be briefly described.

CHAPTER 7. ENVIRONMENTAL EFFECTS OF ACCIDENTS

The applicant should discuss the environmental effects of possible accidents that may occur at the mill and during transportation of materials to and from the mill, whether or not those accidents may produce an impact on the site or its environs. Analyses should be based on relevant experience and statistics from operation of similar milling and transportation operations. The statistical validity of the data should be discussed as well as the rationale for applying the data to the applicant's proposed operation. Accidents caused by both humans and natural phenomena should be addressed.

7.1 Mill Accidents Involving Radioactivity

The applicant should provide accident analyses for a spectrum of accidents that might occur ranging in severity from trivial (essentially no release of radioactivity to the environment) to very large releases. Each class within the spectrum should be characterized by an occurrence rate or probability and its potential consequences, if any. Examples of accidents resulting in large releases would be a tornado striking the mill or the failure of a waste retention system resulting from an act of nature or improper operation. Examples of accidents resulting in small releases would be a fire or explosion in a solvent extraction circuit or failure of the air cleaning system serving the yellowcake area during operation. An example of a trivial accident would be the malfunction of mill process equipment or the rupture of a vessel containing mill solutions.

7.2 Transportation Accidents

The potential environmental effects from transportation accidents involving radioactive and other hazardous materials should be evaluated. Even though the probability of such an accident may be low and its consequences small, the applicant should identify the environmental effects that might result. Adequate documentation should be presented to provide assurance that all safety requirements will be met prior to transportation of hazardous materials (e.g., spillage of hazardous chemicals, ores, fuels, yellow cake, sulfuric acid).

7.3 Other Accidents

In addition to accidents that can release radioactivity to the environs, there may be accidents that, although radioactive materials are not involved, do have consequences that affect the environment. Such accidents as chemical explosions or fires, steam boiler failures, and leakage or rupture of vessels containing toxic materials can have significant environmental impacts. These possible accidents and associated effects should be identified and evaluated.

CHAPTER 8. ECONOMIC AND SOCIAL EFFECTS OF MILL CONSTRUCTION AND OPERATION

The purpose of this chapter is to provide guidance on the information needed to assess the economic and social effects of the proposed facility. There are, of course, limitations on the extent to which all the social and economic benefits and costs of a uranium milling project can be evaluated. The wide variety of benefits and costs are not only difficult to assess, but many are not amenable to quantification or even to estimation in comparable units. Some primary benefits such as the quantity of uranium recovered are, to a degree, measurable as are the capital costs and operating and maintenance costs of the proposed facility. On the other hand, numerous environmental costs and their economic and social consequences are not readily quantified.

8.1 Benefits

The primary benefits of the proposed nuclear facility are those inherent in the value of the uranium to be recovered and the kilowatt-hours of electricity that may be produced from it.

There are other social and economic benefits that affect various political jurisdictions or interests to a greater or lesser degree. Some of these reflect transfer payments or other values that may partially, if not fully, compensate for certain services as well as external or environmental costs, and this fact should be reflected in the designation of the benefit. The following are some examples:

- Tax revenues to be received by local, State, and Federal governments.
- Temporary and permanent new jobs created and payroll (value-added concept).
- Incremental increase in regional product.
- Enhancement of recreational values.
- Environmental enhancement in support of the propagation or protection of wildlife and the improvement of wildlife habitats.
- Creation and improvement of local roads, waterways, or other transportation facilities.
- Increased knowledge of the environment as a consequence of ecological research and environmental monitoring activities associated with plant operation and technological improvements from the applicant's research program.

The applicant should discuss significant benefits that may be realized from the construction and operation of the proposed mill. Where the benefits can be expressed in monetary terms, they should be discounted to present value. In each instance where a particular benefit is discussed, the applicant should

indicate, to the extent practical, who is likely to be affected and for how long. In the case of esthetic impacts that are difficult to quantify, the applicant should provide pictorial drawings of structures or environmental modifications visible to the public (refer to Section 3.2).

8.2 Costs

The economic and social costs resulting from the proposed nuclear facility and its milling project are also complex and should be appraised.

The primary internal costs are (1) the capital costs of land acquisition and improvement, (2) the capital costs of facility construction, (3) other operating and maintenance costs, including license fees and taxes, (4) plant decommissioning, tailings stabilization, and site reclamation costs, and (5) research and development costs associated with potential future improvements of the mill and its operation and maintenance. As in the case of benefits, the applicant should discount these costs to present value.

There are also external costs. Their effects on the interests of people need to be examined. The applicant should supply, as applicable, an evaluation plus supporting data and rationale regarding such external social and economic costs. For each cost, the applicant should describe the probable number and location of the population group adversely affected, the estimated economic and social impact, and any special measures to be taken to alleviate the impact.

Temporary external costs include shortages of housing; inflationary rentals or prices; congestion of local streets and highways; noise and temporary esthetic disturbances; overloading of water supply and sewage treatment facilities; crowding of local schools, hospitals, or other public facilities; overtaxing of community services; and disruption of people's lives or the local community caused by acquisition of land for the proposed site.

Long-term external costs include impairment of recreational values (e.g., reduced availability of desired species of wildlife and sport animals, restrictions on access to land or water areas preferred for recreational use); deterioration of esthetic and scenic values; restrictions on access to areas of scenic, historic, or cultural interest; degradation of areas having historic, cultural, natural, or archeological value; removal of land from present or contemplated alternative uses; reduction of regional products because of displacement of persons from the land proposed for the site; lost income from recreation or tourism that may be impaired by environmental disturbances; lost income attributable to environmental degradation; decrease in real estate values in areas adjacent to the proposed facility; increased costs to local governments for the services required by the permanently employed workers and their families. In discussing the costs, the applicant should indicate, to the extent practical, who is likely to be affected and for how long.

CHAPTER 9. DECOMMISSIONING AND RECLAMATION

The applicant should describe in depth its plans for mill decommissioning and site reclamation.

Detailed discussions should be provided for the following:

1. Plans for reclaiming and restoring lands disturbed by mining and milling activities. These plans should provide sufficient details for the staff to assess the suitability of these plans when compared to other alternatives (e.g., horizontal-vertical slope, type of cover, sources and thicknesses of cover materials, revegetation species, schedule of events from shutdown through final reclamation).
2. A technical and financial feasibility assessment on methods and costs of mill decommissioning and site reclamation, including tailings area.
3. Financial arrangements to be made (such as bonding arrangements) to ensure that adequate funds will be available for mill decommissioning, site reclamation, and restoration when operations are concluded.

CHAPTER 10. ALTERNATIVES TO THE PROPOSED ACTION

In this chapter of the environmental report, the applicant's choice of a particular mill at a particular site and the location of project structures on the site should be supported through a comparative evaluation of available alternatives. To the extent possible, the applicant should discuss all parameters for the available alternatives. The NRC will consider all available alternatives that may reduce or avoid adverse environmental, social, and economic effects expected to result from construction and operation of the proposed milling and mining project. The NRC will not specify in advance which alternatives should be selected by the applicant for consideration. The applicant should make this selection and also make clear the basis and rationale for the choices in regard to number, availability, suitability, and factors limiting the range of alternatives that might avoid some or all of the environmental effects previously identified. Particular attention should be placed on the relationship between tailings management alternatives and mill site and process alternatives.

In the discussion of tailings management alternatives, consideration should be given to the following siting, design, and operation performance objectives developed by the staff in addition to the technical criteria listed in Chapter 9:

1. Locate the tailings isolation area remote from people to reduce population exposures to the maximum extent reasonably achievable.*
2. Locate the tailings isolation area so that disruption and dispersion by natural forces is eliminated or reduced to the maximum extent reasonably achievable. See the EPA reference in the footnote below for additional guidance.
3. Design the isolation area so that seepage of toxic materials into the ground-water system would be eliminated or reduced to the maximum extent reasonably achievable.
4. Eliminate the blowing of tailings to unrestricted areas during normal operating conditions and prior to final reclamation.

* See Environmental Protection Agency, "Criteria for Radioactive Waste," November 15, 1978, Federal Register (Part IX, 6560-01-M), Vol. 43, No. 221, p. 53267: Issue No. 5, Location and Waste Isolation.

CHAPTER 11. BENEFIT-COST ANALYSIS

In this chapter the applicant's benefit-cost statement should be presented. The presentation should be made in the form of a narrative with accompanying tables and charts. It should make clear what the applicant considers to be the important benefits and costs of the proposed facility and why, in the judgment of the applicant, the former outweigh the latter.

The applicant should develop criteria for assessing and comparing benefits and costs where these are expressed in nonmonetary or qualitative terms. The rationales for the selection among mill-site alternatives, as well as among subsystem alternatives, should be presented. In any case, the applicant should carefully describe any aggregation of effects and discuss in detail the trade-offs that were made in order to justify the proposed operation. If any of the benefits or costs are deleted from the applicant's analysis, the rationale for doing so should be explained. The applicant should key all the terms used in the benefit-cost analysis to the relevant sections of the environmental report.

CHAPTER 12. ENVIRONMENTAL APPROVALS AND CONSULTATIONS

List all licenses, permits, and other approvals of construction and operations required by Federal, State, local, and regional authorities authorized to develop and enforce relevant standards for the protection of the environment.* List those Federal and State approvals that have already been received and indicate the status of matters regarding approvals yet to be obtained. For general background, submit similar information regarding approvals, licenses, and contacts with local authorities including any affected Indian tribes.

Discuss the status of efforts to obtain a water quality certification under Section 401 and discharge permits under Section 402 of the Federal Water Pollution Control Act, as amended. If not already obtained, indicate when certification is expected. If certification is not required, explain.

In view of the effects of the plant on the economic development of the region in which it is located, the applicant should also note the State, local, and regional planning authorities contacted or consulted. Office of Management and Budget Circular A-95** identifies the State, metropolitan, and regional clearinghouse that should be contacted, as appropriate.

Cite meetings held with any Federal, State, or local agency or Indian tribe authorized to develop or enforce relevant environmental standards. Also include any meetings or contacts with environmental and other citizen groups and Indian tribes and cite specific instances of the applicant's compliance with or rejection of the recommendations of these groups. Citation should also be given of efforts to locate such agencies or groups and to inform them of the possibilities and procedures for participating further in the environmental review process.

* This list should be updated semiannually until final licensing action is taken by the NRC.

** Inquiries concerning this circular may be addressed to the Office of Management and Budget, Washington, D.C. 20503.

CHAPTER 13. REFERENCES

The applicant should provide a bibliography of all sources used in preparation of the environmental report. References cited should be keyed to the specific sections and page numbers to which they apply.

APPENDIX A

POPULATION DISTRIBUTION DATA

The population distribution should be given in the following manner:

- Sectors are marked off by the sixteen compass directions and radial distances along the compass directions up to 80 km (50 miles).
- The distances (km) should be broken up as indicated on the following page.

POPULATION DISTRIBUTION

COMPASS DIRECTIONS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1.0 - 2.0	0.0	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5	225.0	247.5	270.0	292.5	315.0	337.5
2.0 - 3.0																
3.0 - 4.0																
4.0 - 5.0																
5.0 - 10.0																
10.0 - 20.0																
20.0 - 30.0																
30.0 - 40.0																
40.0 - 50.0																
50.0 - 60.0																
60.0 - 70.0																
70.0 - 80.0																

APPENDIX B

PRINCIPAL PARAMETERS FOR RADIOLOGICAL ASSESSMENT

<u>Parameter</u>	<u>Value</u>
Ore quality, U ₃ O ₈	_____ %
Ore activity, U-238, U-234, Th-230, Ra-226, and Pb-210	_____ pCi/g
Operating days per year (plant factor)	_____ days
Ore process rate	_____ tonnes/yr
Mill water throughput	_____ m ³ /yr
Annual average morning mixing height	_____ m
Annual average afternoon mixing height	_____ m
<u>Ore Handling and Storage</u>	
Estimated capacity of ore per delivery	_____ MT
Number of deliveries	_____ per day/ per week
Estimated ore dust released in delivery	_____ kg/hr or MT/yr
Average grade of ore and ranges	_____ %
Capacity of ore pad: final year of operation	_____ MT
average during operation	_____ MT
Maximum area of ore pad and height of ore storage pile	_____ m ² , m
Approximate amount of ore handled per day i.e., unloaded, loaded, bulldozed, etc.	_____ MT/day
Operation time of front-end loaders, hoppers, feeders, and other ore pad equipment	_____ hr/day
Estimated amount of fugitive ore dust emission from handling of ore on ore pad	_____ MT/yr

Estimated U₃O₈ dust released to atmosphere

Drying _____ MT/yr
Packaging _____ MT/yr

Stack height(s)

Drying _____ m
Packaging _____ m

Recovery rate of U₃O₈

_____ %

Yellowcake yield

_____ tonnes/yr

Yellowcake quality, U₃O₈

_____ %

Heap Leach Piles(if applicable)

Dimensions (height, width, length)

_____ m, m, m

Volume

_____ m³

Capacity

_____ MT

Pile activity for U-238, Th-230, Ra-226,
and Pb-210

_____ pCi/g

Fugitive dust emissions

_____ MT/yr

Control efficiencies for dusting

_____ %

Solid and Liquid Disposal Impoundments
(Tailings, evaporation, and settling ponds)

Area, volume, capacity of sand tailings

_____ km², m³, MT

Area, volume, capacity of slime tailings

_____ km², m³, MT

Area, volume, capacity of submerged tailings

_____ km², m³, MT

If different grades of ore are used or if a
time-dependent scenario is planned, indicate
the following for each change:

Area, volume, capacity of sand tailings

_____ km², m³, MT

Area, volume, capacity of slime tailings

_____ km², m³, MT

Area, volume, capacity of submerged tailings

_____ km², m³, MT

Operating time for impoundment area

Attach graph and tables

Fraction of U-238, Th-230, Ra-226, Pb-210
to tailings for each particular ore grade,
if applicable

_____ %

Tailings density _____ g/cm³

Drying time prior to reclamation _____ yrs

Efficiency of controls for fugitive dusting
(wetting, chemical, etc.) _____ %

Activity, U, Ra-226, Th-230, and
Pb-210 in slimes _____ pCi/g

Activity, U, Ra-226, Th-230, and
Pb-210 in sand _____ pCi/g

Activity, U, Ra-226, Th-230, and
Pb-210 in solution _____ pCi/l

Total tailings area _____ m²

Tailings pond (solution) area _____ m²

Tailings solids area _____ m²

Tailings impoundment depth _____ m

Seepage rate from tailings impoundment _____ gpm

Land Use and Grazing of Cattle

Fraction of year spent grazing locally _____ %

Fraction of feed that is pasture graze
while grazing _____ %

Fraction of stored feed that is grown locally _____ %

Acreage required to graze one animal unit
(450 kg) for one month (AUM) _____ ha

Length of growing season _____ months/yr

Fraction of local consumption of locally
produced:

 vegetables _____ %

 meat _____ %

 milk _____ %

Locations of Sources and Receptors

All locations should be given in terms of:
 x kilometers east of the yellowcake dryer stack
 y kilometers north of the yellowcake dryer stack
 z meters elevation from the base of the yellowcake dryer stack
 (Denote locations to the south and/or west by a negative value.)

EXAMPLE:

Sources	(km) east	(km) north	(m) elevation
1. Yellowcake dryer	0	0	--
2. Grinder(s)	--	--	--
3. Crushers	--	--	--
4. Rod mill	--	--	--
5. Ore pad	--	--	--
6. Fine ore blending	--	--	--
7. Tailings pond no. 1 (midpoint)	--	--	--
8. Tailings pond no. 2 (midpoint)	--	--	--
9. Heap leach pile	--	--	--
10. Other sources (stacks, vents, etc.)	--	--	--
<u>Extra Receptors</u>			
1. Nearest resident	--	--	--
2. Nearest resident in prevailing wind direction	--	--	--
3. Ranch	--	--	--
4. Farm	--	--	--
5. Orchard	--	--	--
6. Grazing location 1	--	--	--
7. Grazing location 2	--	--	--
4. Garden	--	--	--
5. Ranger bunk house	--	--	--
6. Mine camp	--	--	--
7. Town 1	--	--	--
8. Town 2	--	--	--
9. City 1	--	--	--
10. Other nearby residents (industrial or recreational facilities)	--	--	--
11. Restricted area boundaries (N, S, E, W, NE, SW, SE, NW)	--	--	--

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APPENDIX C

METEOROLOGICAL DATA

Annual Joint Relative Frequency Distributions of Wind Direction and Wind Speed by Atmospheric Stability Class

Wind Direction is given in the 16 compass directions.

Wind Speed is given in knots in the indicated classes:

0-3, 4-6, 7-10, 11-16, 17-21, >21

Atmospheric Stability is given in the following manner:

- A - Extremely unstable
- B - Moderately unstable
- C - Slightly unstable
- D - Neutral
- E - Moderately stable
- F - Very stable

The following table should be prepared for each of these stability classes.

STABILITY CLASS

Windspeed Class (knots)

OVER 21

17 - 21

11 - 16

7 - 10

4 - 6

0 - 3

Wind Direction

N

NNE

NE

ENE

E

ESE

SE

SSE

S

SSW

SW

WSW

W

WNW

NW

NNW