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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 4.18 (Task WM 013-4)

STANDARD FORMAT AND CONTENT OF ENVIRONMENTAL REPORTS FOR NEAR-SURFACE DISPOSAL OF RADIOACTIVE WASTE

USNRC REGULATORY GUIDES

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

This guide was issued after consideration of comments received from the public. Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience.

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INTRODUCTION

1. National Environmental Goals

The National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190, 83 Stat. 852) requires the Nuclear Regulatory Commission (NRC) to prepare a detailed statement that assesses the potential environmental effects of major NRC actions significantly affecting the human environment. This statement will assist the NRC in ensuring that its decisions on these actions will be consistent with the national environmental goals. These goals are stated in NEPA as follows:

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

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

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

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

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

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

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

In addition to NEPA, the Atomic Energy Act of 1954, the Energy Reorganization Act of 1974, and the Nuclear Waste Policy Act of 1982, numerous other pieces of legislation and implementing regulations, both Federal and State, may affect any decisions made by the NRC on a proposal. Some of these, such as the Endangered Species Act of 1973, require that the NRC make primary determination of compliance, while for other requirements, such as those of the Federal Water Pollution Control Act, compliance must merely be reported to the NRC.*

* This guide does not discuss any of these requirements in detail. The applicant should independently determine the statutes and regulations that may affect the proposed project. Consulting with the NRC staff in the early stages of developing the project is encouraged to help determine which statutes and regulations may apply.

In accordance with the NEPA requirements, the NRC will prepare an assessment of the potential environmental effects before issuing a license authorizing land disposal of low-level radioactive waste. To obtain information essential for this assessment, § 61.10 of 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," requires each applicant for such a license to submit an environmental report on the potential environmental impact of the proposed project.

2. Applicant's Environmental Report

The NRC regulations implementing NEPA are found in 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection." Section 51.40, "Environmental Reports," of 10 CFR Part 51 requires that each applicant for a license authorizing receipt and disposal of radioactive waste submit 15 copies of an environmental report that discusses the matters described in § 51.20 with the license application. The applicant must retain an additional 85 copies of the environmental report for distribution to Federal, State, and local officials in accordance with written instructions issued by the NRC's Director of the Office of Nuclear Material Safety and Safeguards. The applicant's environmental reports are important documents of public record. Therefore, the applicant is urged to give full attention to their completeness.

The environmental report must discuss the following environmental considerations:

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

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

The environmental report should include a benefit-cost analysis that considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental, economic, technical, and other benefits of the facility. The benefit-cost analysis should, to the fullest extent practicable, quantify the various factors considered. To the extent that such factors

cannot be quantified, they should be discussed in qualitative terms. The environmental report should contain sufficient data to aid the Commission in its development of an independent benefit-cost analysis.

The environmental report should also include a discussion of the status of compliance of the facility with applicable environmental quality standards and requirements that have been imposed by Federal, State, and regional agencies having responsibility for environmental protection. In addition, the environmental impact of the facility should be fully discussed with respect to matters covered by such standards and requirements irrespective of whether a certification from the appropriate authority has been obtained. While compliance with NRC standards and criteria pertaining to radiological effects will be necessary to meet the licensing requirements of the Atomic Energy Act, the benefit-cost analysis for the purposes of NEPA must consider the radiological effects together with a broad range of other environmental effects of the facility.

3. Preparation of Environmental Reports

a. Purpose of This Guide

The Commission's regulations in 10 CFR Part 51 provide only general information concerning the content of an applicant's environmental report. This guide has been prepared to provide specific and detailed guidance for the preparation of environmental reports for land disposal facilities.

This guide identifies the information needed by the NRC staff to assess the potential environmental effects of the proposed land disposal facility and establishes an acceptable format for presenting it. Conformance with this Standard Format is not mandatory. However, use of the format of this guide will help ensure the completeness of the information provided, will assist the NRC staff and others in locating the information, and will aid in shortening the time needed for the review process.

Any guidance in this document related to information collection activities has been cleared under OMB Clearance No. 3150-0021.

b. Scope of This Guide

In order to cover a wide variety of anticipated situations, the scope of this guide is broad. In its development, the NRC staff has tried to anticipate the information needs of a wide range of siting, design, and operational characteristics affecting the potential impacts of a land disposal facility. In some instances, requests for specific information may not apply to a particular project. If any topics are not relevant to the particular project under consideration, the applicant should identify them. If any topics in this guide relate to information not available at the time the report is prepared, the applicant should indicate when the information will be available. The applicant should also include any information not specifically requested that it believes is necessary for an accurate assessment.

c. Presentation of Information

The applicant should present the information in the environmental report clearly and concisely. Each subject should be treated in sufficient depth and with sufficient documentation* to permit the Commission to independently evaluate the extent of the environmental impact. Tables, line drawings, and photographs should be used wherever they contribute to the clarity and brevity of the report. The number of significant figures stated in numerical data should reflect the accuracy of the data. Descriptive and narrative passages should be brief and concise. If test results are needed to support conclusions, test data, procedures, techniques, and a listing of the equipment used to perform the tests should be included or referenced.

Pertinent published information relating to the site, the facility, and its surroundings should be referenced. Published information or assumptions that are essential for evaluating specific environmental effects of the proposed activities should be included in summary or verbatim form in the environmental report or as an appendix to the report.

Some of the information to be included in the environmental report may already have been prepared by the applicant during preparation of the license application for the proposed project. In such cases, this information (whether in the form of text, tables, or figures) may be incorporated in the environmental report by reference. A standard format and content guide for license applications is currently under development by the NRC staff. When this guidance becomes available, it may be helpful in avoiding duplication of information in the license application and the environmental report.

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

1. PURPOSE OF AND NEED FOR PROPOSED PROJECT

In this chapter, the applicant should briefly describe the proposed project and provide the information necessary for evaluating the costs and benefits of not licensing the proposed project. Without a clear need, the resources planned to be committed to the project might be used in another manner more consistent with the national environmental goals. This need should be clearly demonstrated in this chapter.

The information supplied by the applicant should explain the facts considered in concluding that a new disposal site was necessary. This information should include the types, sources, and quantity of radioactive waste to be disposed of; how the waste is currently disposed of; the length of time the present capacity will be adequate; the cost of temporary storage; the cost of transportation to a new site versus the old site; and restrictions on the use of existing waste disposal sites. In discussing need, an important consideration is the relationship of the site to activities for the region or State under the Low-Level Radioactive Waste Policy Act (Public Law 96-573).

2. ALTERNATIVES TO PROPOSED PROJECT

NEPA requires that all reasonable alternatives (i.e., those that are practical or feasible) to a proposed action be considered in detail to evaluate their comparative merits. One way of addressing this evaluation of alternatives is to focus the environmental review on the important issues that should be discussed at each level of the review. This approach helps to eliminate repetitive discussions of the same issues. After the need for the proposed disposal facility has been determined, for example, the alternative of not constructing the facility should no longer be examined. The next level of the environmental review deals with the range of siting and design alternatives for the proposed type of facility. The information in this chapter should describe the procedures used in evaluating these alternatives in sufficient detail to permit an independent analysis of the final selections. The evaluation of the siting and design alternatives for a waste disposal facility represents an important part of promoting the national environmental policy and of ensuring compliance with the performance standards in 10 CFR Part 61. For this reason, an equal level of effort should be used to evaluate each alternative at a particular step of the selection process without emphasizing any preselected site or design to maximize the likelihood of choosing from among the best available alternatives.

2.1 Siting Alternatives

The siting problem requires two basic types of information: (1) the possible impacts of selecting each candidate site and (2) the relative importance given to each identified impact. This information should be obtained by means of a formal study that should help improve the quality of the siting decision by ensuring that all relevant factors have been considered and by providing the rationale and documentation for supporting the complex siting decision.

Whatever site selection process is used by the applicant, it should contain certain essential features. It should be logically sound, defensible, and useful for decisionmaking. It should be of practical use in the real world, and it should improve the perception of the siting analysis by making it understandable and by accounting for the concerns of interested groups. The process should be capable of identifying a slate of candidate sites from a region, describing and evaluating the predicted impacts at each candidate site, and providing a means of comparing these sites to identify the proposed site.

The information necessary for this process will vary with the level of the analysis and the significance of the potential impact. More detailed information should be provided as the choice of sites is narrowed. However, the applicant should place primary reliance on reconnaissance-level information during the entire selection study. Reconnaissance-level information refers to information or analyses that can be retrieved or generated without performing additional site-specific investigations. It includes relevant scientific literature, reports of government or private research agencies, consultation with experts, and analyses performed using such information. It may also include brief site visits or field investigations, particularly for selecting the proposed site from the candidate sites. The study should consider information in such areas as environment, economics, socioeconomics, and public health and safety.

2.1.1 Objectives and Limitations of Site-Selection Process

This section should include the general objectives of the site-selection process and any basic constraints or limitations on the process, e.g., regulations and laws, and the basis and rationale for their applicability.

2.1.2 Description of Site-Selection Process

This section should document the process used to select the proposed site in sufficient detail to permit an independent evaluation of it by the NRC. The NRC evaluation will examine the reasonableness and capability of the process to identify a proposed site that is among the best available. The NRC evaluation will also attempt to determine if there are any sites that are obviously superior to the one chosen.

Describe the parameters, criteria, and weighting factors used for making decisions at each step in the site-selection process. The reconnaissance-level data used at the various steps of the process should be fully identified.

The applicant may wish to use the steps described in the following sections as part of the site-selection process. Another process may be used, however, if it achieves the same goal.

2.1.2.1 Region of Interest Identification. The region of interest is the geographic area initially considered in the site-selection process. This area may be the State, a group of contiguous States, a geographic region, or, in some cases, the entire land area of the United States. Identify the region of interest by providing such information as the geographic boundaries of an individual State or regional compact, and describe how this region was selected. Maps should be provided to locate and describe this region.

2.1.2.2 Candidate Area Selection. Candidate areas are reasonable homogeneous areas within the region of interest investigated for potential sites. Candidate areas may be made up of a single large area or several unconnected ones. The criteria governing homogeneity include natural resources, geography, and population on which the potential project would have an impact. Identify the parameters and criteria used to select the candidate areas from the region of interest. It is expected that each candidate area considered will be small enough for any site developed within it to have the same general environmental characteristics. The areas considered should not be restricted to those on land actually owned by the applicant, a State, or the Federal Government. An attempt should be made to select candidate areas that represent more than one type of general environmental area (where practicable) to provide the greatest range of alternatives from which to select the candidate sites.

If a State, region, locality, or tribe within the region of interest has a law specifically affecting the siting of radioactive waste disposal facilities, the law should be cited and any applicable constraints described.

Wherever possible, maps and charts should be used to portray the distribution of the sources of waste for near-surface disposal,* environmental features, and other relevant information. (A consistent identification system should be established for all graphic and written materials in this section.) The maps should display such pertinent information as:

1. Areas considered by the applicant;
2. Population distribution;
3. Surface- and ground-water resources;
4. Railroads, highways, and waterways (existing and planned) suitable for waste transportation;
5. Important topographic features (e.g., mountains, marshes, fault lines);
6. Dedicated land-use areas (e.g., parks, historical sites, wilderness areas, testing grounds, airports);
7. Valuable agricultural, residential, recreational, mineral resource, or other areas that may be impacted; and
8. Significant sources of waste for near-surface disposal (if they are within the candidate area).

Appropriately scaled maps should be used for displaying candidate areas. Separate maps depicting various features of the candidate areas should have the same scale for ease of reference.

Factors such as the following should be considered for identifying candidate areas:

1. The acceptability of the area for long-term waste isolation, i.e., the site suitability requirements of § 61.50 of 10 CFR Part 61 (the primary criterion);
2. Geographic screening based on such considerations as significant waste sources and transportation routes;
3. Critical habitats for endangered species, wildlife refuges, parklands, and national forests;
4. The compatibility with any existing land-use planning programs for the development of each candidate area; and
5. Current use of the land and the potential for preempting other highly valued uses of land such as agriculture, recreation, residences, or industry.

2.1.2.3 Candidate Site Selection. Candidate sites are those sites that the applicant considers potentially licensable, capable of being developed, and otherwise appropriate for evaluation during the process of selecting a proposed site. It should be demonstrated that the candidate sites are among the best that could reasonably be found. This section should identify and describe the process, the factors, and the selection criteria used to identify candidate sites within the designated candidate areas. At least one (but possibly more than one) site should be identified in each candidate area. All the identified

* To avoid repetition, the applicant should refer, as appropriate, to information presented in Chapter 1, "Purpose of and Need for Proposed Project."

candidate sites should be potentially licensable. The applicant may therefore wish to first identify potential sites, all of which may not be licensable, using less restrictive criteria. Then, from these potential sites, the licensable candidate sites could be selected.

The applicant should show that the selected candidate sites can potentially meet the minimum technical requirements in 10 CFR Part 61 and promote the national environmental policies stated in 10 CFR Part 51. The specific site suitability requirements in § 61.50 of 10 CFR Part 61 are:

1. The disposal site must be capable of being characterized, modeled, analyzed, and monitored.
2. Within the region or State where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives.
3. Areas having known natural resources that, if exploited, would result in failure to meet the performance objectives must be avoided.
4. The disposal site must be generally well drained and free of areas of flooding or frequent ponding. Waste disposal may not take place in a 100-year flood plain, coastal high-hazard area, or wetland, as defined in Executive Order 11988, "Floodplain Management Guidelines."
5. Upstream drainage areas must be minimized to decrease the amount of runoff, which could erode or inundate waste disposal units.
6. The disposal site must provide sufficient depth to the water table that ground-water intrusion, perennial or otherwise, into the waste will not occur. The NRC will consider an exception to this requirement to allow disposal below the water table if it can be conclusively shown that, because of disposal site characteristics, molecular diffusion will be the predominant means of radionuclide movement and, because of the rate of movement, the performance objectives will be met. In no case will waste disposal be permitted in the zone of fluctuation of the water table.
7. The hydrogeologic unit used for disposal must not discharge ground water to the surface within the disposal site.
8. Areas must be avoided where tectonic processes such as faulting, folding, seismic activity, or vulcanism may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives or may preclude defensible modeling and prediction of long-term impacts.
9. Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives or may preclude defensible modeling and prediction of long-term impacts.

10. The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives or significantly mask the environmental monitoring program.

Also, environmental factors should be considered to ensure compliance with applicable Federal, State, and local environmental quality standards and regulations and to promote the national environmental policies. Examples of these considerations include endangered species, unique wildlife habitats, national parklands, critical wildlife breeding areas, and the socioeconomics of the surrounding area.

2.1.2.4 Proposed Site Selection. The proposed site is the site for which an applicant seeks a license to dispose of low-level radioactive waste. It should be possible to demonstrate that there is no alternative site that is obviously superior to the proposed site. Describe the screening process, the factors considered, and the selecting criteria used to identify the proposed site from the slate of candidate sites. An analysis of realistic alternatives in terms of economic, environmental, and public health and safety factors should be made to show why the proposed site is preferred over all other candidate site alternatives. In presenting the analysis, a tabular format showing side-by-side comparison of alternatives with respect to the selection factors should be used insofar as possible. This analysis should summarize the benefits and costs of each alternative site and of the proposed site.

Quantification of the cost and benefits may not be possible for all factors because of the lack of adequate data or the lack of a generally accepted standard. Under such circumstances, qualitative and general comparative statements supported by documentation may be used. Where possible, experience derived from the operation of facilities at the same site or at an environmentally similar site may be helpful in evaluating the nature of expected environmental impacts.

2.2 Alternative Facility Designs

The applicant should discuss the costs and benefits of the proposed design of the facility and possible alternative designs by means of a comparative assessment. This comparison of alternative designs should be conducted only for designs at the proposed site. The design requirements in § 61.51 of 10 CFR Part 61 should form the primary basis for identifying alternative facility designs. The evaluation of impacts of alternative designs should emphasize those impacts that will vary among the alternatives, including ecological, land-use, air-quality, and socioeconomic impacts.

Discussion of alternative facility designs should consider the following, as appropriate:

1. Receiving, classifying, and processing waste;
2. Planned location and configuration of waste disposal units on the site;
3. Construction of disposal units;
4. Onsite transport of waste and placement in disposal units; and
5. Construction of disposal unit covers.

Environmental effects of alternative designs should be documented and supported by available information. To the extent practicable, the magnitude of each effect should be quantified. Where quantification is not possible, qualitative evaluations should be used. A tabular summary of the various benefits and costs of the alternative designs should be presented.

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Keeney, R.L., and C.W. Kirkwood, An Evaluation of Nuclear Power Plant Siting Methodologies, Woodward-Clyde Consultants, San Francisco, Calif., 1977.

Keeney, R.L., and H. Raiffa, Decisions with Multiple Objectives, John Wiley and Sons, New York, N.Y., 1976.

Raiffa, H., Decision Analysis, Addison-Wesley Publishing Company, Reading, Mass., 1970.

3. CHARACTERISTICS OF PROPOSED SITE

In this chapter, briefly describe the location of the facility and the geographical, demographical, ecological, meteorological, hydrological, geological, seismological, and socioeconomic characteristics of the site and surrounding vicinity. The objectives are to describe the environmental baseline characteristics of the proposed site to determine the environmental impacts of constructing, operating, and closing the disposal facility. Where applicable, clear references to data provided in the license application will avoid unnecessary duplication of information.

3.1 Geography and Demography

Information about the site such as geography, population, and land use should be provided.

3.1.1 Site Location

The approximate center of the site should be described by specifying the latitude and longitude to the nearest second and the Universal Transverse Mercator coordinates* to the nearest 100 meters. The State and county in which the site is located should be identified along with nearby towns and cities. To facilitate presenting this information, maps and aerial photographs should be used. The U.S. Geological Survey 7.5-minute maps are appropriate for this purpose, but 15-minute maps may be used if 7.5-minute maps are not available. This map should encompass a 10-km radius around the site. The location of the site relative to prominent geographical characteristics and features such as topography and surface drainage should also be indicated. Similar maps should be provided to show significant features near the site such as buildings (e.g., schools, churches, and industries), excavation sites, roads, railroads, streams, or ponds. Detailed information in this section may be referenced in subsequent chapters to minimize repetition.

3.1.2 Site Description**

A map or maps of the site and surrounding region should be included in the environmental report and should clearly define the boundary and buffer zones of the site, as defined in 10 CFR Part 61. Distances from significant surface and subsurface features to the site boundary and to the edge of buffer zones should be shown.

* As found on U.S. Geological Survey quadrangle base maps.

** A regulatory guide on site selection, suitability, and characterization is under development and, when issued, should provide additional guidance in this area. A branch technical position on this topic (NUREG-0902) is now available at current rates through the GPO Sales Program, ATTN: Sales Manager, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 or from the National Technical Information Service, Springfield, Va. 22161.

The topography of the site and vicinity should be described using aerial photography and topographic mapping. The maps and photographs of the site and adjacent drainage areas should identify such features as drainage divides, sizes of drainage areas, surface gradients and any abrupt changes in them, areas of internal or closed drainage, areas of flash flooding, and areas of scour or sedimentation. Topographic mapping of the disposal site and upstream drainage area should be at a scale of 1:2400, with a contour interval of 1 foot. For downstream drainage areas, U.S. Geological Survey 7.5-minute quadrangle maps should be used if available.

Vegetative cover (e.g., crops, forests, pastures) and surface soil characteristics (U.S. Department of Agriculture soil survey, if available) should be mapped and described sufficiently to indicate potential erosion and flood hazards. Major transportation routes should also be displayed.

3.1.3 Population Distribution

Population data should be presented and based on the most recent U.S. census data and State and local population projections that are available. On a map that identifies cities and towns within a 10-km radius, the residential population density should be provided. A table, appropriately keyed to the map, should provide the current residential population density in the 10-km radius for the expected first year of facility operation and for census years through the anticipated operational life of the facility. The distance to the nearest residence should be noted. The basis for population projections should be described. Also list the sizes of towns with populations greater than 10,000 within approximately 50 km of the proposed site, and identify the size of any significant transient populations in the site area.

3.1.4 Uses of Adjacent Lands and Waters

The applicant should briefly describe the natural resources within 10 km of the site, including minerals, coal or hydrocarbon deposits, geothermal energy sources, timber, and water. This information should include resource recovery that may occur at the ground surface, in the hydrogeologic units used for disposal and isolation, and at greater depths that might require excavation or drilling through the disposal units. Potential indirect effects such as increased infiltration rates or steepened hydraulic gradients caused by nearby exploitation should be evaluated. Any rights, e.g., ownership, lease, or easement, to these resources should be stated.

The land-use survey may be largely conducted from existing published materials such as local land-use plans, aerial photography, topographic maps, or other sources. The land-use survey, therefore, will most likely have been included in the site-selection process. However, field work may be necessary to verify current conditions or to answer any questions that arise during the site-selection process. The survey should include land-use patterns within a radius of approximately 10 km from the site. Land use should be classified as agricultural, residential, management areas (e.g., parks, scenic areas, military reservations) or other use categories and should be mapped accordingly. The applicant should review and describe zoning categories of the site and the 10-km radius of the study area. Trends in land use in the site vicinity should also be identified.

The applicant should include an inventory of existing surface water users and municipal water supplies relying on surface water within approximately 10 km downstream of the site. For these locations, the inventory should include the location, type, and amount of use; source of supply; type of intake; and surface-water-quality data as submitted to the Environmental Protection Agency periodically for certification. When these uses are for crop irrigation or livestock watering, also specify the type and acres of crops or the type and number of livestock.

An inventory of existing ground-water users within approximately 2 km of the site should be included. For these ground-water users, the inventory should include the location, type, and amount of use; the hydrogeologic unit used; typical well construction details; and general ground-water quality. The inventory should include both ground-water wells and water users at points of ground-water discharge, e.g., springs. The inventory should identify, for use in the ground-water pathway analysis, the nearest downgradient ground-water users and the nearest municipal supply relying on ground water.

If surface- or ground-water use rates are anticipated to change over the life of the project and beyond, indicate projections and the source of the projection information. Such projections may be available from users or planning agencies at different levels of government.

3.2 Ecology

In this section, discuss the flora and fauna within 5 km of the site. The initial inventory based on available studies or preliminary investigations will reveal certain organisms that, because of their importance to the community, should be given specific attention. A species is "important" (for the purposes of this guide) if the disposal facility may affect the species or its habitat 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 criteria (1) or (2), or (4) the species is a biological indicator of radionuclides or chemical pollutants in the environment.

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

* 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 set forth in Public Law 93-205, 87 Stat. 884. However, State laws and regulations and unregulated rare species and ecologically important habitat areas should also be considered.

currently in progress. If such studies are unavailable, sampling for the ecological survey should be conducted for a minimum period of 1 year on a quarterly basis to determine seasonal variations (where appropriate) of important terrestrial and aquatic species. The survey should use established scientific methods for surveying, data retrieval, and data reduction.

3.2.1 Terrestrial Ecology

Describe the flora and fauna in the vicinity of the site, their habitats, and their distribution. Identify any species considered important (as defined in Section 3.2) and their critical habitats. Also describe the natural and man-induced effects (e.g., farming) on the site vegetation and the successional stage of the plant community.

Discuss in detail the quantitative abundances of the important terrestrial species. The discussion should include species that migrate through the area or use it for breeding grounds. Special attention should be given to the relative importance of the site area to the total available wildlife habitat in the region.

The applicant should provide data on the number and distribution of important domestic fauna, particularly cattle, sheep, and other meat animals that may be involved in the exposure of man to radionuclides. Important game, dairy, recreational, and work animals should receive similar treatment. A map that shows the distribution of the principal farm crops in the site area should be provided.

A discussion of species-environment relationships should be included describing how the area is used by important species (e.g., nursery, breeding); life histories of important regional organisms, their normal seasonal population fluctuations, and their habitat requirements; and identification of food chains and other interspecies relationships, particularly when these contribute to predicting or evaluating the impact of the disposal operation on the regional terrestrial biota.

3.2.2 Aquatic Ecology

Describe the aquatic organisms in the vicinity of the site, their habitats, and their distribution. Identify any species considered important (as defined in Section 3.2) and their critical habitats. Discuss in detail the quantitative abundances of these important species. The discussion should include species that migrate through the site vicinity or use it for a breeding area. Special attention should be given to the relative importance of the aquatic habitat within the site vicinity to the total available aquatic habitat within the region.

A discussion of species-environment relationships should be included describing how the local aquatic habitat is used by important species (e.g., nursery, breeding), life histories and habitat requirements of important aquatic organisms, and identification of food chains and other interspecies relationships, particularly when this information will contribute to predicting or evaluating the disposal operation impact on the regional aquatic biota.

3.3 Meteorology and Air Quality*

This section should describe the meteorology of the site and the surrounding area. Meteorological conditions that influence the design and operation of the facility should be identified. Sufficient information should be included to permit an independent evaluation by the NRC staff of atmospheric dispersion characteristics of the local area. State the sources of this information and data, and include data collected from the onsite meteorological measurement program. The basis for all meteorological parameters used as a design basis for any facility structure should be described. Where applicable, reference to the data provided in the license application will avoid unnecessary duplication.

3.3.1 Meteorology

Meteorological data are needed primarily for three analyses: determining a water budget for the disposal site; analyzing the airborne pathway; and determining the frequency, probability, and potential consequences of severe meteorological phenomena.

For analysis of the site water budget and the airborne pathway, site-specific meteorological data should be collected during the site characterization program. This program should include measurements of the amount, type, and temporal distribution of precipitation; dates and depth of frost penetration; and dates and thickness of snow cover. It should also include continuous recordings of air and soil temperature, wind speed, wind direction, surface humidity, dew point, and atmospheric pressure. Air and soil temperatures are typically needed at several levels up to 1 meter above and below the ground surface. Since atmospheric stability is typically estimated from fluctuations in wind speed and wind direction at about 2 and 10 meters, these parameters should be measured continuously at both levels.

The staff anticipates that a minimum record of 1 year of site-specific meteorological data will be collected during site characterization. Data collected from the onsite meteorological station should be compared to historical records from nearby recording stations in similar topographical and hydrometeorological settings to determine whether the site-specific data fit within the regional data and to what extent this 1-year period of record represents a "typical" weather year when compared to the historical record. The longer-duration, regional data base may be useful in extending the site-specific data base for use in long-term analyses.

*

A regulatory guide on site selection, suitability, and characterization is under development and, when issued, should provide additional guidance in this area. A branch technical position on this topic (NUREG-0902) is now available at current rates through the GPO Sales Program, ATTN: Sales Manager, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 or from the National Technical Information Service, Springfield, Va. 22161.

The onsite meteorological station should be incorporated into the site monitoring program to extend the length of record of site-specific data collected during the site characterization studies. The increased record of site-specific data can then be used to verify data used in the analysis of water budget and atmospheric dispersion.

3.3.2 Air Quality

This section should include analyses of onsite air quality for estimating facility-generated radiological and nonradiological impacts on air quality and for performing atmospheric transport/dispersion modeling. The air-quality studies are especially important if the applicant plans atmospheric releases of potential radiological or nonradiological contaminants, e.g., through the use of an evaporator or incinerator.

Air-quality parameters measured should define the level of airborne radionuclides contributed by atmospheric fallout, natural radiation released from the soil, and agricultural activities such as spray application of fertilizers or insecticides. Suspended particulates should also be measured. The measurement of air-quality parameters should provide at least a 1-year record of site-specific information.

3.4 Hydrology*

Sufficient information should be provided to allow an independent review of all hydrologically related design bases, performance requirements, and operating procedures important to safe and environmentally sound operation. Identify the sources of the hydrologic information, the types of data collected, and the methods and frequency of collection. The surface and subsurface geohydrology and time-history characteristics of the site should be described. Lithographic and geologic maps extending radially 10 km from the site boundary should be provided to show hydrologic, geologic, and stratigraphic characteristics of the site. Where applicable, reference to the data provided in the license application will avoid unnecessary duplication.

3.4.1 Ground Water

The applicant should describe the hydrology of the region that affects the local ground-water aquifers, formations, sources, and sinks. Describe the recharge potential of the immediate facility area. Sufficient site-specific data should be provided for evaluating the effects of construction and operation of the facility on established ground-water tables and usage. Typically, a minimum of 1 year of measurements at the proposed site will be required. This minimum record should be supplemented, if possible, with regional data covering a longer time period.

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Descriptions of the major aquifers in the area should include potentiometric surface maps, hydraulic gradients, horizontal and vertical permeabilities for representative geologic features, total and effective porosities, bulk density estimates, storage coefficients, dispersion and distribution (sorption) coefficients, descriptions of pertinent geologic formations and soil types, including formation depth throughout the site, natural background chemical and radiological properties (as required by EPA Water Quality Standards or by any existing State regulation, including pH, total dissolved solids, and specific conductivity), and time histories of ground-water fluctuations. Emphasis should be placed on those parameters that may be affected by the proposed facility or that might enhance the movement of radionuclides away from the site.

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

3.4.2 Surface Water

The applicant should describe the location, size, shape, and other general hydrologic characteristics of water bodies in the environs of the site, using maps if necessary. Include a description of upstream and downstream river control structures, and provide a topographic map showing the major hydrologic features. Information should also be included for determining the extent of the 100-year flood plain in the immediate site vicinity for compliance with Executive Order 11988, "Floodplain Management Guidelines." In addition, the baseline water quality of water bodies adjacent to the site should be provided, including, for example, pH, alkalinity, suspended solids, specific conductivity, biological oxygen demand, chemical oxygen demand, turbidity, total dissolved solids, dissolved oxygen, and the natural background radiation levels.

3.5 Geology and Seismology*

Geological and soil studies (e.g., those conducted in support of the license application) should be briefly summarized and references made to the relevant reports. These studies should include those factors that might enhance radionuclide movement away from the site and that describe the natural background radiation levels in the soil.

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

A survey of the site and surrounding region to a radius of approximately 10 km from the site should be performed to identify areas valued for their historic, archeological, architectural, scenic, cultural, or natural landmark significance. This survey should be coordinated with the State Historic Preservation Officer and should attempt to identify, via literature review, field reconnaissance, and limited surface testing (if necessary), the potential

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for encountering cultural resources of significance as defined by Federal, State, or local historic preservation laws. Both historic and prehistoric resources should be discussed.

The cultural resources survey of the disposal site should include mapping of identified cultural sites and an evaluation of the potential of any cultural site for inclusion on the National Register of Historic Places or in any State or local registers. The survey of the area surrounding the site should include a listing of cultural sites within a radius of approximately 10 km that are currently listed or nominated for inclusion on the National Register of Historic Places, the National Registry of Natural Landmarks, or any similar State or local lists.

3.7 Socioeconomics

A description of the socioeconomic environment is needed in the environmental report for the analysis of the facility impacts. The socioeconomic study may be conducted from any existing published materials or from informal field surveys; therefore, much of this information will most likely have been included in the site-selection process. However, the applicant may need to collect additional data in the area surrounding the proposed site (usually defined on the basis of political jurisdictions such as counties) to more accurately describe the population, labor availability, labor skills, transportation, political structure, historic commuting patterns, school systems, health system, public safety system, utilities, tax base, economic structure, commerce, housing stock, and property values.

A sociocultural analysis may also be appropriate. In such cases, attitudinal surveys should be performed during site characterization. Sociocultural dimensions to be surveyed may include community cohesion, family stability, local attitudes and lifestyle, prevailing community problems, community composition, cultural values, and other quality-of-life indicators.

BIBLIOGRAPHY FOR CHAPTER 3

Lutton, R., et al., Tests for Evaluating Sites for Disposal of Low-Level Radioactive Waste, NUREG/CR-3038, U.S. Nuclear Regulatory Commission, Washington, D.C., 1982.

Lutton, R., et al., Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste, NUREG/CR-2700, U.S. Nuclear Regulatory Commission, Washington, D.C., 1982.

Pangburn, G., and R. Pennifill, Technical Position Paper on Near-Surface Disposal Facility Design and Operation, U.S. Nuclear Regulatory Commission, Low-Level Waste Licensing Branch, Washington, D.C., 1982.

Siefken, D., et al., Site Suitability, Selection, and Characterization, Branch Technical Position--Low-Level Waste Licensing Branch, NUREG-0902, U.S. Nuclear Regulatory Commission, Washington, D.C., 1982.

4. DESIGN OF PROPOSED FACILITY

This chapter should provide a brief discussion of the principal features of the disposal facility. It should provide information in sufficient detail on facility equipment and systems that interact with the environment to permit an independent evaluation by the NRC staff of the environmental effects of the proposed project. Where applicable, the license application should be referenced to avoid unnecessary repetition of data.

4.1 Description of Wastes To Be Accepted

The applicant should briefly describe the average annual volumes of fuel-cycle and non-fuel-cycle radioactive wastes to be accepted at the disposal facility. A summary of the data on wastes to be accepted provided in Chapter 1, "Purpose of and Need for Proposed Project," or in the license application should be included.

4.2 Facility Description

The applicant should describe the facilities, land, buildings, and equipment to be used for placing the wastes into the disposal units.

4.2.1 Principal Features

On an appropriately scaled map or drawing, locate the buildings and other installed surface features, as well as subsurface features. Also show roadways, parking areas, and utility and water service locations. Diagrams used in Chapter 3, "Characteristics of Proposed Site," may be referenced. References to the license application should be made as necessary to supplement these descriptions.

4.2.1.1 Restricted Areas. Show any restricted areas as defined in paragraph 20.3(a)(14) of 10 CFR Part 20, "Standards for Protection Against Radiation."

4.2.1.2 Site Boundary and Buffer Zones. Show the boundary that encompasses the area owned and controlled by the applicant. Indicate existing and proposed fenced areas and the location and size of the buffer zone.

4.2.1.3 Site Utility Supplies and Systems. Identify and describe the utility supplies and systems and the sources of water. Include the location and purpose of all wells and utility lines (if appropriate).

4.2.1.4 Storage Facilities. Show the location for general storage of materials and equipment.

4.2.2 Site Utilization Plan

Identify and discuss general plans for the future use of the facility. Discuss the order in which disposal units will be developed. On an appropriately scaled map or drawing, show the location and layout of future buildings and disposal units.

4.2.3 Construction Plans

4.2.3.1 Excavation and Engineering Modifications. Briefly discuss the design bases and construction plans required to enhance and improve the ability of the natural site characteristics to confine the waste after disposal. Using drawings as necessary, show the layout of the functional features of the burial facilities.

4.2.3.2 Waste Placement. Briefly describe how the waste will be placed in the disposal units.

4.2.3.3 Backfilling and Compaction. Briefly describe criteria, procedures, and methods that will be used to backfill and compact the fill and cover materials during the operational phase. Include consideration of composition and specification of backfill, reconsolidation procedures, precautions to prevent water intrusion, thermal and radiological effects, waste or waste container interactions, and materials (e.g., clay) added to mitigate waste migration.

4.2.3.4 Disposal Unit Covers and Use of Engineered Structures. Briefly describe measures to direct surface water away from disposal areas. Discuss any engineered methods or structures for keeping the infiltration of rain and surface water to a minimum. Describe waterproofing techniques to be used, including the chemical and physical properties of materials selected. Describe the thickness and type of cover and the stabilization techniques to be used on the cover surface.

4.2.3.5 Site Drainage and Erosion (Operational and Postclosure). Briefly describe the drainage system and show how it will ensure efficient and rapid removal of precipitation waters and prevent flooding and erosion. Discuss surface treatment to resist erosion and to prevent particulate releases via wind erosion. Also discuss the use of vegetation on the disposal unit covers and on the site in general to control erosion and water infiltration. Describe the planned onsite use of any pesticides or herbicides and any chemicals used to deter plant or animal penetration of the trench cover.

4.3 Support Facilities

4.3.1 Types of Structures

4.3.1.1 Administration Buildings. Briefly describe the functional features of these facilities, including laboratories, records and equipment storage areas, dining area, shower, decontamination rooms, and change rooms. Describe the planned disposal of any sanitary waste generated at the facility.

4.3.1.2 Storage and Waste Handling Area. Briefly describe, using drawings as necessary, the layout of the functional features of this area, including capabilities for (1) receiving, offloading, storage, and handling waste; (2) repackaging damaged containers; (3) decontaminating transport equipment; and (4) short-term storage.

4.3.1.3 Decontamination Area for Equipment. Briefly describe, using drawings as necessary, facilities for decontaminating transport, handling, and other equipment. Also describe the vehicle maintenance area and the planned disposal of any chemical waste generated at the facility.

4.3.2 Excavated Materials Area

The applicant should describe facilities for surface storage and protection of excavated materials. Indicate the spoil pile elevations. Discuss the potential for erosion of these piles by wind or water runoff from them. Describe any measures for mitigating these impacts. Describe the use of this material for backfill and planned disposition of any excess material. Discuss the potential for siltation to nearby water bodies.

5. ENVIRONMENTAL EFFECTS OF PROPOSED FACILITY

The construction and operation of a disposal facility may have short-term and long-term effects on the environment; some of the effects may be adverse and some may be 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, or less esthetically or culturally pleasing; if the change or stress reduces the diversity and variety of individual choice, the standard of living, or the extent of sharing of life's amenities; or if the change or stress tends to lower the quality of renewable resources or to impair the recycling of depletable resources.

In the discussion of adverse environmental effects, it should be made clear which of these are considered unavoidable and subject to later amelioration and which are regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should receive detailed consideration. (In the context of this discussion, "irretrievable commitment of resources" means a permanent impairment of the natural resources, 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.) Sufficient data should be provided for independent analysis of the effects of a disposal facility on the environment. Also discuss the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. As used in this guide, "short term" refers to the operating life of the proposed facility, and "long term" refers to time periods extending beyond the operating life.

5.1 Short-Term Environmental Effects

In this section, discuss the short-term effects of the facility on the environment. Effects are considered short term if they are related to construction, operation, or closure of the disposal facility and occur during the operational phase of the facility.

5.1.1 Site Preparation and Construction Effects

5.1.1.1 Land-Use Effects. Describe how the construction activities will affect the land-use patterns at the site and the surrounding areas. This section should emphasize the changes to current land uses and should explain how the construction will affect local and regional land-use plans for the site and vicinity.

This section should also discuss the effect of construction activities on the historic, archeological, architectural, scenic, cultural, and natural landmarks identified in Section 3.6. Measures aimed at mitigating potential impacts to these places should be identified.

5.1.1.2 Ecological Effects. This section should identify the terrestrial and aquatic ecological effects of the facility construction. The terrestrial and aquatic effects should be addressed separately in the environmental report. In each case the information should provide a general description of the effects

and should provide information about the effects on the important species identified in Section 3.2 and their habitats. Also, measures designed to reduce adverse impacts should be described.

1. The terrestrial section should consider the effects of truck traffic and dust and such activities as creating material supply areas; building roads, bridges, or service lines; disposing of trash; and cleaning, excavating, and land filling. Include an analysis of any impacts on domestic animals and crops in the area.

2. The aquatic section should consider any impacts on surface waters, e.g., soil erosion, stream diversion, and chemical runoff from vehicles, and should explain how and to what extent these impacts may affect aquatic organisms.

5.1.1.3 Socioeconomic Effects. The first section on socioeconomic effects should provide information on the extent of direct physical impacts on the local community from the construction activities. These effects may include noise, odors, dust, vibration, and disruptions from increased truck traffic.

The next section should provide information for assessing and evaluating the social and economic impacts of construction on the surrounding region and individual communities that could be affected by the proposed facility. These impacts result from constructing the facility and from the activities and demands of the construction labor force. Where practical, quantitative measures of these effects should be developed. To the extent practical, the analysis of these effects should be in terms of location, duration, and magnitude. The type of impacts discussed should relate to the socioeconomic information provided in Section 3.7 and how the situation described there will be expected to change during construction activities. Some impacts that might deserve special attention are impacts on local property values and on the marketability of local agricultural products. Any measures planned to reduce the potential socioeconomic impacts should be described.

5.1.1.4 Resources Committed. Discuss any irreversible and irretrievable commitments of resources (e.g., loss of land for competing uses and permanent destruction of wildlife habitat or natural resources) that are expected if site preparation and facility construction proceed.

5.1.2 Facility Operation Effects

This section should describe the interaction of the operating waste disposal facility and the environment. Measures planned to reduce any undesirable effects of the total project should be described in detail.

Environmental effects that are considered unavoidable but either temporary or subject to later amelioration should be clearly distinguished from those regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should be described in detail.

The impacts of operation of the proposed facility should be, to the fullest extent practicable, quantified and systematically presented. In the discussion of each impact, make clear whether the supporting evidence is based on theoretical, laboratory, onsite, or field studies undertaken for the planned project or for other endeavors. The source of each impact 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.

5.1.2.1 Radiological Impact on Biota Other Than Man. In this section, consider the impact on biota other than man attributable to the release of radioactive materials from the facility. The biota to be considered are those species of local flora and local and migratory fauna defined as "important" in Section 3.2. If the region contains many important species, efforts should be concentrated on those important species whose terrestrial and aquatic habitats provide the highest potential for radiation exposure.

5.1.2.2 Radiological Impact on Man. In this section, consider the radiological effects on man, including site workers, of operations and transportation of radioactive materials. Estimates of the radiological impact on man via various exposure pathways should be provided. The various possible pathways for radiation exposure of man should be identified and described in the text and in flow charts. Discuss any exposure pathways involving radionuclide accumulation in specific components of the environment.

5.1.2.3 Effects of Chemical Discharges. Operation of the disposal facility may involve chemical discharges. In this section, the specific concentrations of nonradioactive wastes in effluents at the points of discharge should be compared with natural ambient concentrations without the discharge and also compared with applicable standards. The projected effects of the effluents for both acute and chronic exposure of 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.

5.1.2.4 Effects of Sanitary and Other Waste Discharges. Describe and discuss the environmental impact associated with sanitary and other facility waste systems.

5.1.2.5 Other Effects. Discuss any effects of operation that do not clearly fall under any single topic of paragraphs 5.1.2.1 through 5.1.2.4. These may include changes in land and water use at the project site; interaction of the facility with other existing or projected neighboring facilities; effects of construction and operation of roads, railroads, etc.; disposal of solid and liquid wastes other than those already discussed; additional socioeconomic effects; air-quality degradation due to truck traffic; and erosion and sedimentation in local aquatic habitats.

5.1.3 Facility Closure Activities Effects

This section should describe the interaction of the closure activities and the environment. Such activities are expected to include dismantling, decontaminating, filling, grading, revegetation, marking, and capping. A statement should be made that includes a listing and description of the various activities that will be considered part of closure at the facility. Because of the short

duration of the activities, the information requirements of this section, as described below, are similar to those of Section 5.1.1, which also deals with activities of short duration.

5.1.3.1 Land Use and Terrestrial Impacts. Describe how closure activities may disturb the existing terrain and wildlife habitats. Identify and discuss all significant impacts that will result from closure activities. Of the impacts identified, indicate whether these will be temporary and end with facility closure or whether they will continue after the facility has been closed. Discuss any plans to mitigate or reverse undesirable effects through measures such as erosion control, dust stabilization, landscape restoration, and restoration of affected habitats.

The discussion should also include any effects of site closure activities that may be beneficial to the region.

5.1.3.2 Water Use and Aquatic Impacts. The discussion of water use should describe the impact of facility closure activities on area water sources. Such activities may include use of water for decontamination and reseeded and discharge of associated effluents and sediment. Describe the effects of these activities on fish and wildlife resources, water quality, water supply, esthetics, and recreation, as applicable. Describe measures designed to mitigate undesirable effects.

The discussion should also include any effects of site closure that may be beneficial to the region.

5.2 Long-Term Environmental Effects

In this section, discuss the long-term effects of the disposal facility on the environment. Effects are considered long term if the environmental impact continues to occur after site closure, e.g., the effects of long-term land commitment or possible radionuclide migration from the facility.

To reduce the long-term effect of radionuclide migration on the public safety, § 61.41 of 10 CFR Part 61 provides specific limits for the concentrations of radioactive material released to the general environment. In the license application, the applicant must demonstrate that the requirements of § 61.41 will be met. A duplication of this analysis is not necessary in the environmental report, but a summary of the results should be provided here for completeness.

5.2.1 Environmental Effects of Long-Term Containment

The applicant should describe the environmental effects of long-term containment of the waste in the disposal facility. Consider the effects of items such as land commitment, institutional safeguards, monitoring, maintaining access, and site maintenance. Discuss any measures designed to mitigate or reverse undesirable effects, any effects of long-term containment that may be beneficial to the region, and any irreversible and irretrievable commitments of resources.

5.2.2 Environmental Effects of Potential Radionuclide Releases

Describe the environmental effects of the migration of radionuclides and hazardous chemicals from the disposal facility. Radionuclide migration pathways, including air, ground water, surface water, plant uptake, and exhumation by burrowing animals, should be analyzed to demonstrate that the general population is protected from releases of radionuclides. The environmental effects described should include both radiological and nonradiological effects. Where applicable, reference the data provided in the license application to avoid unnecessary duplication.

5.2.2.1 Radiological Health Impacts. Describe radiological impacts of waste migration from the disposal facility on humans. Determine the internal dose received by ingestion or inhalation from the various pathways that may be assumed to exist at the site.

5.2.2.2 Nonradiological Health Impacts. Describe the health impacts of chemically hazardous waste migration from the disposal facility. Determine to the extent practicable the concentrations of hazardous chemicals in the ground water at the site boundary. Also describe the potential effects of hazardous substances from other pathways. These discussions should consider both the effects on the health of humans and the effects on the health of the local ecology.

5.2.2.3 Socioeconomic Impacts. Determine to the extent practicable the long-term socioeconomic impacts on the local and regional communities from the presence of the closed disposal facility.

6. ENVIRONMENTAL EFFECTS OF ACCIDENTS

In this chapter, the applicant should discuss the environmental and health effects of possible accidents that may occur at the facility during operation. Accidents due to human error should be addressed.

Provide accident analyses for the types of accidents listed below. Discuss the severity of the accident and its potential effect on the environment. A probability analysis based on existing data from operating sites and other studies may be used to assess the likelihood of such accidents occurring. Precautionary measures to be followed to lower the probability of occurrence of these accidents should be described. This discussion should provide a qualitative review, not a formal quantitative risk assessment.

Types of accidents to be addressed include:

1. Waste spillage,
2. Equipment failure or site worker error,
3. Fire and chemical reactions,
4. Mishaps involving transport vehicles,
5. Nearby offsite accidents, and
6. Possible criticality events if special nuclear material is to be a part of the waste received.

7. SUMMARY EVALUATION OF PROPOSED PROJECT

The information in this chapter should summarize the important adverse environmental impacts and the overall benefit-cost analysis for the proposed project. When presenting this information, the applicant should keep in mind that not all benefits and adverse impacts can be stated in monetary terms, although, when possible, they should be. This does not mean, however, that those benefits or adverse impacts that cannot be quantified should automatically be considered trivial. An attempt should be made to state the benefit or adverse impact in the terms that best describe it.

7.1 Unavoidable Adverse Environmental Impacts

Identify and describe the predicted adverse environmental impacts of the proposed waste disposal facility that cannot be avoided and for which no mitigative measures are planned. Organize this information according to the nature of the impacts: land use, ecological, socioeconomic, and radiological.

7.2 Irreversible and Irretrievable Commitments of Resources

Identify and describe the predicted irreversible and irretrievable* commitments of resources involved in the construction, operation, and closure of the proposed waste disposal facility that cannot be avoided by practical means. The analysis and summary should be presented in two sections: (1) irreversible environmental commitments by environmental categories and (2) irretrievable material resources used for the project.

7.3 Relationship Between Short-Term Uses and Long-Term Productivity of Man's Environment

This section should include an analysis and summary of the predicted short-term unavoidable adverse environmental impacts (or environmental benefits) of the construction and operation of the disposal facility and the predicted long-term adverse environmental impacts (or benefits) resulting from the disposal facility. "Short term" will be defined here as the period from start of construction to closure of the disposal facility. "Long term" represents the period extending beyond the closure of the facility.

7.4 Benefit-Cost Balance

This section should include a summary of the benefits and costs associated with the proposed waste disposal facility. This summary should provide a general discussion of the project benefits, a general discussion of the project costs, and a tabulation of all the benefits and costs arranged in categories.

* "Irreversible" applies to environmental resources and concerns commitments of the environment that cannot be altered at some later time to restore the present order of environmental resources. "Irretrievable" applies to material resources and concerns commitments of materials that, when used, cannot by practical means be recycled or restored for other use.

The summary of the project benefits should include all those benefits identified in the preceding sections of the environmental report and other benefits such as the service provided by the facility; increases in employment; State and local tax revenues; incremental increase in regional productivity; recreational, esthetic, or environmental enhancements; and creation or improvements of roads or other facilities. These should be quantified in monetary or other appropriate terms whenever possible; otherwise they should be presented in qualitative terms.

The summary of the project costs should include all those costs identified in the preceding sections of the environmental report. It should also include all other costs such as capital costs; transportation costs; operating and maintenance costs; and other social, ecological, or economic costs not previously described. These costs should be quantified in monetary or other appropriate terms whenever possible. If the costs cannot be quantified, appropriate qualitative terms should be used.

8. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

In this chapter, the applicant should describe the means by which the baseline data presented in other chapters were collected and should also describe the plans and programs for monitoring the impacts of the proposed activities on the environment.*

Section 8.1 should address the measurement of preexisting characteristics of the site and the surrounding region. This program should establish a reference framework for assessing subsequent environmental effects attributable to the proposed activity and for use as baseline reference data at the time of site closure.

Attention should be directed to two considerations pertinent to Section 8.1. First, the term "preexisting" refers to the characteristics of the site prior to any waste-disposal-related activities. A given characteristic or parameter does not require assessment prior to facility construction if that particular characteristic will not be altered at any stage. Second, in most instances this guide indicates the specific environmental effects to be evaluated; consequently, the parameters to be measured will be apparent. In some cases, it may be necessary to establish a monitoring program based on potential or possible effects identified by the applicant and to provide the underlying rationale for such a program. Accordingly, the plans for measuring preexisting conditions should be carefully reviewed to ensure that these plans include all factors that should be subsequently monitored as discussed in Section 8.2.

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

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

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

* A regulatory guide on site selection, suitability, and characterization is under development and, when issued, should provide additional guidance in this area. A branch technical position on this topic (NUREG-0902) is now available at current rates through the GPO Sales Program, ATTN: Sales Manager, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 or from the National Technical Information Service, Springfield, Va. 22161.

8.1 Preoperational Environmental Programs

The program to collect the initial or baseline environmental data before the environmental report is submitted should be described in sufficient detail to make it clear that the applicant has established a thorough and comprehensive approach to environmental assessment. The description of these programs should be confined principally to technical descriptions of instrumentation, scheduling, technique, and procedures.

Information from the literature should be concisely summarized and documented by reference to original data sources. If the availability of original sources that support important conclusions is limited, the applicant should provide either quotations from or references to accessible secondary sources.* In all cases, clearly distinguish information derived from published results from information derived from field measurements.

8.1.1 Meteorological Baselines

Describe the program for obtaining information on local air quality and local and regional meteorology.

Identify sources of meteorological data used to determine the atmospheric dispersion characteristics reported in Section 3.3. Specify locations and elevations of observation stations, instrumentation, and frequency and duration of measurements for the applicant's measuring activities and for activities of governmental agencies or other organizations on whose information the applicant intends to rely. The description should show the basis for predicting such effects as the dispersion of airborne effluents and should present the methodology for gathering baseline data.

Describe in detail any models used either to derive estimates of basic meteorological information or to estimate the effects of effluents, and discuss their validity and accuracy.

8.1.2 Hydrology and Water Quality

Describe the source of baseline ground-water data presented in Section 3.4.1. Provide a map of the site area showing the location of test holes, wells, springs, ditches, and drains used for the collection of baseline data. The location of lysimeters and tensiometers in the unsaturated zone should also be shown on the map. Provide a summary table for the sampling locations shown on the map with the following information:

1. Ground elevation, drilled depth, intake depths, and elevations for wells;
2. Frequency and period of sampling; and
3. Water quality and hydrological parameters measured.

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

Explain the rationale for the number and location of sampling points. Statistical analyses of data should be used to show that the baseline water-quality parameter has been accurately characterized. Possible correlations of the water-quality parameters with soil moisture and water table elevation should also be investigated. Measurements of water table and soil moisture should be sufficient to estimate the expected variations in these parameters throughout the life of the facility and to provide a reasonably accurate map of the ground-water table.

Also discuss precautions taken to avoid contamination of aquifers when installing monitoring wells or test holes in two aquifer systems.

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

8.1.3 Terrestrial Environment

In this section, discuss the program used to assess the ecological characteristics of the site with primary reference to important species identified in Section 3.2. The program for determining the presence and abundance of important species should be detailed in terms of frequency, pattern, and duration of observation.

Describe the methods used or to be used for observing natural variations of ecological parameters. If these methods involve indicator organisms, the criteria for their selection should be stated.

Discuss the basis for predicting any nonlethal physiological and behavioral responses of important species that may be caused by construction or operation of the facility. This discussion should be appropriately correlated with the description of the monitoring program.

8.1.4 Radiological Baselines

In this section, describe in detail the methods used to determine the pre-operational radiation levels at the site and the concentrations of radionuclides in important local and regional biota, soil, sediment, vegetation, air, and surface and ground waters. The following specific information should be provided: (1) the types of samples collected; (2) a map clearly showing sampling locations and keyed to a table listing sampling locations as a function of direction and distance from the proposed site; (3) analyses to be performed on each sample; (4) general types of sample collection equipment; (5) sample collection and analysis frequency; (6) lower limit of detection for each analysis; and (7) the approximate starting date and duration of the program. The discussion should include the justification for the choice of sampling sites, analyses, and sampling frequencies. Reference may be made to Sections 8.1.2 and 8.1.3 regarding meteorological and hydrological baseline studies.

The applicant should summarize any information available from the literature regarding background radiological characteristics of the site that were considered in designing the program.

8.2 Operational Monitoring

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

8.2.1 Meteorological Monitoring System

The applicant should describe the proposed operational meteorological monitoring system. In addition to the physical description, discuss how the data collected during the preoperational monitoring were used to design the operational monitoring system.

Also discuss details of proposed maintenance and inspection of the monitoring system.

8.2.2 Hydrological Monitoring System

The applicant should describe the proposed operational hydrological monitoring system. In addition, discuss how the baseline hydrological data were considered in the design of the operational monitoring system. Particular detail should be provided in discussing the piezometric surface and its expected variations, soil moisture variations, and the location of hydrostratigraphic units. Discuss how any routine liquid effluent releases (e.g., water that collects in operational trenches from precipitation) will be monitored. Details of proposed inspection and maintenance of the monitoring system should also be discussed.

8.2.3 Ecological Monitoring System

The applicant should describe the proposed operational ecological monitoring system. In addition, discuss how the baseline ecological data collected during the preoperational monitoring were used to design the system. Reference may be made to Section 8.1.3 regarding the selection of indicator organisms and statistical methods of analyses.

8.2.4 Radiological Monitoring System

The applicant should describe the proposed operational radiological monitoring system. In addition, discuss how the baseline radiological data collected during preoperational monitoring were used to design the system. As in the case of the preoperational monitoring program, the following specific information should be provided: (1) the types of samples collected; (2) a map clearly showing sampling locations and keyed to a table listing sampling locations as a function of direction

and distance from the proposed site; (3) analyses to be performed on each sample; (4) general types of sample collection equipment; (5) sample collection and analysis frequency; and (6) lower limit of detection for each analysis. The discussion should include the action levels for radionuclide concentrations in air and water samples and the actions to be associated with these levels. Reference may be made to Sections 8.2.1 and 8.2.2 regarding meteorological and hydrological operational monitoring.

8.3 Postoperational Monitoring

The applicant should describe the postoperational monitoring system (meteorological, hydrological, ecological, and radiological) as conceptually planned using available data. Also describe how data collected from the operational monitoring program and from the facility's inspection and maintenance program will be considered in the final design of the postoperational monitoring system. This postoperational monitoring system should be designed to be a continuation of preceding monitoring systems but at an appropriate level.

9. STATUS OF COMPLIANCE

In this chapter, list all permits, licenses, approvals, and other entitlements required by Federal, State, local, and regional authorities that must be obtained for protection of the environment, and discuss the status of compliance with these requirements. The discussion of alternatives in the report should include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements.

VALUE/IMPACT STATEMENT

The NRC staff performed a value/impact assessment to determine the proper procedural approach for providing guidance on the standard format and content of environmental reports for near-surface disposal of radioactive waste. This assessment resulted in a decision to develop a regulatory guide. The results of this assessment were included in a draft regulatory guide on this subject that was issued for public comment in April 1982. A copy of this draft guide and the associated value/impact statement (identified by its task number, WM 013-4) is available for inspection and copying for a fee at the Commission's Public Document Room at 1717 H Street NW., Washington, D.C.

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