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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

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STANDARD FORMAT AND CONTENT OF LICENSE APPLICATIONS, INCLUDING ENVIRONMENTAL REPORTS, FOR IN SITU URANIUM SOLUTION MINING

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INTRODUCTION

A Nuclear Regulatory Commission (NRC) source and byproduct material license is required under the provisions of Title 10, Code of Federal Regulations, Part 40, "Domestic Licensing of Source Material," to recover uranium by in situ solution mining techniques (in situ leaching). An applicant for a research and development or commercial-scale license or for the renewal or amendment of an existing license is required to provide detailed information on the facilities, equipment, and procedures to be used and an environmental report that discusses the operation's impact on the health and safety of the public and on the environment. This information is used by the Commission to determine whether the applicant's proposed activities will, among other things, result in undue risk to the health and safety of the public or adversely affect the environment. General guidance for filing an application and an environmental report is provided in § 40.31, "Applications for Specific Licenses," of 10 CFR Part 40 and in 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," respectively. The purpose of this guide is to provide specific guidance on the format* and content of an application, including an environmental report, for an in situ uranium solution mining facility license. Applications for licenses authorizing research and development studies are treated in a similar but less comprehensive manner than commercial-scale operations since such activities are not considered to be major Federal actions.

This guide is intended to provide instructive guidance. It should not be considered as a substitute for a careful evaluation of a program proposed by an applicant. Information not specifically discussed in this guide should be included in the application if it is a part of an applicant's proposed or existing operations or health and safety or environmental protection program. In some cases, information discussed in this guide may not be appropriate or necessary depending on site-specific characteristics and circumstances. In those cases, an applicant should describe why the information is not necessary or appropriate. An incomplete application will result in processing delay and may result in the rejection of a license application.

Changes to existing licensed activities and conditions require the issuance of an appropriate license amendment. An application for such an amendment should describe the proposed changes in detail and should discuss the potential environmental and health and safety impacts, using the appropriate sections of this document for guidance.

Filing an Application

The National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852), implemented by Executive Order 11514 and the Council on Environmental Quality

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* In cases where an applicant is also required to file an application with the licensing or permitting agency of a non-Agreement State, the applicant should consult with the NRC and the State agency prior to preparing the application so that a format agreeable to both agencies can be developed. This will provide the applicant with an opportunity to prepare a single application document and/or environmental report that would satisfy both State and Federal agencies.

regulations of July 30, 1979 (44 FR 55978), requires all agencies of the Federal Government to prepare detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The principal objective of the NEPA is to build into the agency decisionmaking process an appropriate and careful consideration of the environmental impacts of the proposed actions. The NRC licensing and regulatory policies and procedures for the preparation and processing of environmental impact statements and related documents such as environmental impact appraisals in accordance with the NEPA are set forth in 10 CFR Part 51.

The provisions of paragraph 40.31(f) of 10 CFR Part 40 and of 10 CFR Part 51 require the submittal of both a license application (Form NRC-2) and a separate environmental report for certain activities requiring an NRC source and byproduct material license, including in situ uranium solution mining operations. In view of the nature of an in situ uranium solution mining operation, where the major consideration of both an applicant's submittal and the staff's review is the assessment of environmental impacts of the proposed activity, it appears reasonable that an application and environmental report for an in situ uranium solution mining license should consist of a single document (hereinafter referred to as the application) containing the information discussed herein.

An application for a new commercial-scale license should be filed at least 12 months prior to planned construction for the proposed operation. An application for a new research and development license should be filed at least 6 months prior to planned construction for the proposed operation. An application for a renewal of an existing license should be filed at least 30 days prior to the expiration date of the existing license. An application for an amendment to an existing license should be filed with sufficient lead time to permit a detailed assessment by the NRC staff and issuance of the required authorization before the proposed modification is scheduled to be implemented. All applications must be accompanied by a remittance in the full amount of the fee specified in § 170.31 of 10 CFR Part 170, "Fees for Facilities and Materials Licenses and Other Regulatory Services Under the Atomic Energy Act of 1954, As Amended." Applications may be filed with the Director, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, or may be filed in person at the Commission's offices at 1717 H Street NW., Washington, D.C., or 7915 Eastern Avenue, Silver Spring, Maryland.

Section 51.40 of 10 CFR Part 51 requires an applicant for a license authorizing commercial-scale in situ uranium solution mining to submit to the Director of Nuclear Materials Safety and Safeguards 15 copies of the application described above. The applicant is also required to retain an additional 85 copies of the application for distribution to Federal, State, and local authorities in accordance with written instructions issued by the Director of Nuclear Materials Safety and Safeguards. An applicant for a license authorizing research and development in situ uranium solution mining or for amendments or renewals for any in situ uranium solution mining operation should submit 10 copies of the application and/or environmental report to the Director, Office of Nuclear Materials Safety and Safeguards.

In situ uranium solution mining licenses are generally issued for 5-year periods and are renewable over the life of the project. License renewal applications are processed in a manner similar to that used for new applications. Operational experience, site-specific data, and proposed continuing activities are the primary factors considered by the NRC staff in processing renewal applications.

Presentation of Information

The applicant should strive for clear, concise presentation of the information in the license application. Each subject should be treated in sufficient depth and with sufficient documentation* to permit the Commission to independently evaluate the information presented. An evaluation of information or data should clearly state the conclusions of the evaluation and should 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 application. The number of significant figures stated in numerical data should reflect the accuracy of the data. Descriptive and narrative passages should be brief and concise. In cases where test results to support conclusions are presented, the procedures, techniques, and equipment used to obtain the test data should be included.

Information previously submitted to the Commission may be incorporated into the application by reference. Each reference should be clear and specific, i.e., the reference should indicate by document, date, page, and paragraph the information the applicant wishes to reference and how such information is pertinent.

Pertinent published information relating to a proposed site or facility and its surroundings should be referenced. Where published information or assumptions may be essential to evaluate specific aspects of the proposed activities, they should be included in summary or verbatim form or as an appendix to the application.**

An in situ uranium solution mining operation may include one or more ore bodies or well fields in the same general area plus an associated processing plant. An applicant should address all projected activities to the extent

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* Documentation as used in this guide means presentation of information, supporting data, and statements and includes (1) references to published information, (2) citations from the applicant's experience, and (3) references to unpublished information developed by the applicant or the applicant's consultants. Statements not supported by documentation may be acceptable provided the applicant identifies them as such or as expressions of belief or judgment.

** The distinction between pertinent and essential hinges on the effect that the information may have on 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, whereas information that may reasonably be necessary for the review to ensure protection of public health and safety and the environment is essential.

possible over the anticipated lifetime of operations. If the proposed operation is at the site of other licensed uranium recovery activities, an applicant should consider the cumulative or synergistic effects of directly associated activities.

All pages of the application should be numbered and dated. Any changes to the original license application or environmental report made prior to issuance of a source material license should be submitted to the NRC in the form of replacement pages, figures, charts, graphs, or tables. The date of the change should be included on each page of replacement material. The applicant should review the entire application and related documents to eliminate any contradictory statements or proposals that may result from changes to a particular chapter or section.

Contents of an Application

The application should contain the information specified in items 1 through 8 of Form NRC-2. The information required in items 9 through 14 of Form NRC-2 should be incorporated into the various items identified in the chapters of this Standard Format that primarily address processing, in-plant radiation safety, and environmental considerations. Particular attention should be given to the information requested in Chapter 5, "Operations," of this Standard Format. Compliance with the specifications delineated in Chapter 5 is normally made a specific condition of the NRC operating license. The written specifications to be presented in the application in accordance with Chapter 5 (these written specifications are required by paragraph 40.31(h) of 10 CFR Part 40) are related to information in other chapters. Accordingly, Chapter 5 of this Standard Format should be reviewed in connection with other information throughout the total application. The following environmental concerns must also be fully addressed in these chapters:

1. The environmental impact of the proposed action,

2. Any adverse environmental effects that could not be avoided if the proposal were implemented,

3. Alternatives to the proposed action,

4. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

5. Irreversible and irretrievable commitments of resources involved in the proposed action if it were implemented.

1. PROPOSED ACTIVITIES

This chapter of the application should summarize the overall proposed activities for which a license is requested in sufficient detail to permit the reviewer to obtain a basic understanding of the proposed activities and potential environmental impact. Review of the chapters that follow can then be accomplished with a better perspective and with recognition of their relative importance to the overall operations. The following subjects should be addressed: the corporate entities involved; the location of the proposed activities; land ownership; ore-body locations and estimated U_3O_8 content; proposed solution mining method and recovery process; operating plans, design throughput, and anticipated annual U_3O_8 production; estimated schedules for construction, startup, and duration of operation; plans for project waste management and disposal; plans for ground-water-quality restoration, decommissioning, and land reclamation; and surety arrangements covering eventual facility decommissioning, ground-water-quality restoration, and site reclamation. Applications for licenses authorizing commercial-scale operations should rely heavily on results from research and development operations as a basis for the proposed processes, operating plans (including plans for ground-water-quality restoration), and assessment of potential environmental impact.

2. SITE CHARACTERISTICS

This chapter should present the basic relevant information concerning those physical, ecological, demographic, and social characteristics of the environs that might be affected by the proposed operations. To the extent possible, the information presented should reflect observations and measurements made over a sufficient period of time to allow defensible conclusions to be reached.

2.1 Site Location and Layout

Provide a map showing the site and its location with respect to any Federal land and to State, county, and other political subdivisions. On detailed maps, show the location of the proposed in situ uranium solution mining operations; well fields and all principal structures (e.g., waste ponds, evaporation ponds, recovery plant); exclusion area boundaries and fences; applicant's property; adjacent properties, including water bodies, wooded areas, and farms; nearby settlements; and transportation links (e.g., railroads, highways, waterways). Indicate total acreage owned or leased by the applicant and that part occupied or modified by the proposed activity. Also indicate other existing and proposed uses of the applicant's property and the acreage devoted to these uses. A contour map of the site should be supplied with elevation contours of an interval suitable to show significant variations of the site environs and drainage gradients. For clarity, this information should be supplied on separate maps.

2.2 Uses of Adjacent Lands and Waters

Indicate, within a 3.3-km (2-mi) radius [0.8 km (0.5 mi) for research and development operations], the nature and extent of present and projected land use (e.g., agriculture, sanctuaries, hunting, grazing, industry, recreation, roads) and any recent trends of changes in population or industrial patterns. In addition, for commercial-scale operations, identify any other nuclear fuel cycle facilities located or 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 each of the 16 compass points, i.e., north, north-northeast, etc., the distances (to a distance of 3.3 km (2 mi)) from the center of the site to the following:

1. Nearest residence.

2. Nearest site boundary.

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 3.3 km (2 mi) of the site boundary [0.8 km (0.5 mi) for research and development operations] and the present and projected population associated with each use point, where appropriate.

Data on both present and projected future water use(s) 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. Distances from proposed uranium solution mining well fields.

3. Withdrawal Rate: Provide present and projected withdrawal rate for each water use. For ground-water uses, indicate depth of wells, ground-water elevations, flow rates, interval(s) screened, drawdown, and aquifers from which water is withdrawn, and characterize the uses of the aquifers.

4. Return Rates: Provide present and projected return rates if appropriate.

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

6. 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.

7. Abandoned Wells: Furnish a tabulation of all abandoned wells and drill holes giving the location, depth, type of use, condition of closing, plugging procedure used, and date of completion for each well or drill hole within the site area and within 0.4 km (0.25 mi) of the well-field boundary. This information is generally available from public records and from inspection of the area.

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

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 [3.2 km (2 mi) for research and development operations] from the approximate center of projected activities, concentric circles should be drawn, with the site at the center point, at distances of 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km. The circles should be divided into 22-1/2-degree sectors with each sector centered on one of the 16 compass points, i.e., north, north-northeast, northeast, etc. A table appropriately keyed to the map should provide the current residential population within each area and for census years through the anticipated life of the operation. The table 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.

In addition, for commercial-scale operations, descriptive material should include tables giving significant population and visitor statistics of neighboring schools, plants, hospitals, sports facilities, residential areas, parks, etc., within 3.3 km (2 mi) of the solution mining operations. The material should also include appropriate available food production data in kg/yr for

vegetables (by type and totals), meat (all types), and milk and any available future predictions by local governmental, industrial, or institutional organizations within 3.3 km (2 mi) of the site boundary.

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

The application should include a brief discussion of the historic, scenic, archeological, architectural, cultural, and natural significance, if any, of the proposed site and nearby areas with specific attention to the site and nearby 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 the Federal Register (37 FR 1496). The National Register of Historic Places also appears in the Federal Register (44 FR 7416) where additions are published annually. General guidance on the treatment of historic, archeological, architectural, and cultural features can be obtained from the National Park Service publication entitled "Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archeological, Architectural) Resources," August 1973.*

The application should identify those properties included in or eligible for inclusion in the National Register of Historic Places located within the area of the proposed project. The applicant should also consult with the appropriate State Historic Preservation Officer (SHPO) concerning the identification of properties included in or eligible for inclusion in the National Register of Historic Places. The application should contain evidence of contact with the appropriate SHPO. A copy of the SHPO's comments concerning the effect of the facility on historic, archeological, architectural, and cultural resources should be included in the application.

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

2.5 Meteorology

This section should provide a description of the meteorological diffusion characteristics of the site and its surrounding area. The description should be based on data collected on site and/or at nearby local meteorological stations. Sufficient data should be included to permit independent evaluations and assessments of atmospheric diffusion characteristics. Based on past application reviews of research and development operations, detailed meteorological data (other than basic wind speed and direction and precipitation/evaporation data) are not needed.

The following data concerning site meteorology from meteorological measurements taken on site and/or at nearby representative stations should be provided:

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* Copies may be obtained from Chief Historian, Room 1226, National Park Service, 18th and C Streets NW., Washington, D.C. 20240.

1. Joint frequency data

   a. National Weather Service (NWS) station data

      (1) Locations of all NWS stations within an 80-km (50-mi) radius

      (2) Available joint frequency distribution data by wind direction, wind speed, and stability class (3-dimensional numerical array)

      (3) Period of record by month and year

      (4) Height of data measurement

   b. Onsite meteorological data

      (1) Locations and heights of instrumentation

      (2) Description of instrumentation

      (3) Minimum of 1 full year of onsite joint frequency distribution data broken down by wind direction, wind speed, and stability class (3-dimensional array) with a joint data recovery of 90 percent or more

2. Miscellaneous data

   a. Annual average mixing layer heights

   b. Description (general) of regional climatology, particularly including frequencies and durations of extreme wind speeds

3. Total precipitation and evaporation by month

This information should be fully documented and substantiated as being representative of expected long-term conditions at and near the site.

The joint wind speed-stability-direction frequencies should be presented in tabular form, giving the frequencies as fractions when using 5-year NWS summaries or as the 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 is presented in Regulatory Guide 1.23 (Safety Guide 23), "Onsite Meteorological Programs."

In addition, this section should provide a discussion of general climatology, existing levels of air pollution, 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 of temperature and humidity should also be provided.

2.6 Geology and Seismology

A description of the geology of the site and establishment of the continuity of the geologic environs represented in the strata at the site should be included in the application. The discussion should note local and regional stratigraphy, structure, and tectonic history and should include geologic features such as dips, faulting, fracturing, and continuity of geologic strata at the site and in nearby regions. Structural and stratigraphic maps and cross sections, with representative core and geophysical well-log data, of the site and its environs should be included. Also include an isopach map of the intended zone of injection or production and confining beds. Conclusions concerning the geology, particularly the lateral continuity and vertical thickness of the ore zone(s), surrounding lithologic units, and confining zones, should be based on lithologic logs from core and drill cuttings, geophysical data, remote-sensing measurements, and the results of other appropriate investigations that are needed to define the geology. Geologic and geophysical logs and other data should be furnished in an appendix. Proprietary data should be so designated and kept separate from the remainder of the application.

An inventory of economically important minerals and energy-related deposits, in addition to the uranium ore, should be included in the discussion. Data defining the geochemistry of the ore zone and the geologic zones immediately surrounding the ore zone that will or could be affected by injected lixiviant should be included. Unique minerals (including those that might be affected by fluid movement associated with the proposed project such as bentonite) or paleontological deposits of particular scientific interest should also be identified. Any effect that planned operations might have on the future availability of other mineral resources should be noted.

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

2.7 Hydrology

The effects of well construction and well-field operation on adjacent surface and ground waters and the effective control and monitoring of subsurface process fluids 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-water bodies and aquifers associated with the proposed project. Ranges, averages, and extremes should be evaluated to the extent that such characteristics can be distinguished from possible excursions during operations. Water-quality data should include measurements made both at and in close proximity (within 200-400 feet) of the proposed in situ uranium

solution mining areas (well fields). NRC staff Technical Position Paper* WM-8102, "Groundwater Monitoring at Uranium In Situ Solution Mines," should be reviewed in connection with this section. The position paper provides specific guidance for obtaining both surface- and ground-water-quality baseline data.

2.7.1 Ground Water

The hydrology of both regional and local ground-water systems should be described. The description of the ground-water setting should include identification of the average thickness, lateral extent, general flow direction, average yield, and premining water elevation maps of the regional aquifer, the ore zone aquifer, and surrounding aquifers that might be affected.

Within the local ground-water systems, all aquifers that may be affected by the proposed in situ uranium solution mining operations should be identified. The hydrologic properties of the local aquifers, including aquifer thickness, distribution of potentiometric levels, flow gradients, flow directions, flow velocities, directional permeabilities, transmissivities, storage coefficients, and porosities, should be described in detail. Confining beds or other lithologic units separating the ore zone(s) from other aquifers should be described. Vertical permeabilities, horizontal permeabilities, competence, lateral extent, and other data sufficient for evaluation of the confining properties of the beds with respect to preventing excursions should also be defined. A description of soil types and near-surface material, including hydrologic properties, should be presented in sufficient detail to permit evaluations of the effects of surface activities related to the proposed uranium mining operations. Conclusions concerning the hydrologic characteristics of site aquifers and confining beds and soil types should be based on well borings and cores, aquifer pumping tests, laboratory permeability tests, soil surveys, and the results of other appropriate investigations needed to define the hydrology.

Descriptions of local ground-water wells, including well location, uses, amounts used, depth, screened intervals, yield, static water level, and preoperational water quality used, should be presented in the application. The descriptions should be in sufficient detail to fully define the uses and sources of ground water in the project environs.

All project-related wells, including well location, elevation, depth, screened intervals, static water level, and preoperational water quality, should be described in the application.

The preoperational water quality of all aquifers that might be affected by the proposed operations, as well as the changes expected in quality due to the solution mining activities, should be described.

Data and analysis of pumping tests, water-quality measurements, and other tests should be furnished to verify all hydrologic interpretations and conclusions. Methods of testing and analysis should also be described.

*NRC staff technical position papers that are referenced in this Standard Format may be obtained from the Director, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

2.7.2 Surface Water

Describe the location, size, shape, and hydrologic characteristics and uses of surface-water bodies in the environs of the site.

Include a description of upstream and downstream river control structures, and provide a topographic map showing the major hydrologic features. Water-quality analysis and flow rates from U.S. Geological Survey gaging stations in nearby environs should be included.

In the vicinity of evaporation ponds near drainage courses or where surface runoff is rerouted, the drainage areas of the water courses should be delineated. Where an embankment prevents surface runoff from entering or threatening an impoundment, stream cross sections in the impoundment vicinity should be provided to clearly show the vertical and horizontal relationships of the channel and the pond embankments.

2.8 Ecology

In this section, the applicant should describe the flora and fauna in the vicinity of the site, their habitats, and their distribution. This inventory should identify species that may require specific attention because of their importance to the community. A species is important (for the purposes of this guide) if a specific causal link can be identified between the facility and the species and if one or more of the following criteria applies: (1) the species is commercially or recreationally valuable, (2) the species is threatened or endangered,* (3) the species affects the well-being of some important species within criterion (1) or (2), or (4) 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 inventory should establish the identity of the majority of the terrestrial and aquatic organisms on or near the site and their relative (qualitative) abundance. The applicant should identify the important species from this list and should discuss in detail their quantitative abundance. This 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 proposed site environs to the total regional area for the living resources (potential or exploited).

For commercial-scale operations and for research and development operations involving drying of yellowcake, 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 involved in the exposure of man to radionuclides. Important game animals should receive similar treatment. A map showing the distribution of the principal plant communities should be provided.

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* 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 to be endangered or threatened with endangerment by the Secretary of the Interior and the Secretary of Commerce. New terminology defining "endangered or threatened with endangerment" has been issued in Public Law 93-205, 87 Stat. 884.

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

Any definable preexisting environmental stresses from sources such as pollutants, as well as pertinent ecological conditions suggestive of such stresses, should be identified. The status of ecological succession should be described.

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, a list of pertinent published material dealing with the ecology of the region should be presented. All ecological or biological studies of the site or its environs currently in progress or planned should be referenced and described.

2.9 Background Radiological Characteristics

Report site-specific radiological data, including both natural background radiation levels and results of measurements of concentrations of radioactive materials occurring in important biota, in soil, in air, and in surface and ground waters that could be affected by the proposed activities. These data, whether determined during the applicant's preoperational surveillance program or obtained from other sources, should be referenced. NRC staff Technical Position Paper WM-8102 should be reviewed in connection with background (baseline) surface- and ground-water-quality monitoring programs.

2.10 Background Nonradiological Characteristics

Site-specific nonradiological characteristics, particularly those that are related to expected site-related effluents, should be reported. Data should include such indicators as heavy metals and other potentially toxic substances in surface and ground waters, atmospheric pollutants, dusts, etc., that could affect water or air quality. Other regional sources of these same materials should be noted along with a discussion of the possible incremental contribution to the existing levels found at the site. NRC staff Technical Position Paper WM-8102 should be reviewed in connection with background (baseline) surface- and ground-water-quality monitoring programs.

2.11 Other Environmental Features

Some relevant information on the environs may not clearly fall within the scope of the preceding topics. Additional information may be required 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 in this section.

Much of the information from the preceding topics will be used by the NRC to perform an independent assessment of offsite radiological impacts. Detailed

computer assessments are performed for commercial-scale operations. Suggested formats for supplying much of the information necessary for an independent assessment of offsite radiological impacts resulting from the operation of a proposed commercial-scale facility are included as Appendix A to this guide.

3. DESCRIPTION OF PROPOSED FACILITY

The in situ uranium solution mining operation should be described in this chapter. Since environmental effects are of primary concern, the combined effects of mining effluents and related systems that interact with the environment should be described in sufficient detail to permit an independent evaluation by the NRC of the proposed project.

3.1 Solution Mining Process and Equipment

The entire in situ solution mining process should be described in sufficient detail to permit evaluation of all operations and processes involved. This description would include data about the ore bodies, the feasibility of processing defined well-field areas, well construction techniques and integrity testing procedures to ensure that well installations will not result in hydraulic communication between production zones and overlying or underlying aquifers, how wells and ponds will be completed, injection/production rates and pressures, proposed operating plans and schedules, details of the proposed uranium recovery facility and its operation, plant material balances and flow rates, lixiviant makeup and recovery efficiency, and major constituents and their concentrations in the gaseous, liquid, and solid wastes and effluents that will be generated in the process. The following should also be provided:

1. A map or maps showing the proposed sequence and schedules for the in situ uranium solution mining well-field area(s) and well-field ground-water-quality restoration operations,

2. A flow diagram of the process and/or circuit,

3. A material balance diagram,

4. A description of any chemical recycle systems,

5. A water balance diagram for the entire system, and

6. A map or maps showing the proposed sequence and schedules for land reclamation of the well-field areas.

3.2 Recovery Plant Equipment

A physical description and operating characteristics for the proposed major items of process equipment should be provided. A diagram of the proposed plant layout, indicating areas and points where dusts, fumes, or gases would be generated, should be included. The diagram should also show the locations of all ventilation, filtration, confinement, and dust collection systems, as well as the location of the radiation monitoring equipment identified in Chapters 4, "Effluent Control Systems," and 5, "Operations."

3.3 Instrumentation

A description of proposed process instrumentation and control systems relevant to safety and radiation safety sampling and monitoring instrumentation, including their minimum specifications and operating characteristics, should be provided. This includes well-field process control equipment for monitoring injection pressures and rates and production rates. Sufficient information should be included to permit an evaluation of the interrelationship between instrumentation systems and the operations or processes to be controlled or monitored.

4. EFFLUENT CONTROL SYSTEMS

4.1 Gaseous and Airborne Particulates

Provide a description of all proposed ventilation, filtration, and confinement systems that are to be used during operations to control the release of radioactive materials to the atmosphere. Include an analysis of equipment as designed and operated to prevent radiation exposures to employees and to limit such exposures to as low as is reasonably achievable (ALARA). The definition and operating philosophy for ALARA are contained in paragraph 20.1(c) of 10 CFR Part 20 and in Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable." Also include a physical description of discharge stacks, types and estimated composition and flow rates of atmospheric effluents, and proposed methods for controlling such release levels ALARA.

4.2 Liquids and Solids

To the extent that information is not provided in Section 3.1, provide a realistic estimate of the quantities and composition of all waste residues expected, along with proposed procedures for their management. Where retention systems such as ponds are to be used to prevent the release of liquid or solid wastes containing radioactive material, provide the information specified in Regulatory Guide 3.11, "Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills," and describe the type of liner and leak detection system proposed, as well as the quality assurance program to be used for installation of the liner and leak detection system. Also provide descriptions and design details for all temporary and permanent surface-water diversion facilities. NRC staff Technical Position Papers WM-8101, "Design, Installation, and Operation of Natural and Synthetic Liners at Uranium Recovery Facilities"; WM-8201, "Hydrologic Design Criteria for Tailings Retention Systems"; and "Explorations for Design and Evaluation of Uranium Mill Tailings Retention Systems," should be consulted in addition to Regulatory Guide 3.11 to provide design criteria acceptable to the NRC staff. Describe contingency plans to mitigate any environmental impact in the event that leakage occurs from impoundments containing potentially harmful materials. (See § 20.301 of 10 CFR Part 20.)

If effluents are to be released into waters of the United States, provide a discussion of 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, or submit copies of these items if already issued.

4.3 Contaminated Equipment

Provide a description of the methods for disposing of contaminated waste solids (e.g., ion exchange resins, filters, filter presses, obsolete or worn-out equipment) that are generated in the uranium recovery process.*

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*See Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976. Copies may be obtained from the Director, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

5. OPERATIONS

Compliance with the statements, representations, and procedures provided in this chapter will normally be made a specific condition of the NRC source material license. Thus, the sections of this chapter should be considered as specific commitments on the part of the applicant for conducting operations, radiological protection programs, and all monitoring programs. In addition, the bases for all programs addressed in this chapter, as well as the demonstration of their adequacy, should be provided. In order to facilitate administration of the license by the licensee and NRC, this chapter should be complete in itself, insofar as possible, without references to other submittals.* The requirements of 10 CFR Part 20 are an integral part of this chapter. Specific sections of 10 CFR Part 20 are referenced where appropriate.

5.1 Corporate Organization and Administrative Procedures

Provide a detailed description of the applicant's proposed organization, including authority and responsibility of each level of management and supervision with regard to development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and ground-water monitoring programs and associated quality assurance programs, routine and nonroutine maintenance activities, and changes in any of the above.

5.2 Management Control Program

Describe the proposed management control program and administrative procedures to ensure that all activities are conducted in accordance with written operating procedures that will be approved and reviewed at specified frequencies by the applicant's radiation safety staff. This program should provide a method for ensuring that any nonroutine work or maintenance activity not covered by an effective operating procedure will be conducted in accordance with a special work permit reviewed and approved by the applicant's radiation safety staff.

5.3 Management Audit and Inspection Program

Describe the proposed management audit and internal inspection program, including frequencies and types and scopes of reviews and inspections, action levels, and corrective action measures. Identify by management position the person responsible for each phase of the audit and inspection program. Also

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* Draft Regulatory Guides OH 941-4, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable," OH 710-4, "Health Physics Surveys in Uranium Mills," and Regulatory Guide 8.22, "Bioassay at Uranium Mills," should be reviewed in connection with this chapter. Although these guides are for uranium mills, some of the guidance may be applied to solution mining recovery plants since the basic processes and potential for exposing workers to uranium and its daughters in a recovery plant are similar to those of certain milling operations.

provide a detailed description of the program for ensuring that employee exposures (to both airborne and external radiation) and effluent releases are as low as is reasonably achievable (ALARA program). (See paragraph 20.1(c) of 10 CFR Part 20.)

5.4 Qualifications

Provide a description of the minimum qualifications and experience required for personnel holding positions in the applicant's proposed organization who will be assigned the responsibility for developing, conducting, and administering the radiation safety program. Describe in an appendix the qualifications of the persons currently proposed for these positions. (In cases where specific individual appointments may not have been made when an application was filed, minimum specifications will suffice.)

5.5 Training

Provide a description of the proposed employee radiological protection training program, including the content of the initial training or indoctrination, testing, on-the-job training, and extent and frequency of retraining. In an appendix in conformance with § 19.12 of 10 CFR Part 19, provide a copy of the proposed written radiological safety instructions to be provided to employees. These instructions should include provisions for personal hygiene (including washing), for contamination surveying prior to eating or leaving the operating area, for wearing personnel monitoring devices and respirators, for good housekeeping requirements, for cleaning up spills within the site boundary, and for emergency action in the event of accidents.

5.6 Security

Provide a description of the proposed method for preventing unauthorized entry into the controlled area. (See § 20.203 of 10 CFR Part 20.)

5.7 Radiation Safety Controls and Monitoring

Paragraph 20.1(c) of 10 CFR Part 20 states that "... persons engaged in activities under licenses issued by the Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974 should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable." Regulatory Guide 8.10 provides the NRC staff position on this important subject. License applicants should give consideration to the ALARA philosophy, as described in Regulatory Guide 8.10, in the development of plans for work with licensed radioactive materials. The following material should be provided.

5.7.1 Effluent Control Techniques

Describe the proposed systems and procedures designed to minimize in-plant and environmental emissions at each step of the process where releases might occur. Provide the minimum performance specifications such as filtration or scrubber efficiency and airflow for operating the ventilation, filtration, and

confinement systems throughout the recovery plant and associated laboratories at their reasonably expected best performance and the frequency of tests and inspections to ensure that these specifications are being met. Include descriptions of the contingency plans to be implemented in the event of equipment failures or spills.

5.7.2 External Radiation Exposure Monitoring Program

Describe the proposed methods, instrumentation, and equipment for determining exposures of employees to external radiation, in conformance with § 20.101 of 10 CFR Part 20, during routine and nonroutine operations, maintenance, and cleanup activities. Also describe the type of surveys to be conducted, criteria for determining survey locations, frequency of surveys, action levels, management audits, and corrective action requirements. For personnel monitoring devices such as film badges, indicate the number and category of personnel involved in the program and the sensitivity and range of the devices. For survey instruments, provide instrument sensitivities, ranges, calibration methods (in an appendix), and frequency of calibration. (See §§ 20.201 and 20.202 of 10 CFR Part 20.)

5.7.3 Airborne Radiation Monitoring Program

Describe the proposed sampling program to determine concentrations of airborne radioactive materials (including radon) during routine and nonroutine operations, maintenance, and cleanup activities. (See §§ 20.103, 20.201, and 20.203 of 10 CFR Part 20.) In the description of the sampling program, include:

1. The criteria for determining sampling locations with respect to process operations and personnel occupancy; and

2. The frequency of sampling, type of analyses, sensitivity of overall sampling and analyses, action levels, management audits, corrective action requirements, and instrumentation calibration frequency. Procedures for sample analyses and instrument calibration should be included in an appendix.

5.7.4 Exposure Calculations

Describe the proposed procedure, in conformance with § 20.103 of 10 CFR Part 20, to determine the intake of radioactive materials by personnel in work areas where airborne radioactive materials could exist. Include those exposures incurred during nonroutine operations, maintenance, and cleanup activities as well as during routine activities.

5.7.5 Bioassay Program

Describe the proposed bioassay program to confirm the results derived from the programs identified in Sections 5.7.3 and 5.7.4. Indicate the number and category of personnel involved in the program, the types and frequencies of bioassays performed, and action level criteria to be applied to bioassay results. (See §§ 20.103 and 20.108 and Appendix B to 10 CFR Part 20.)

5.7.6 Contamination Control Program

Describe the proposed occupational radiation survey program to determine that employees (plus their workclothes or coveralls, etc.) entering clean areas (lunchrooms, offices, etc.) or leaving the site are not contaminated with radioactive materials. The description should include proposed housekeeping and cleanup requirements and specifications in process areas to control contamination; frequency of surveys of clean areas; survey methods; and minimum sensitivity, range, and calibration frequency of survey equipment. Provide proposed contamination criteria or action levels for clean areas and for the release of materials, equipment, and workclothes to clean areas or from the site. Procedures for instrument calibration should be included in an appendix. (See §§ 20.201 and 20.202 of 10 CFR Part 20.) See also Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976.

5.7.7 Airborne Effluent and Environmental Monitoring Programs*

Describe in detail the proposed effluent and environmental monitoring programs, including methods and procedures for measuring concentrations and quantities of both radioactive and nonradioactive materials released to and in the environs. The description of the proposed monitoring programs should include the technical basis used to determine environmental concentrations to show conformance with §§ 20.103, 20.105, and 20.106 of 10 CFR Part 20.

For both effluent and environmental monitoring, the frequency of sampling and analysis, the types and sensitivity of analysis, action levels and corrective action requirements, and the minimum number and criteria for locating effluent and environmental monitoring stations should be provided. Proposed locations should be indicated on a topographic map of the site and surrounding area.

5.7.8 Ground-Water and Surface-Water Monitoring Programs

Describe the monitoring programs to be used to determine if the lixiviant and/or contaminants are in hydrologic communication with other lithologic zones or with ground-water or surface-water supplies or have migrated laterally outside the well-field area. This description should include the technical basis for the monitoring programs, including the number and location of monitoring stations, the criteria used for locating sampling stations and determining sampling frequency, the excursion indicators and criteria used in determining them, and upper control limits for excursion indicators and corrective action requirements. Provide the procedures for sample collection and analyses in an appendix. See NRC staff Technical Position Paper WM-8102 regarding excursion indicator sets, upper control limits, and operational ground-water monitoring. (See §§ 20.103, 20.105, and 20.106 of 10 CFR Part 20.)

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* Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills," should be reviewed in connection with this section.

5.7.9 Quality Assurance*

Describe the quality assurance programs for all radiological and nonradiological in-plant, effluent, and environmental (including ground-water) monitoring programs.

*Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment," should be reviewed in connection with this section.

6. GROUND-WATER-QUALITY RESTORATION, SURFACE RECLAMATION, AND PLANT DECOMMISSIONING

The applicant should describe in detail proposed plans for ground-water-quality restoration, surface reclamation, and plant decommissioning.

Detailed discussions should be provided for the following:

1. Plans and schedule(s) for ground-water-quality restoration, including:

a. An estimate of the quantities, concentrations, and lateral and vertical extent of those chemicals that may persist in leached-out well-field production zones after termination of in situ mining operations and prior to restoration activities;

b. A description of proposed methods and techniques to be used to achieve ground-water-quality restoration, including identification of in situ chemical reactions that may hinder or enhance restoration. The applicant should provide an analysis of the methods and techniques to be used to achieve restoration in terms of fluids to be used during restoration and the hydraulic and geochemical properties of the receiving stratum. For commercial-scale operations, the restoration methods and techniques should be based on results obtained from research and development operations. In addition, for commercial-scale operations, a schedule for sequential restoration of mine units should be included;

c. A description of the expected postreclamation conditions and quality of restored ground waters, compared with the preoperational land and water-quality characteristics;

d. An assessment of the proposed water-quality restoration operations with respect to adversely affecting ground waters outside production zones; and

e. The procedures to be used for plugging, sealing, capping, and abandoning all wells associated with the in situ solution mining operations.

2. Plans and schedule(s) for reclaiming disturbed lands, including;

a. A contour map showing the approximate postreclamation surface contours for affected lands and immediate surrounding area(s);

b. Procedures for the reclamation of any temporary diversion ditches and impoundments;

c. Procedures for reestablishing any surface drainage that may be disrupted by the solution mining operations;

d. Procedures for mitigating or controlling the effects of any subsidence; and

e. Procedures for ground surface preparation, depth of topsoil replacement and revegetation plans, erosion control and water conservation practices, and proposed postoperational land use.

3. Procedures for removing and disposing of structures used in conjunction with the in situ solution mining operations, including procedures for managing all toxic and radioactive materials. In the discussion pertaining to the disposal of wastes produced by in situ solution mining operations, procedures for removal and disposal of byproduct material to an existing uranium mill tailings disposal site or licensed burial site should be included.

4. Procedures for conducting postreclamation and decommissioning radiological surveys to ensure that sufficient potential radioactive contamination has been removed from the site to permit its release for unrestricted use. Include plans for postoperational ground-water monitoring to ensure that restored water quality is stabilized. See NRC staff Technical Position Paper WM-8102 regarding postoperational ground-water monitoring programs.

5. Financial arrangements to be made to ensure that adequate funds will be available for the ground-water-quality restoration, facility decommissioning, land reclamation, offsite disposal of byproduct waste material, and monitoring described above. Such arrangements should be based on a financial assessment of estimated costs, which should also be included.

7. ENVIRONMENTAL EFFECTS

The construction of facilities and well drilling will inevitably affect the environment; some of the effects may be adverse and others beneficial. Effects are considered adverse 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, less esthetically or culturally pleasing; if the change or stress reduces the diversity and variety of individual choice or the standard of living; or if the change or stress tends to lower the quality of renewable resources or to impair the recycling of depletable resources.

The applicant's discussion of adverse environmental effects should distinguish between those that are considered unavoidable and subject to later amelioration and those that are regarded as unavoidable and irreversible. Those effects representing an irreversible and irretrievable commitment of resources should receive detailed consideration. (In the context of this discussion, "irretrievable commitment of resources" refers to natural resources and means their permanent impairment, 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 expenditure of directly used resources.)

7.1 Site Preparation and Construction

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

A description of how construction activities may disturb the existing terrain and wildlife habitats should be included in the land-use discussion. Consider the effects of such activities as building temporary or permanent roads, bridges, or service lines; disposing of trash; excavating; and land filling. Provide information bearing on such questions as how much land will be disturbed and for how long, and will there be dust or smoke problems. Indicate proximity of human populations, and identify undesirable impacts on their environment arising from noise, disruption of stock grazing patterns, and inconvenience due to the movement of men, material, and 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 historic 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 the consequences of which 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. The applicant should describe the effects of these activities on fish and wildlife resources, water quality, water supply, esthetics, etc., as applicable. Describe measures such as pollution control and other procedures for habitat improvement to mitigate undesirable effects.

7.2 Effects of Operations

The impacts of operation of the proposed activity should be, to the fullest extent practicable, quantified and systematically presented in this section. 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 for this or for previous operations. 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, etc.

7.3 Radiological Effects

In this section, the applicant should consider the radiological effects of operations on man. Estimates of the radiological impact on man via various exposure pathways should be provided.

7.3.1 Exposure Pathways

The various possible pathways for radiation exposure of man 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. Suggested formats for supplying information necessary for the NRC independent evaluation of offsite radiological impacts resulting from the operation of a proposed commercial-scale facility are outlined in Appendix A to this guide.

7.3.2 Exposures from Water Pathways

Estimate the expected annual average concentrations of radioactive nuclides in receiving water at locations where water is consumed or is 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.

Estimate the expected radionuclide concentrations in aquatic and terrestrial organisms significant to human food chains. Use bioaccumulation factors as necessary.

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

7.3.3 Exposures from Air Pathways

From release rates of airborne radioactivity and meteorological data, estimate total annual body and significant organ doses (in millirems) to individuals exposed at the point of maximum ground-level concentrations off site, 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 nearest residence in the direction of the prevailing wind. Assume annual average meteorological conditions. Identify locations of points of release (e.g., stack, roof vent) used in these calculations.

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

Provide an appendix describing the models used in these calculations.

7.3.4 Exposures from External Radiation

Provide an estimate of the maximum annual external dose (in millirems) that would be received by an individual from direct radiation at the nearest site boundary.

7.3.5 Total Human Exposures

Provide estimates of the maximum annual doses (in millirems) that could be received via all pathways described above by an individual at the site boundary and at the nearest residence.

For commercial-scale operations, the applicant should also present a table that summarizes the estimated radiation dose to the regional population (within 80 km) from the uranium recovery plant and well-field-related sources using values calculated in previous sections. The tabulation should include the total annual 100-year environmental dose commitment (person-rems) to the population from all pathways.

7.3.6 Exposures to Flora and Fauna

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. Tabulate and reference the values of bioaccumulation factors used in these calculations.

7.4 Nonradiological Effects

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 should also be compared with applicable standards. The projected effects of the effluents for both acute and chronic exposure of the biota (including 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 distances from the point of discharge should be provided. The effects on terrestrial and aquatic environments from chemical wastes that contaminate ground water should be included.

Also discuss any potential effects of the proposed operation that do not clearly fall under any specific topic delineated above. These may include changes in land and water use at the project site; sanitary and other recovery plant waste systems; interaction of the facility with other existing or projected neighboring facilities; effects of ground-water withdrawal on ground-water resources in the vicinity of the well field(s) and recovery plant(s); effects of construction and operation of roads, transmission corridors, railroads, etc.; effects of changes in surface-water availability on biotic populations; and disposal of solid and liquid wastes other than those already discussed.

7.5 Effects of Accidents

Discuss the environmental effects of possible accidents that may occur, whether or not those accidents may produce an impact on the site or its environs. Analyses should be based on relevant experience and accident statistics from similar operating facilities. Accidents due to both human causes and natural phenomena should be addressed. See §§ 20.403 and 20.405 of 10 CFR Part 20 regarding reporting requirements.

7.5.1 Accidents Involving Radioactivity

The applicant should provide realistic analyses of accidents involving radioactivity for a spectrum of accidents that might occur ranging in severity from trivial (essentially no release of radioactivity to the environment) to 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 an undetected lixiviant excursion or the failure of a waste retention system resulting from an act of nature, faulty design, or misoperation. Examples of accidents resulting in small releases would be failure of a pumping circuit with ground surface lixiviant release or failure of the ventilation system serving the chemical makeup area. An example of a trivial accident would be the leakage of a vessel containing barren lixiviant solution. Also describe measures to be taken to prevent accidents, and provide a discussion of proposed contingency plans to be implemented in the event that accidents occur.

7.5.2 Transportation Accidents

The potential environmental effects from transportation accidents involving radioactive and other hazardous materials should be evaluated.

7.5.3 Other Accidents

In addition to accidents that could release radioactivity to the environs, there might be accidents that, although radioactive materials would not be involved, would have consequences that could affect the environment. Such accidents as chemical explosions or fires, steam boiler failures, and leakage or rupture of vessels containing toxic materials could have significant environ-

mental impacts. These possible accidents and associated effects should be identified and evaluated.

7.6 Economic and Social Effects of Construction and Operation

The purpose of this section is to provide guidance on the information needed to assess the economic and social effects of the proposed operations. There are, of course, limitations on the extent to which the social and economic benefits and costs of a 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 commensurable 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 quantifiable. All potential significant social and economic benefits and costs should be addressed in the application and, to the extent possible, should be discussed in quantitative terms.

Based on past reviews of research and development operations, the economic and social effects of construction and operation are usually minimal. However, the applicant should consider these to determine if there are any unique circumstances that could result in significant economic or social effects.

7.6.1 Benefits

The primary benefits of the proposed facility are those inherent in the value of the uranium to be recovered and the kilowatt-hours of electricity the uranium represents.

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. Some examples are:

- 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 programs.

Discuss significant benefits that may be realized from construction and operation of the proposed facility. Where the benefits can be expressed in monetary terms, they should be discounted to present worth. 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.

7.6.2 Costs

The economic and social costs resulting from the proposed operations are complex and need to 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) groundwater-quality restoration, surface reclamation, and plant decommissioning, and (5) research and development costs, including postoperational monitoring requirements. As in the case of benefits, the applicant should discount these costs to present worth.

There are also external costs. Their effects on the interests of people need to be examined. The applicant should supply, as applicable, an evaluation, including 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 housing shortages; 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 of 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; and 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.

7.6.3 Resources Committed

Any irreversible and irretrievable commitments of resources due to the operation should be discussed. This discussion should include both direct commitments such as depletion of uranium resources and irreversible environmental losses such as destruction of wildlife habitat.

In this discussion, the applicant should consider lost resources 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, the loss of a given area of highly desirable land 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 in which the amount of expected resource loss is related to the total resource in the immediate region and in which the total in the immediate region is related to that in surrounding regions. The latter should be specified in terms of areas and distances from the site.

8. ALTERNATIVES TO PROPOSED ACTION

In this chapter, the applicant's choice of the particular mining and recovery processes for the ore body must be supported through a comparative evaluation of available alternatives. To the extent possible, discuss realistic alternatives for the various processing stages. Discussion of alternatives should include a description of the ground-water-quality restoration program to be applied for each alternative. The NRC will consider all those alternatives that may reduce or avoid significant adverse environmental, social, and economic effects expected to result from construction and operation of the proposed activity. The NRC will not preselect the alternatives that should be considered by the applicant; rather, the applicant should make this determination for this specific case and should also make clear the bases and rationales 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 identified in Chapter 7, "Environmental Effects." For commercial-scale operations, the comparative evaluation of available alternatives should include results obtained from research and development operations.

In the discussion of waste management alternatives, consideration should be given to the following siting, design, and operational performance objectives developed by the NRC staff in addition to the plans for final disposal discussed in Chapter 6, "Ground-Water-Quality Restoration, Surface Reclamation, and Plant Decommissioning."

1. Locate the liquid impoundment area(s) at sites where disruption and dispersion by natural forces are eliminated or reduced to the maximum extent reasonably achievable.

2. Design the impoundment area(s) so that seepage of toxic materials into the ground-water system would be eliminated or reduced to the maximum extent reasonably achievable.

9. BENEFIT-COST ANALYSIS

In this chapter, the applicant's benefit-cost statement should be summarized. The presentation should be made in the form of a narrative with accompanying tables and charts. It should clearly discuss the important benefits and costs of the proposed operations to justify the issuance of the license.

The applicant will have to develop criteria for assessing and comparing benefits and costs where these are expressed in nonmonetary or qualitative terms. The rationales for the selection of process alternatives as well as subsystem alternatives should be presented. In any case, the applicant should describe potential cumulative effects and should discuss in detail the tradeoffs that were made in order to warrant licensing of the proposed operation. The rationale for omitting apparent benefits or costs from the applicant's analysis should be explained. Key all the terms used in the benefit-cost analysis to the relevant sections of the application.

10. ENVIRONMENTAL APPROVALS AND CONSULTATIONS

List all licenses, permits, and other approvals of construction and operations required by Federal, State, local, and regional authorities for the protection of the environment.* List those Federal and State approvals that have already been received, and indicate the status of pending approvals. For general background, submit similar information regarding approvals, licenses, and contacts with local authorities. Indicate whether or not an environmental assessment or a full environmental impact statement has ever previously been prepared for the proposed mining site area or surrounding area. If so, cite the document.

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 required. If not already obtained, indicate when certification is expected. If certification is not required, explain.

In view of the potential effects of a proposed commercial-scale operation on the economic development of the region in which it would be 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.

Describe meetings held with environmental and other citizen groups with references to specific instances of the applicant's compliance with citizen group recommendations.

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

**Copies of this circular are available from the Office of Management and Budget, Washington, D.C. 20503.

11. REFERENCES

The applicant should provide a bibliography of all sources used in preparing the application. References cited should be keyed to the specific sections and page numbers to which they apply. The applicant should also list the names, together with their qualifications (expertise, experience, professional disciplines), of the persons who were primarily responsible for preparing the application.

APPENDIX A

INFORMATION NEEDED BY NRC STAFF TO PERFORM RADIOLOGICAL IMPACT EVALUATIONS FOR COMMERCIAL-SCALE IN SITU URANIUM SOLUTION MINING FACILITIES

1. Detailed site plot plan (overlaid on topographic map, with scale and true north arrow) clearly identifying all locations of:

   a. Site property boundaries

   b. Restricted area boundaries, if different from site property boundaries

   c. All radiological effluent release points (or areas) such as

      (1) Production wells

      (2) Yellowcake drying and packaging area emission stacks or vents (if applicable)

      (3) Evaporation, settling, or any other solid/liquid disposal pond areas

      (4) Any other release points of emission to the atmosphere, e.g., surge tanks, process building vents

   d. Lands owned, leased, or otherwise controlled (including mill site claims) by the applicant

   e. Lands usable and available for grazing

   f. Private residences or other structures used by the general public

   g. Vegetable or other crops, identified by type and growing season

   h. Milk animals (cows or goats)

2. Locations of sources and receptors

   All locations should be given in terms of distances from a central release point. Coordinates relative to this release point should be given as follows:

   a. x kilometers east of the central release point

   b y kilometers north of the central release point

   c. z meters elevation from the base of the central release point

   (Note: Locations to the south and/or west should be denoted by a negative value. Any recognizable facility will suffice as a central frame of reference.)

Table 1 lists the types of sources and receptors and the format suggested for reporting the locations requested.

Table 1

Sources		East (km)	North (km)	Elevation (m)
1.	Yellowcake dryer	0	0	--
2.	Center of ore bodies (at ground surface level)	--	--	--
3.	Solid/liquid disposal areas	--	--	--
4.	Production wells	--	--	--
5.	Other sources, if applicable	--	--	--
Receptors				
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)	--	--	--

3. Time-sequenced bar graph describing various stages of the facility's operational and postoperational life. This should include any alterations relating to the sources of emission such as source location, operation, restoration, termination. Changes in exposed areas in evaporation ponds should also be indicated.

4. The following parameter values should be provided (if there are changes in Part 3 above, multiple corresponding values for each stage should be reflected here):

Parameter	Value
Average ore quality, U_3O_8, in ore body	_____ %
Ore activity, U-238, U-234, Th-230, Ra-226, and Pb-210	_____ pCi/g
Operating days per year (plant factor)	_____ days
Dimensions of the ore body or bodies	
· Acres per year to be mined	_____ acres
· Average thickness of body (bodies)	_____ meters
Average production flow rate	_____ gpm
Formation porosity	_____ %
Process recovery	_____ %
Leaching efficiency	_____ %
Rock density	_____ g/cm^3
Restoration flow rate	_____ gpm
Production cell parameters	
Residence time	_____ days
Type of cell pattern (5, 7 spot, or other)	_____
Radius	_____ m
Average cell flow rate	_____ gpm
Annual Rn-222 emission from production	_____ Ci/yr
Annual Rn-222 emission from restoration	_____ Ci/yr

(Note: If the Rn-222 is not measured, indicate the complete calculational methodology, providing all assumed parameter values and references.)

Yellowcake drying and packaging data (if applicable)

Processing rates for drying and packaging if different	_____MT/hr
Estimated annual yellowcake production rate	_____MT/yr
Expected yellowcake purity, U_3O_8 by weight	_____%
Any measured airborne effluent concentrations	_____Ci U-238/yr
	_____Ci Th-230/yr
	_____Ci Ra-226/yr
	_____Ci Pb-210/yr
Stack heights and airflows	Drying_____m, m^3/s
	Packaging_____m, m^3/s
	Other_____m, m^3/s
Anticipated release rates for dryer stack, the packaging area ventilation exhaust, and any yellowcake storage area ventilation exhausts	Dryer Stack_____kg/hr
	Packaging Stack_____kg/hr
	Other_____kg/hr
Drying and packaging operations are carried out	_____hr/d and d/yr
Description of all ventilation air filtration equipment with design, expected, and minimum efficiencies (if applicable)	(Attach sheet)
Filtration equipment testing procedures and frequencies	(Attach sheet)
Solid/liquid disposal impoundments, e.g., evaporation ponds	(Attach sheet)

Complete physical, chemical, hydrological, and radiological description of disposal impoundment system.

Total area of each impoundment area and surface areas expected to be under water, saturated, moist, and dry (indicate surface moisture contents used as basis of estimates).

Anticipated Rn-222 release rates for surface areas under water, saturated, moist, and dry, Ci/yr per m^2.

If not included above, please provide the following:

Total dissolved solids in liquid waste _____ g/l

Activity of solids in impoundments _____ pCi U-238/g

_____ pCi Th-230/g

_____ pCi Ra-226/g

_____ pCi Pb-210/g

Activity in liquids in impoundments _____ pCi U-238/l

_____ pCi Th-230/l

_____ pCi Ra-226/l

_____ pCi Pb-210/l

Density of solids _____ g/cm^3

5. Meteorological Data

Annual joint relative frequency distributions of wind direction and wind speed by atmospheric stability class (see Table 2 on page 3.46-37).

a. Wind direction to be given in the 16 compass directions.

b. Wind speed to be given in knots in the indicated classes (i.e., 0-3, 4-6, 7-10, 11-16, 17-21, over 21)

c. Atmospheric stability to be given in the following manner:

A - Extremely unstable

B - Moderately unstable

C - Slightly unstable

D - Neutral

E - Moderately stable

F - Very stable

Further information is available in Regulatory Guide 1.23 (Safety Guide 23), "Onsite Meteorological Programs." For each atmospheric stability class, provide the data in the format indicated in Table 2.

Table 2

Stability Class Wind Direction	Wind Speed Class (knots) 0-3	 4-6	 7-10	 11-16	 17-21	 Over 21
N						
NNE						
NE						
ENE						
E						
ESE						
SE						
SSE						
S						
SSW						
SW						
WSW						
W						
WNW						
NW						
NNW						

d. Regional Data (Within 80 km) (Attach sheet)

(1) Population distributions by direction (12) and radius (1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km) for a recent year (no earlier than 1970) and for the last year of expected operations (see Table 3 on page 3.46-39 for reporting table format).

(2) Available county food production data, in kg/yr, for vegetables (by type and totals), meat (all types), and milk; if available, include any future predictions by local governmental or industrial or institutional organizations.

6. Miscellaneous

If not included above, please provide:

Fraction of year during which cattle graze locally _____%

Fraction of cattle feed obtained by grazing _____%

Fraction of stored cattle feed grown locally _____%

Acreage required to graze 1 animal unit (450 kg) for one month (AUM) _____ ha

Length of growing season _____ mo/yr

Fraction of locally produced vegetables consumed locally _____ %

Fraction of locally produced meat consumed locally _____ %

Fraction of locally produced milk consumed locally _____ %

Table 3

Kilometers	N 0.0	NNE 22.5	NE 45.0	ENE 67.5	E 90.0	ESE 112.5	SE 135.0	SSE 157.5	S 180.0	SSW 202.5	SW 225.0	WSW 247.5	W 270.0	WNW 292.5	NW 315.0	NNW 337.5
Population Distribution																
1.0- 2.0																
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																

VALUE/IMPACT STATEMENT

An NRC source and byproduct material license is required in order to process uranium solutions extracted from in situ uranium solution mining operations. General guidance for filing an application is provided in § 40.31 of 10 CFR Part 40, "Domestic Licensing of Source Material." Regulatory Guide 3.46 (Task FP 818-4) provides specific guidance on the format and content of applications, including environmental reports, for licenses to authorize in situ uranium solution mining operations. The guide conforms to NRC regulations and reflects experience gained over the past several years in actual licensing cases.

Basic detailed guidance is essential to applicants for the efficient preparation of applications, including environmental reports, for in situ uranium solution mining facility licenses and for their review by the NRC staff. Such detailed guidance is not presently delineated in NRC regulations or in regulatory guides. Based on experience gained in the issuance of such licenses, the NRC staff has identified information that should be contained in applications, including environmental reports, to reflect present needs and practices. Such information provided in a regulatory guide will be helpful to both applicants and the NRC staff in reducing the cost and time involved in preparing and processing license applications. It should result in a significant reduction in the number of questions and requests for clarification submitted by the NRC staff to applicants, should improve the consistency in application reviews because of more uniform application submittals, should reduce the amount of NRC staff review effort in license processing, and should expedite licensing actions.

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

PACKAGE DIVIDER