

MAJOR CONSIDERATIONS FOR DEVELOPMENT OF A LICENSE APPLICATION FOR A NEW LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY IN ILLINOIS

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ABSTRACT

Chem-Nuclear Systems, Inc. was awarded a contract from the State of Illinois, Department of Nuclear Safety, to design, license, construct and operate the low-level radioactive waste disposal facility for the Central Midwest Compact states of Illinois and Kentucky. A complete license application was submitted by Chem-Nuclear in May of 1991 and after a coordinated review by the Department of Nuclear Safety and its subcontractors, questions requiring response were given to the company in November of 1991. This paper discusses how the license application took into consideration the federal and state guidelines for format and content of a license application and evaluated the site's natural characteristics against the site suitability requirements. Also discussed are how the design features and components met the performance objectives and how Chem-Nuclear performed analysis and computer modeling to assess the site and the design's ability to protect the environment and the long-term public health and safety.

INTRODUCTION

On May 15, 1991, Chem-Nuclear Systems, Inc. submitted a license application to the Illinois Department of Nuclear Safety. The license application is presently under review by the Illinois Department of Nuclear Safety's Division of Low-Level Radioactive Waste Management, which has the authority to issue a license for construction and operation of a low-level radioactive waste (LLW) disposal facility in Illinois. Major considerations in development of the license application for a new LLW disposal facility include: the regulatory framework that contains the specific legal, technical and administrative requirements to be addressed in the application; the natural site characteristics that encompass the site characterization and environmental studies performed to determine site suitability; the facility design that provides for the containment of the waste and waste constituents; and the safety and environmental assessment that both models and quantitatively analyzes the facility's operational and post-operational performance.

REGULATORY FRAMEWORK

The Federal Low-Level Radioactive Waste Policy Act requires each state to provide for the safe disposal of the low-level radioactive waste generated within its boundaries. The Act also encourages states to establish regional compacts so the wastes generated in several states can be disposed in a single host state. The State of Illinois and the Commonwealth of Kentucky joined to form the Central Midwest Interstate Low-Level Radioactive Waste Compact. Illinois has been designated as the host state for the low-level radioactive waste disposal facility.

The Illinois Low-Level Radioactive Waste Management Act (the Act) designates the Illinois Department of Nuclear Safety (the IDNS) as the agency responsible for licensing the low-level radioactive waste disposal facility. In July 1989, IDNS designated Chem-Nuclear Systems, Inc. (CNSI) as the facility developer and operator. Additional legislation enacted by the Illinois Legislature in June 1990 created the Illinois Low-Level Radioactive Waste Disposal Facility Siting Commission. This independent three-member panel was charged with evaluating the safety and suitability of the site

and the facility design. In June 1991, the Commission began a hearing on the IDNS proposal that Martinsville, Illinois, serve as the host community for the Illinois Facility.

To proceed with development of the Illinois Low-Level LLW Disposal Facility, two things must occur: the Siting Commission must approve the safety and suitability of the site, and CNSI must obtain a license from IDNS to dispose of low-level radioactive waste. It is the purpose of the license application to provide all interested parties with detailed evidence that the facility can be operated safely, and that CNSI possesses the technical, managerial, and financial resources necessary to design, construct, operate, and close the facility in compliance with all requirements (1).

The Illinois Low-Level Radioactive Waste Management Act states "No person shall operate any facility for the storage, treatment or disposal of low-level radioactive waste away from the point of generation in Illinois without a license granted by the Department of Nuclear Safety". The regulatory requirements for a license to construct and operate a low-level facility are contained in Illinois Administrative Codes 340, 601, and 606. Additional guidance used by an applicant in Illinois are found in licensing guidelines published by the Department. These licensing guidelines address topics that should be included in an application and the scope and extent to which they should be addressed.

Contained within this regulatory framework are requirements that the applicant explain how the natural and demographic characteristics of the site and adjacent vicinity have influenced the facility design and operating criteria, and show the adequacy of the site characteristics regarding the long term performance of the facility. Of particular importance to regulators and the public is information regarding: how the principle design features of the facility provide for the long term isolation of the disposed waste; how these design features minimize active maintenance after closure; and how the principle design features improve the site's natural characteristics in order to protect public health and safety.

NATURAL SITE CHARACTERISTICS

In January 1991, the IDNS proposed that the Illinois disposal facility be constructed at a site near Martinsville, Illinois. Martinsville, located in the east central part of the

state near the Indiana border and immediately north of Interstate 70, is a rural agriculture and manufacturing based community of some 1200 persons. The announcement of Martinsville as the site location by the Director of the IDNS culminated a four year process of site identification, site characterization and site selection. This project milestone was reached after surveying the state for governing bodies willing to allow the IDNS and their technical subcontractors to perform exclusionary and favorability analyses, identifying candidate areas, and performing designation and site characterization studies of specific sites within these approving governing bodies' jurisdictions.

The goal of this process was to fully characterize and select a technically suitable and politically acceptable location for the Illinois LLW site. To document this site characterization process, the IDNS subcontractor responsible for managing and completing this work presented an assessment of the site's compliance comparing the site's natural characteristics to the applicable regulatory site suitability requirements. The subcontractor also provided for collection, analysis and interpretation of the site's environmental, geologic and hydrologic conditions. Conclusions derived from the study of the site's natural characteristics were reviewed against Section 12(b) of the Illinois Act. The Act contains seven general criteria which a site must meet before it can be proposed as a suitable site for developing and operating a LLW facility.

The conclusions of the characterization of the site's natural characteristics, as contained in the Martinsville Alternative Site Investigation Studies, are that the site meets the seven requirements of 12(b) of the Act, and also meets the technical site suitability requirements of the Illinois Administrative Code (32 IAC Part 601) (2, 3). Based on these conclusions, Chem-Nuclear was able to begin the application development process.

DESIGN

The facility design and plans for construction are, like the natural site characteristics, integral elements of successful licensing. The IDNS licensing guidelines include how the application should describe the principle design features that improve the natural site characteristics for the protection of public health and safety, provide for long-term isolation of the waste and minimize the need for post-closure active maintenance by the site's institutional care custodian.

The State of Illinois has established four performance objectives for the facility to assure that exposures to workers and the general public to radioactivity are maintained within regulatory limits (3). The facility must meet these objectives through its design, construction, operation, closure and post-closure control, and they must be evidenced in the license application. The four performance objectives are:

- protection of the general population from releases of radioactivity;
- protection of individuals from inadvertent intrusion;
- protection of individuals during operations; and,
- stability of the disposal site after closure.

The performance objectives are achieved by using principle design features. A principle design feature is defined in NRC guidelines as "an important or prominent part of a land disposal facility requiring deliberate and purposeful planning to ensure safe construction, operation and closure of the waste

disposal facility" (4). The Illinois facility license application presented two principle design features: the disposal units for low-level radioactive waste, and the site drainage system. The two principle features are designed to achieve the performance objectives by applying the functional requirements specified by state regulations and by professional engineering codes and standards.(5)

The license application describes specific functional requirements the components of the facility must perform. The principal design features and other facility components will assure that the functional requirements are met.(6) The eleven functional requirements, listed below, are derived from the Illinois Administrative Code:

- minimizing infiltration of water into the disposal units;
- assuring integrity of the vault covers;
- providing structural stability of backfill, wastes, and covers;
- minimizing contact of waste with standing water;
- providing adequate site drainage during operations and after closure;
- facilitating disposal site closure and stabilization;
- eliminating to the extent practicable the need for long-term disposal site maintenance;
- providing a barrier against inadvertent intrusion;
- maintaining occupational exposures as low as reasonably achievable;
- providing adequate disposal site monitoring; and,
- providing an adequate buffer zone for monitoring and potential mitigative measures.

The disposal units, one of the two principle design features, are constructed for above ground disposal of waste materials and consist of an engineered multi-layered cover and a series of disposal modules within which are stored individual waste packages holding containers of low-level radioactive waste. Disposal modules serve as separate structural components and are the "building blocks" of the disposal unit. Each of the 192 modules is equipped with its own engineered features and monitoring devices for routine observation and monitoring of the facility's on-going ability to meet the performance objectives and principle design features.

The second design feature, the site drainage system, consists of a network of engineered drainage ditches supplemented by site grading that direct runoff to a retention/sedimentation pond. The overall site drainage system is designed to efficiently remove and contain runoff from the disposal areas, construction areas and operation building areas of the site. The networking of these ditches will allow for interception of flow along the *ground surface* and, by rapid removal, will reduce the amount of water available for deep infiltration.

SAFETY AND ENVIRONMENTAL ASSESSMENT

The safety and environmental assessment included in the license application demonstrates the site's ability to meet the requirements and various boundary dose limits contained in the Act and the Illinois Code. The application also shows, via model analyses and calculations, that the site will meet performance objectives through the five periods of site life.

In performing a safety and environmental assessment, an application must assess the potential impacts of the disposal facility during construction, operation, closure, post-closure and institutional care. For the Illinois facility these periods equate to 50 years of operation, 2 years for closure, 10 years for post-closure monitoring, and 300 years of institutional care, the first 100 of which is active and the remainder passive. The potential impacts that must be assessed include: radiological and nonradiological health effects, both from routine operations and from various accidental release scenarios; socioeconomic effects; and effects on land use, ecology and natural and cultural resources. In the application, these potential impacts are assessed and categorized as short-term or long-term. Short-term impacts may occur during site preparation and construction, facility operations, facility closure or post-closure. Long-term impacts may occur during or after the institutional care period. The assessment of potential impacts requires knowledge of the site's natural characteristics and the proposed design for the facility.

The license application also includes a discussion of the long-term stability of the disposal site and a description of the facility features which are designed to prevent an inadvertent intruder from coming in contact with the waste after the institutional care period. The assessment of long-term stability assumes that minimal active maintenance will be performed for at least 100 years after facility closure and evaluates the stability of natural and man-made slopes, the potential for settlement and subsidence, and the ability of the surface drainage and erosion control systems to continue to function.

SUMMARY

Chem-Nuclear Systems, Inc. in its application for a license to construct and operate a LLW disposal facility in Illinois addressed Federal Acts, State Administrative Codes and the State regulatory agency's guidelines for preparation of a license application. The applicant presented detailed

information on the natural site characteristics which must be present to meet site suitability requirements and details on how the principal design features assure that the facility will meet the functional requirements derived from the Illinois Administrative Codes. Finally, the applicant performed and presented in the application quantitative analysis and computer modeling sufficient to demonstrate that the regulatory requirements will be met and that the site will protect public health and safety.

REFERENCES

1. "The Illinois Approach: Guidelines for Preparing a License Application for a Low-Level Radioactive Waste Disposal Facility in Illinois", Illinois Department of Nuclear Safety, Springfield, Illinois (September 1990).
2. "Alternative Site Investigation Studies, Martinsville Alternative Site, Clark County, Illinois", Volume IV - Assessment of Site Compliance, Battelle Memorial Institute and Hanson Engineers, Inc., Springfield, Illinois (1990).
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5. "Design Basis Specification, Illinois Low-Level Radioactive Waste Disposal Facility, Martinsville Alternative Site", Chem-Nuclear Systems, Inc., Morrison-Knudsen Corporation, and Dames & Moore, Springfield, Illinois (September 1990).
6. "Illinois Low-Level Radioactive Waste Disposal Facility - License Application to Illinois Department of Nuclear Safety", Volume 5, Chem-Nuclear Systems, Inc. (May 1991).