

LICENSING ISSUES IN WASTE ISOLATION

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INTRODUCTION

The National Waste Terminal Storage Program conducted by the Department of Energy has as its goal the development of necessary technology and the qualification of adequate sites in geologic media to isolate nuclear waste from the commercial nuclear fuel cycle. Through public laws, the Department of Energy has control of all waste generated from nuclear activities and is charged with finding appropriate methods to isolate this waste from man and his environment. Through other public laws, the Nuclear Regulatory Commission is charged with developing the necessary licensing capability, promulgating regulatory guides and carrying out activities to fully license these repositories in such a manner that they will, in fact, adequately protect the environment and the public health and safety from nuclear waste. To fulfill their respective roles, the Department of Energy and the Nuclear Regulatory Commission are vigorously developing the necessary technology and capabilities to locate and qualify adequate sites and to provide licensing capabilities to meet these goals for geologic repositories in the continental United States. The Department of Energy on one hand will be acting as an applicant and as such must provide through license application documents the necessary data base, engineering, environmental, and safety analyses to satisfy Congress, the public, and the regulatory bodies that the environment and public health and safety are adequately protected. The Nuclear Regulatory Commission on the other hand has the responsibility for promulgating the criteria and regulatory guidance deemed necessary to evaluate and assess the Department of Energy's application for a repository and eventually to determine site suitability and containment provided by the proposed repository. All of this activity must be conducted in an open and straightforward manner to provide the public adequate means for participation in the site selection and licensing process. Ultimate issuance of a license to the Department of Energy for the construction and operation of a deep geologic nuclear waste

isolation repository must reflect public acceptance of such action as well as adequate assurance that the action will provide for public health and safety. Even though there have been in the past 30 years a large number of nuclear facilities constructed and operated in the United States by the Department of Energy and its predecessors -- the Energy Research and Development Administration and the Atomic Energy Commission -- no attempt has ever been made to provide for permanent isolation of nuclear waste. Considerable amounts of waste are already in existence, primarily from defense activities. However, these wastes are presently contained in liquid and semi-liquid forms in engineered structures near the surface of the earth. These wastes and those presently being generated by commercial nuclear power reactors will ultimately need to be processed in some manner and placed in facilities which will isolate them from the human environment with a minimum amount of surveillance required.

Although a considerable number of nuclear facilities have been licensed by the Nuclear Regulatory Commission and its predecessor, the Atomic Energy Commission, no application for a permanent waste isolation facility has ever been made. Therefore, the necessary data base criteria and regulatory guides for accepting and processing such an application do not exist. The development of this data base and the necessary criteria and regulations are in process and are expected to be available in time to receive the first application for a repository. However, these criteria and regulatory guides have not been exercised and there are a number of technical questions and social and political considerations that must be addressed prior to actually exercising these regulations.

It is expected that the issuance for review of the Generic Environmental Impact Statement (GEIS) for commercially generated nuclear waste will bring to light many of these questions and provide a public forum in which they may be discussed and hopefully in many cases be resolved. However, it is felt that a number of issues may still remain unresolved by the time the Department of Energy applies for a construction permit for its first repository, and it is this subject that will be discussed in the remainder of the paper.

In order to systematically discuss these issues, it was felt necessary to group them in some order. The order selected

and used herein follows closely the life cycle of selecting and qualifying a site; licensing process; and the construction, operation and eventually closing or decommissioning of a proposed repository.

ISSUES RELATED TO SITE SELECTION

Those issues related to a site for a repository are primarily concerned with the process of selecting a site, evaluation of alternative sites, acquiring public acceptance of sites, and the involvement of the public and the states in determining where sites will actually be located. The site selection process developed by the Department of Energy must be such that it will support the evaluation of alternative sites as required by the National Environmental Policy Act (NEPA) and lead to a site which can be qualified in terms of providing the necessary barriers to the release of radioactivity over a long term. Therefore, the site selection process and the eventual recommendation of a given site for a geologic repository must satisfy both the technology and engineering aspects required for isolation of nuclear waste, as well as the social, economic, and public acceptance aspects of locating a site within the United States or some particular region thereof. There is, however, some concern regarding the ability of any particular siting process to provide an adequate discussion of alternative sites. The fact that the United States is so large and that there is a wide variety of media that might be acceptable for containing a repository makes it almost impossible financially and time-wise to do an exhaustive alternative site evaluation. There may never be a time when enough information is available from each kind of medium from various parts of the United States such that a logical evaluation can be made leading to the designation of a best site. Therefore, some other approach must be taken, such as site selection on a regional or on a host-rock basis. If the national policy should eventually be to have repositories in various regions of the United States, some of the problems associated with alternative site evaluation could be lessened.

The Nuclear Regulatory Commission has made it clear that it would like to be involved in the site selection process. As the selection and recommendation of a site for a deep geologic

repository is a unique undertaking, it is felt that early involvement of the regulatory staff could be a positive action in ultimately selecting a suitable site. This involvement would not be official but would be more of a guidance nature with the guidance being provided by the review of characterization and recommendation documents as the siting process narrows from regions and areas to specific locations. The exact procedure by which this interaction may be carried out is not yet fully defined.

The multiple barrier concept which has been used to direct technology development and is required in the present conceptual designs for waste repositories, continues to be an issue in regards to how these barriers may be evaluated in the licensing process. In general, these barriers consist of the waste form itself, any cannisters or overpacks that may be placed over the waste, any backfilling materials that may be used for special purposes after the waste is placed in the repository, the medium in which the repository is located, and the geologic structure or formation that surrounds the host medium. Each of these barriers is expected to provide some additional protection of public health and safety by slowing down or retarding the release and transport of radioactivity in the geosphere. However, there is some question as to which of these barriers one may actually take credit for when doing long-term safety assessment analyses for licensing applications. This issue will probably remain largely unresolved and credit for any of these barriers will have to be defended by the applicant in his license application materials.

The actual designation of a given site as a proposed site for a repository will depend in a large part on the public's acceptance of such an action and the participation of individuals and organizations and even states in the site selection process. Exactly what this process should be and how states, organizations and individuals may participate in the site selection process is still an open issue. It may be dependent on the process used in the development and promulgation of site selection criteria. With the open process the Department of Energy has promised, the considerable participation by individuals, organizations, and states will be reflected in the ultimate criteria used for the selection of any particular site.

Other related issues in the site selection arena include those of ownership or control of the land and geology in which the repository may be located, methods for determining long-term stability of such a formation and the actual methods and procedures for exploring geologic formations to determine their suitability for repositories.

Though there are several issues still unresolved in the site selection process for a geologic repository, considerable work is presently in progress -- under sponsorship of the Department of Energy, the Environmental Protection Agency and the Nuclear Regulatory Commission -- to provide an adequate data base for making these decisions. Early discussions and interactions between the applicant and the regulators and early developments and promulgation of regulatory guides and criteria is expected to lead to acceptable methods of exploration and site selection.

ISSUES IN CONGRESSIONAL FUNDING

As site selection and technology development progress, the Department of Energy will be required to submit a request to Congress for funding for the design and construction of a proposed repository. This legislative action may require the preparation of a draft environmental impact statement (DEIS) to accompany the Department's request in direct response to the National Environmental Policy Act. During its deliberations, Congress may call hearings. These hearings may be relatively closed and of a highly technical nature or they may be rather open public hearings. This issue may cause considerable perturbation in the overall timing and scheduling of funding and licensing activities for a repository. It is not clear at this time how the states or public groups or individuals would be allowed to participate in such hearings if they occur. The Department of Energy is not expected to have any appreciable control over this review and hearing process. However, they will be a major participant in these hearings and will be expected to provide considerable input and answers to questions that may be raised. There is some question as to what issues would actually be discussed in these funding hearings; that is whether the scope of the hearings would be limited only to repositories or whether they would

include all aspects of the nuclear fuel cycle. It is evident that the scope of the Congressional review and hearings could have a considerable impact on the overall licensing process for a geologic waste repository if they were to occur.

ISSUES RELATED TO LICENSING APPLICATIONS

It is anticipated that the licensing procedure for a geologic waste repository will be similar to the process that has been developed for the review and licensing of other fuel cycle facilities, particularly, nuclear power reactors. The documentation that will be required is expected to be similar, that is, one will be required to proffer a quality assurance manual, a preliminary safety analysis report (PSAR), and environmental report (ER), and ultimately a final safety analysis report (FSAR) or documents which will be similar in format and content. It is expected that these documents will be reviewed by the NRC staff and by the Advisory Council on Reactor Safeguards (ACRS). It is also expected that public review and other agency review of these documents will follow the same procedures as have been followed for nuclear power reactors. It is also expected that public hearings with intervention and appeals will follow in the same licensing manner. It is expected that there will be a series of questions and answers between the staff and the applicant in order to clarify materials which have been offered for review. However, there are still a number of issues which are open and are expected to be subjects for discussion for some time to come. High on the list of issues is the development of criteria. Though dependence may be made on criteria developed for nuclear power plants, many criteria will need to be developed for facilities, processes, and operations unique to repositories. Normally, the development and acceptance of criteria is rather a lengthy process as is evidenced by some criteria that are still under development for the nuclear power industry. Therefore, it is expected that the criteria factors and specifications used in the first application for a repository will need considerable justification in application documents. The data to justify these criteria will come primarily from research and development presently being conducted to provide the basis for repository technology. Detailed safety analyses will be required in order to assess the application of criteria to protecting the health and safety of the public.

Along these lines will be the application of the principle of as low as reasonably achievable (ALARA) radiation dose. When and how this principle will be applied in the licensing of a repository is also an open issue. The application of the ALARA concept can only follow the accumulation of a considerable knowledge of equipment and processes and consequences of certain actions and operations. Since the construction and operation of a geologic repository is a unique action, there will be essentially no experience upon which to base a determination of as low as reasonably achievable. There may be certain aspects of design and operation of surface facilities to which this principle may be applied. However, the application of this principle to the construction of the underground facilities and the operation of these facilities is highly questionable. The guiding principle in this case may be the evidence that the repository design and operation and ultimate confinement of the waste will be adequate to protect the health and safety of the public.

The determination of design basis accidents for a repository is an additional issue in the licensing process. What accidents actually relate to design bases of a mine may be in question and what kinds of accidents may provide or lead to the most severe release of radioactive material may be difficult to determine. The method of performing the safety analysis will also be of concern. For example, what credit will be allowed for multiple barriers, will the analyses be of a probabilistic or of a deterministic nature and how will safety analyses fit in with the total systems analysis of the repository?

The inclusion of decommissioning plans in the license application may cause some consternation. The strategy of decommissioning or of mine closure is a very ambiguous subject. The determination of criteria for continuous backfilling or closure of rooms is undetermined and the advantages of keeping the whole repository open until it is filled is in question. There are a number of factors which affect the decision on decommissioning and decommissioning will have a large effect on the type of safety and systems analyses that may be required for the repository. The effect of heat generated in the fuel when it is actually in place, whether the fuel is in a storage mode in the repository during its cooling process or on the surface will affect licensing. The overall process of reviewing the license application and issuing a construction permit

is another open issue. It is anticipated that the lead agency concept will be used for repositories. The necessary inter-agency agreements and memoranda of understanding must be negotiated prior to the NRC's accepting an application. This process will involve the identification of those agencies which may have some authority in the licensing of the repository, as well as how this authority must be handled in the overall licensing process.

In the present licensing procedure for nuclear power plants, there is an option for the applicant to request a limited work authorization (LWA) in order to meet his needs, schedules, or funding. There is some question in regards to the licensing of a repository as to what kinds of permits should be issued, i.e., what operations they should govern. There is a difference in the approach to the design and construction of an engineered structure and the development of a mine. There is some question as to whether it will require more than one step in licensing of the construction activities of a geologic repository. How many steps (permits) may be required prior to operation of a repository could considerably affect the overall schedule and effort required in the submittal of licensing documents.

ISSUES AND CONSTRUCTION ACTIVITIES

Several issues are still unresolved as concerns the construction schedule for a repository. These issues seem to revolve around the central issue of the construction of or development of a mine, that is, whether a mine can be designed in total or whether a mine needs to be developed as you move into each new area of rock. This concept will probably have considerable effect on whether or not a limited work authorization will be required for the drilling of a shaft or the drilling of horizontal drifts. It may be that a permit would allow only drilling of a shaft and that additional information would have to be gathered and evaluated before further drilling would be permitted. Because of the unknowns at the time of application, the review of data and testing of the mine cavities during excavation will be much more extensive than one would normally expect during the construction of surface facilities which brings us to the issue of the role of the NRC

Office of Inspection and Enforcement (OIE) in the overall construction activities of the underground facilities for the repositories. This issue is mostly unresolved and may encompass the ability of the OIE to conduct such work and their relationship to the Mining Safety and Health Administration. Inter-agency agreements and memoranda of understanding between the Nuclear Regulatory Commission and Government agencies involved in underground mining may be required. The extent of these requirements and the adherence to standards set by these other agencies is still an open subject.

ISSUES RELATED TO THE OPERATION OF THE REPOSITORY

As related earlier, it is expected that the operating license stage will be more prolonged and more detailed than the operating license stage for nuclear power reactors. Even though a construction permit might be issued for a repository and construction activities might proceed continuously under this permit, considerable information will be gathered during construction and operation as a result of continual testing in the cavities and drifts to determine the characteristics of the rocks and to continually update the design of the repository. As a result of the testing and other activities conducted during construction, it is expected that the final safety analysis report and the updated environmental report necessary for an operating license will be considerably more detailed than in other nuclear facility applications. It is also possible, because of the detail of the application and the quantity of new materials presented for the operating license application, that the Nuclear Regulatory Commission will require public hearings for this activity. These kinds of reviews and public hearings have not normally been required for nuclear power plant licensing.

Issues that still remain open for operation of the repository are primarily associated with the accountability of the waste, the operation of the facility according to the principle of as low as reasonably achievable exposure to operating personnel, and the development of requirements for emergency plans. A discussion of the ALARA principle for the operation of a repository follows the argument given in the section on construction, that is, there is not enough experience

to determine what is as low as reasonably achievable and that the guiding principle will most likely have to be: is the procedure and the operation acceptable in light of protection of personnel, the environment, and public health and safety.

Emergency plans for a repository are expected to be somewhat different than those associated with a nuclear power facility. As with other safety analyses conducted for the application, one must consider those aspects of the waste material and the operation that might lead to the release of radioactive materials. It is evident in these analyses that the potential for release of radioactivity is considerably less for a repository than a power plant primarily because the potential energy of the waste in a facility of this sort is many orders of magnitude less than the potential energy in the core of a nuclear power reactor. However, in terms of emergency plans for operating personnel, there are some unique differences due to the presence of the underground facilities. It is expected that development of these plans will be predicated by the standards soon to be promulgated by the Environmental Protection Agency.

ISSUES RELATED TO REPOSITORY DECOMMISSIONING FOR CLOSURE

The integrity of the overall repository must be maintained subsequent to filling the repository with waste material. It is anticipated that the weakest part of the confinement of the repository will be associated with the drilled holes that were required for operation of the repository itself. These are the large shafts used for transporting and ventilation and other holes drilled in the vicinity of the repository for exploration and testing. Even though consideration must be given to methods for backfilling in regards to weakening of the formation by structural changes, the largest issue at hand is the ability to plug or seal these man-made entrances into the repository.

The decommissioning of engineered facilities on the surface is expected to be a relatively straightforward operation and one which can be related to the decommissioning of nuclear fuel cycle facilities already conducted. Another issue that is

still outstanding is that of monitoring requirements during and following the closure of a repository. The ultimate goal of a repository is to provide maintenance of the waste in the geologic formation. Therefore, if the formation is properly selected and evaluated and if the repository is properly designed, constructed, operated and backfilled, one should be able to walk away from the repository knowing that the repository will remain intact for the period of time necessary to keep the radioactive waste out of the biosphere. Should all of these requirements be met, it seems evident that no monitoring should be required at all. However, it seems prudent that some monitoring should be conducted in and near the repository for some period following closure. This monitoring should provide the proof that the integrity of the repository is being maintained. However, there is considerable discussion as to what kind of monitoring is needed, whether proper measurements can be made to show that the integrity is being maintained and how monitoring data should be evaluated in order to determine these conditions.

The ability to close and seal and demonstrate the integrity of a geologic repository is a major concern of regulatory agencies and the public. The ability to license a repository may be determined in large part by the public's conception of the Department of Energy's ability to seal a repository and to maintain that closed repository for long periods of time necessary to guarantee public health and safety from isolated waste. Therefore, some of the prime issues in the decommissioning area are those concerned with developing criteria for closure of a repository; for example, what constitutes the integrity of a repository, how does one determine whether that integrity has been maintained, and how long does that integrity need to be maintained, what constitutes the volume of the repository, and how does one determine whether the waste has gotten out of that volume?

PROVIDING A MECHANISM FOR IDENTIFICATION AND RESOLUTION OF LICENSING ISSUES

The Department of Energy in determining its strategy for site selection and licensing of a geologic repository has considered the feasibility of preparing and submitting to the

Nuclear Regulatory Commission a preliminary information report (PIR). This information report would be prepared in a format and content similar to that expected to be necessary for a preliminary safety analysis report required for an application to construct a repository. This report would be based on a conceptual design for a repository in a reference geological/environmental regime. The data, criteria and analytical methods used for the analyses of the repository would be that information presently available from programs conducted by the Department of Energy. The report would be directed toward presenting the state-of-the-art of repository design, operation and decommissioning. Safety analyses would be performed on this system to indicate the state of analytical methods for near-term and far-term safety assessments for a proposed repository. The purpose of preparing this report would be to initiate meaningful discussions between the Nuclear Regulatory Commission and the Department of Energy in regards to licensing of a geologic repository.

The report when submitted to the Nuclear Regulatory Commission would also be submitted to the ACRS and made available to the public, interested states, and other government agencies. Review of the document and resulting discussions are expected to resolve many licensing issues and to identify specific issues which may require additional attention. The overall objective of such a report would be to focus the discussions of licensing a repository on those issues which are deemed most important. The results of the NRC review would be a preliminary safety evaluation report of the conceptual system. The results of the ACRS review would be a letter identifying unresolved concerns. The information gained from this review could lead to further definitions of major criteria and a better understanding of the important aspects of repository licensing.

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