

**Licensing an
Assured Isolation Facility
for Low-Level Radioactive Waste**

**Volume 1:
Licensing Strategy and Issues**

*National Low-Level Waste Management
Program*

July 1998

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**Volume 1:
Licensing Strategy and Issues**

July 1998

Prepared for the
**National Low-Level Waste Management Program
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ABSTRACT

This Report provides a detailed set of proposed criteria and guidance for the preparation of a license application for an assured isolation facility (AIF). The Report is intended to provide a detailed planning basis upon which a prospective applicant may begin pre-licensing discussions with the Nuclear Regulatory Commission and initiate development of a license application. The Report may also be useful to the NRC or to state regulatory agencies that may be asked to review such an application. Volume 1 of this Report provides background information, and describes the licensing approach and methodology. Volume 2 identifies specific information that is recommended for inclusion in a license application.

DISCLAIMER

This Report is the product of Department of Energy contractors and independent reviewers who have experience in preparing license applications for fuel cycle facilities, and represents their best technical judgment regarding the contents of such applications and the potential standards that may be used by regulatory agencies for their review.

However, the Report has not been formally reviewed or approved by the U.S. Nuclear Regulatory Commission or specific Agreement State agencies that may be responsible for reviewing and evaluating such license applications. Therefore, any organization planning to prepare a license application for an assured isolation facility, as described in this Report, should consult with applicable regulatory agencies prior to proceeding with the development of such an application.

Neither the United States nor the United States Department of Energy, nor any of their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in the Report.

FOREWORD

The National Low-Level Waste Management Program (NLLWMP) provides technical assistance to state agencies and compact organizations on matters related to the management and disposal of low-level radioactive waste (LLW). The NLLWMP is operated by Lockheed Martin Idaho Technologies Company at the Idaho National Engineering and Environmental Laboratory, with funding and direction from the Department of Energy's Idaho Operations Office.

The NLLWMP was asked by representatives of six states (Connecticut, Massachusetts, Michigan, New Jersey, New York, and North Carolina) to conduct an in-depth examination of regulatory issues related to the licensing, by the U. S. Nuclear Regulatory Commission (NRC) or an NRC Agreement State, of a LLW assured isolation facility (AIF or facility).

This Report has been prepared for the NLLWMP by the law firm of Morgan, Lewis & Bockius LLP (ML&B) with technical assistance from Rogers & Associates Engineering Corporation, Incorporated (RAE). Experience profiles for the preparers and the principal personnel involved in the development of the report are included in Appendix A of this Volume.

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Licensing an Assured Isolation Facility for Low-Level Radioactive Waste

Volume 1: Licensing Strategy and Issues

1.0 INTRODUCTION

No new disposal facility for the full range of low-level radioactive waste (LLW) has begun operation in the United States since 1979. Because of the difficulty in establishing new disposal facilities, several states have been interested in determining whether development of an assured isolation facility (AIF or facility) may provide a feasible approach for achieving the primary objective of disposal -- the safe, long-term management of commercially-generated LLW. While existing Nuclear Regulatory Commission (NRC) regulations provide an appropriate framework for licensing such facilities, there is no detailed licensing guidance directed specifically towards the particular attributes of an AIF. Detailed guidance is available for near-surface LLW disposal facilities and for certain types of "materials" license facilities which may possess source material, byproduct material or special nuclear material. Other nuclear fuel cycle facilities are typically licensed by applying pertinent provisions from various parts of NRC regulations.

The purpose of this Report is to provide a detailed set of proposed criteria and guidance for the preparation of an AIF license application for submittal to the NRC. The Report is intended to provide a detailed planning basis upon which a prospective applicant interested in pursuing an AIF may begin pre-licensing discussions with the NRC and initiate license application development. The Report may also be useful to the NRC or to state regulatory bodies that may be asked to review an AIF license application in formulating application review guidance.

Pursuant to Section 274 of the Atomic Energy Act and applicable NRC policy, Agreement State requirements must be compatible with NRC regulations. Typically, Agreement State requirements and regulatory interpretations closely parallel NRC regulations and interpretations. Thus, the guidance in this Report should also be helpful to an Agreement State applicant in preparing an AIF license application. An applicant would need to tailor its application to the requirements of the particular Agreement State agency. Because of the potential range of variation in state requirements, no effort was made in this Report to identify and address such differences. The proposed licensing guidance is based exclusively on NRC licensing criteria.

The Report is composed of two volumes, as described below.

Volume 1

This volume, Volume 1, describes the background information, licensing approach and methodology used in the project. It is organized in the following manner:

Section 1 provides this Introduction.

Section 2 provides a general description of the principal attributes of an AIF. That description was used as the basis for the analyses performed by ML&B and RAE.

Section 3 provides an overview of the basic licensing approach used in the Report and the rationale for selecting that approach. The approach was chosen based upon the determination by ML&B that it represents the most efficient strategy for obtaining an AIF license. However, the approach selected is not without certain disadvantages. Therefore, both the advantages and disadvantages of the proposed approach are presented.

Section 4 discusses the preferred licensing approach in more detail and summarizes the basic components of the NRC licensing guidance selected for use. It highlights the key issues that were confronted as such guidance was considered, and then either applied or not. An AIF license applicant, of course, may choose to address one or more of those issues in a different manner and still remain within the framework of the basic licensing approach discussed in Section 3.0.

Section 5 describes the methodology used in the analysis and selection of the detailed licensing guidance and criteria, and summarizes the nature of the external reviews that were conducted in preparing the Report.

Volume 2

Volume 2, entitled "Recommendations on the Content and Review of an Application," contains the detailed licensing guidance developed for an AIF application. Volume 2 provides the following specific information:

- 1) A detailed outline of topics to be covered in an AIF license application in the form of a proposed license application table of contents;
- 2) An identification of the information appropriate and necessary for inclusion in such a license application for each topic -- comparable to an NRC Standard Format and Content Guide¹ entry;

¹ The NRC issues Standard Format and Content Guides (SF&CGs) to provide license applicants with detailed guidance on an acceptable format for and content of license applications.

- 3) An identification of appropriate regulatory agency review guidance for each application topic -- comparable to an NRC Standard Review Plan;² and
- 4) A summary of the bases for selection of the application content information (item 2 above) and agency review guidance (item 3 above), in order to assure that the rationale for selection or rejection of existing NRC guidance is clear.

2.0 ATTRIBUTES OF AN ASSURED ISOLATION FACILITY

An AIF is a robust engineered facility in which LLW is isolated for an indefinite period of time. For purposes of this Report, it has been assumed that the AIF will be comprised of above grade, reinforced concrete vaults with engineered earthen covers as illustrated in Figure 1. Where protection from freezing and thawing is not required, other suitable protection may be provided to assure integrity of the concrete vault roof, and divert precipitation and infiltrating water away from the concrete vaults.

The licensing guidance provided in this report pertains only to an AIF housing byproduct material as defined in Section 11.e(1) of the Atomic Energy Act of 1954, as amended, source material, and special nuclear material. While the AIF concept and guidance contained in this Report may be appropriate for the management of naturally-occurring or accelerator produced radioactive materials, uranium or thorium mill tailings, mixed hazardous and radioactive waste, or waste that exceeds Class C limits, no attempt was made to identify and incorporate specific provisions addressing these waste types.

² The NRC issues Standard Review Plans (SRPs) to provide uniform guidance to the NRC Staff on review of license applications. These SRPs typically conform closely to the Standard Format and Content Guide used by license applicants in preparing their license applications and provide, among other things, evaluation and acceptance criteria for use by the NRC Staff in conducting application reviews.

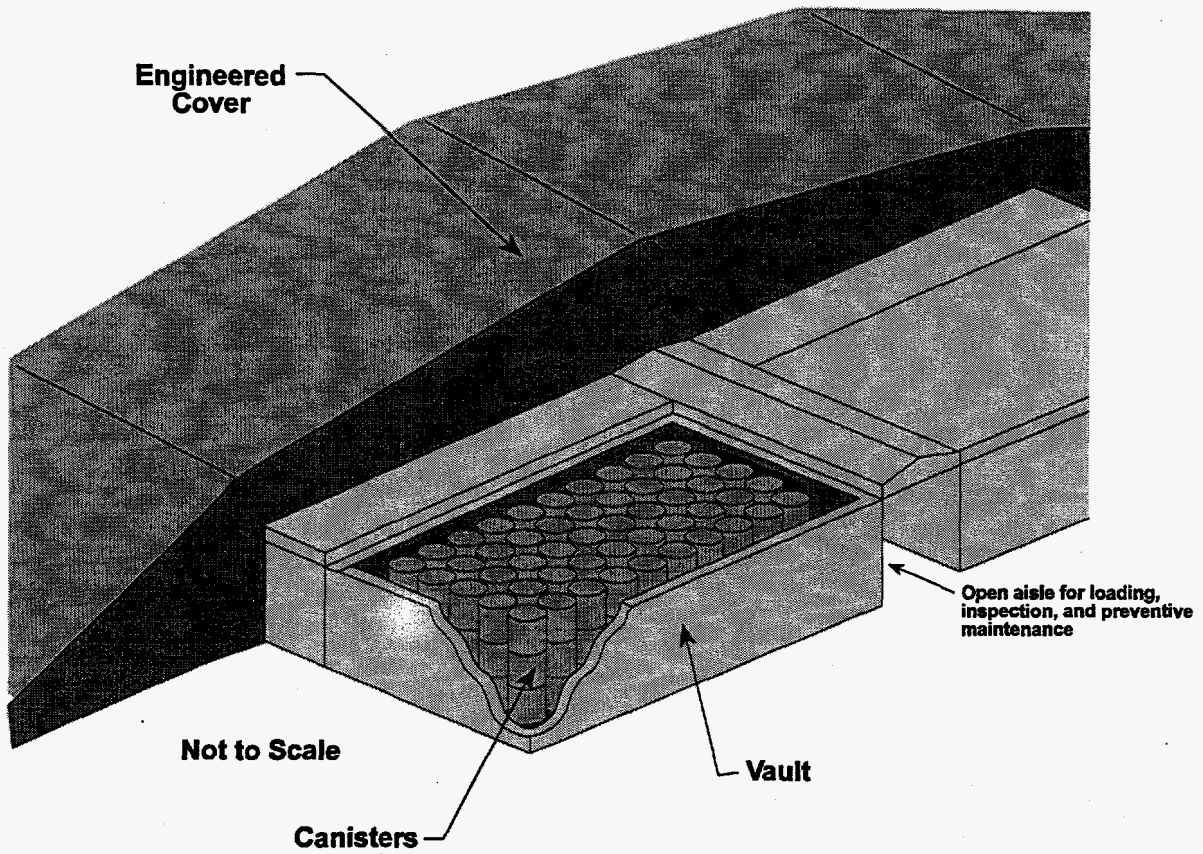


Figure 1. Perspective of an assured isolation vault.

It has also been assumed that commercially generated waste classified as Class A, B or C waste pursuant to 10 CFR § 61.55 or DOE waste with similar characteristics would be placed in the facility in cylindrical, reinforced concrete containers which are then placed in the vaults. A granular material would be used to fill any void spaces inside each concrete container. Spaces between the waste containers and the vault walls would be left open to allow movement of equipment and personnel for inspection and maintenance activities. Where utilized, the earthen cover resembles, but is not as elaborate as, the complex multi-layered cover usually specified for an earthen covered above-grade LLW disposal facility. The engineered cover would be designed to protect the concrete from freeze-thaw cycles and would also divert precipitation and infiltrating water away from the concrete vaults. Drains would be constructed within the facility as a secondary safeguard that could route any water that may reach the floors of the vaults into collection tanks. The engineered cover and drainage channels would ensure that surface water would be diverted away from isolation units.

During the operating life of the AIF, the waste and the facility itself are subject to active, ongoing monitoring and maintenance. To assure protection of public health and safety, reliance is placed on regular direct inspection and maintenance of the engineered facility and the individual waste containers, rather than on monitoring for radioactive releases in the groundwater surrounding the facility. As analyzed in this Report, the AIF would continue to be actively monitored and maintained throughout the license term and until completion of decommissioning. The AIF would be operated in a manner that preserves the widest range of future waste management options.

For additional discussion of the AIF concept see *Life Cycle Costs for Disposal and Assured Isolation of Low-Level Radioactive Waste in Connecticut* (DOE/LLW-246, March 1998), prepared by Rogers and Associates Engineering Corporation for the NLLWMP.

3.0 BASIC LICENSING APPROACH

The criteria for licensing and regulating an AIF are designed to ensure that, from a health and safety standpoint, the facility can accomplish its limited regulatory objective: *To safely isolate LLW over the term of the license.* (See The Term of the License, Section 4.5 of this volume). The licensing requirements, themselves, would not go beyond the criteria necessary to accomplish this objective. These regulatory criteria would include, among other things, adequate financial assurance arrangements to ensure that a means is available to decommission the facility and its waste contents at any point during the license term, or upon license termination.

In addition to meeting these regulatory objectives, however, such a facility would likely be designed, built and operated in a manner that would allow continued operations long past the initial licensing period and well into the indefinite future. The facility would be designed and operated in a manner that would ensure the preservation of a wide range of options for future management of the waste. On an ongoing basis, a facility operator would likely collect and

analyze data about the performance of the engineered structures that could support future decisions related to the regulatory status of the facility and its waste contents. These activities, however, would be driven primarily by investment considerations rather than regulatory requirements, and would be conducted in accordance with the facility's operating or management plan.

The relationship between the licensing strategy and a prudent, comprehensive management plan is significant. In order to obtain from public or private investors sureties adequate to meet regulatory demands, especially decommissioning requirements, it would be necessary to undertake design, construction and operating activities that go beyond those required simply to isolate waste in a safe manner for a fixed licensing term. Risk underwriters, whether public or private, would want a high degree of confidence that the facility would not be shut down for inability to safely isolate the waste during the term of the license. They would want to have a high degree of confidence that the facility would have no trouble meeting requirements for license renewal long into the future.

The AIF will involve the receipt, packaging or containerization, and long-term monitored isolation of LLW in a highly-engineered facility. Materials received will be a combination of source material, byproduct material and special nuclear material. Thus, the criteria to be applied to the licensing review should provide reasonable assurance that the materials can be received, packaged and isolated at the AIF without undue risk to public health and safety or the common defense and security. From a regulatory perspective, the AIF can and should be viewed as a materials license facility comparable to those licensed in the past under 10 CFR Parts 30, 40, and 70, and the appropriate radiation protection guidance of Part 20. This Report concludes that an AIF can and should be licensed under such regulations.

However, the NRC materials licensing regulations set forth in Parts 30, 40 and 70 are broadly written to encompass a wide range of facilities and materials uses, and do not provide the level of detailed guidance that a prospective AIF license applicant would most likely desire. To develop guidance specific to an AIF application, NRC interpretive guidance documents developed under Parts 30, 40 and 70 were consulted and applied as appropriate.

In addition to these, 10 CFR Part 61 also provides a useful source of information from which to draw some of the licensing criteria for an AIF. NRC guidance governing the format, content and NRC staff review of a license application under Part 61 was adopted and utilized where it was determined that such guidance provided the best source of information for the license application. It is important to note, however, that such criteria have only been used to provide more detailed licensing guidance to an AIF applicant for licensing the facility under the requirements of 10 CFR Parts 30, 40 and 70. An AIF would not be licensed under Part 61.

Using Part 61 provisions in some cases can also help to preserve future waste management options, a key element of the AIF concept. For example, specifying waste acceptance criteria and recordkeeping requirements that are normally associated with near surface disposal facilities

would help ensure that the waste could be accepted by another waste management facility or a disposal facility in the future.

Part 61 regulatory criteria, however, must be selectively applied. Part 61 includes many provisions whose only purpose is to facilitate the closure, institutional control, and eventual termination of active monitoring and maintenance of a near surface disposal facility. For example, extensive site characterization data are collected and analyses performed in order to meet Part 61 requirements. Such information is needed because, under the Part 61 concept, the facility structures and waste will be covered with earthen material and will no longer be accessible for direct inspection long before data can be obtained to predict the actual long term performance of the manufactured barriers. While an AIF will not foreclose, and indeed may be specifically designed to preserve, the option of terminating active monitoring and maintenance in the future, the proposed licensing approach recognizes that such termination may never occur, or may occur at a time so far in the future that it would not be prudent or reasonable to attempt to obtain a license today for such activities.

A potential disadvantage of the preferred licensing approach is that, if siting requirements for near surface disposal of LLW in the future continue to be based on the precepts of today's Part 61, then it may be difficult to close the AIF and discontinue active oversight of the facility if the AIF operator wishes to do so. This would foreclose one available waste management option.

Two considerations, however, mitigate the impacts of such an outcome. First, after a long period of institutional control, a portion of the waste in the AIF may have decayed to levels no longer requiring the kind of isolation provided for in a Part 61 facility. Over an extended period of time, LLW might even be transferred out of the facility to a more appropriate disposition. Under such a program, the AIF itself might be decommissioned in stages, until only a small residual of the waste remained.

Secondly, after active inspection, observation and testing of the AIF over such a long period of time, site operators will have a substantial data base of information with which to project continued performance of the facility in relation to natural site conditions. If the licensee has extensive test data showing that the AIF barriers had performed well and could continue to be relied upon into the distant future, then it would be reasonable for a regulatory agency to take such data into consideration as part of its review of an application to terminate active controls.

Siting considerations would, therefore, not be significant among the licensing requirements but might be an important consideration to project investors. Finally, regulations many years from now will almost certainly be different than those of today, and waste management technologies will almost certainly provide options beyond those currently available. The AIF concept emphasizes preservation of a wide range of waste management options, while the preferred licensing strategy ensures that LLW can be managed safely under existing requirements until alternative management options are reviewed and approved.

4.0 KEY LICENSING ISSUES

The purpose of this section of the Report is to describe the proposed licensing approach in more detail by discussing the key issues that were addressed in applying and modifying the existing NRC guidance governing (1) license applications for near surface disposal facilities under 10 CFR Part 61; (2) radiation protection under 10 CFR Part 20; and (3) materials licenses under 10 CFR Parts 30, 40 and 70. For each of the key issues, this section describes in general terms whether the Part 61 guidance, Part 20 guidance, or materials licensing guidance was used and explains the rationale or basis for the approach selected.

The key issues confronted during the analysis were as follows:

- Application of Part 61 Performance Objectives to an AIF
- Application of Part 61 Technical Requirements to an AIF
- Dose Pathways
- Selection of Financial Assurance Guidelines
- The Term of the License
- Criticality Safety and Physical Protection
- National Environmental Policy Act Requirements
- Emergency Planning Guidelines

4.1 Application of Part 61 Performance Objectives to an AIF

Under 10 CFR Part 61, Subpart C, the NRC has established four basic "performance objectives" for land disposal facilities. Section 61.40 requires such facilities to be "sited, designed, operated, closed and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established" in those performance objectives.

The first performance objective governs "protection of the general population from releases of radioactivity" and states as follows:

"Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable." (10 CFR § 61.41.)

Within the scope of the AIF application, this objective is generally not applicable because the established radiation protection standards these were developed specifically with anticipated Environmental Protection Agency standards for land disposal facilities in mind and, thus, are

peculiar to a disposal facility. Furthermore, the dose criteria contained in this performance objective go beyond those established under 10 CFR Part 20 applicable to virtually all NRC licensees, and there is no apparent reason to impose more stringent requirements on an AIF applicant. Therefore, the exposure limits from 10 CFR § 61.41 have not been incorporated into this guidance document. Radiation protection standards during facility operations are covered under the third performance objective and are based on 10 CFR Part 20.

The second performance objective governs "protection of individuals from inadvertent intrusion" and states:

"Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed." (10 CFR § 61.42.)

The fundamental purpose of this objective is to provide assurance that after the loss of institutional control of a disposal site, persons who may inadvertently come in contact with the site or the waste, and who may be unknowingly exposed to radiation from the waste, are adequately protected. The AIF would remain under active institutional control throughout the term of the license, thus eliminating the possibility of inadvertent intrusion by an inadvertent intruder. Therefore, the Part 61 guidance used to demonstrate compliance with this objective is not used in this guidance document.

The third Part 61 performance objective governs "protection of individuals during operations" and states:

"Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by § 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable." (10 CFR §61.43.)

This objective is intended to ensure that operations at a land disposal facility comply with 10 CFR Part 20 radiation protection standards, maintain releases in effluents in accordance with 10 CFR § 61.41 (the first Performance Objective), and adhere to the ALARA principle. As discussed above, while Part 20 dose limits and ALARA requirements are considered applicable to an AIF, the requirements of 10 CFR § 61.41 are not.

The fourth performance objective in Part 61 governs "stability of the disposal site after closure" and states:

“The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required.” (10 CFR § 61.44.)

The AIF will remain under active institutional control throughout the term of the license. Therefore, as a licensing requirement, this objective would not apply. As discussed in Section 3.0, such considerations may be applicable to project planners and investors as a way to ensure the preservation of future options.

4.2 Application of Part 61 Technical Requirements of an AIF

Under 10 CFR Part 61, Subpart D, the NRC has established a series of detailed “Technical Requirements for Land Disposal Facilities.” Within Subpart D, there are ten separate regulations encompassing a wide range of technical matters including disposal site suitability, waste classification, and institutional and land ownership requirements. Provided below is a summary of how each of these regulations has been considered and applied in preparing this guidance document.

4.2.1 Disposal Site Suitability (10 CFR § 61.50)

This regulation defines the minimum characteristics a disposal site must have to be acceptable for development as a near-surface disposal facility. As applied to disposal facilities, the site suitability criteria are generally directed toward the first Performance Objective of protecting the general population, especially following the assumed end of institutional control of the facility. These siting criteria require that detailed site characterization data be collected and analyzed in order to conduct an extensive performance assessment for the intended disposal facility.

For an AIF, however, siting criteria need not be as rigorous as those required for siting a disposal facility under 10 CFR § 61.50. Considering the physical and operating characteristics of the AIF, licensing under 10 CFR Parts 30, 40, or 70 is appropriate. However, using 10 CFR Parts 30, 40, and 70 for AIF siting criteria is not particularly instructive because these regulations require only that the materials license applicant briefly describe the site and area near the site. In this guidance document we have, on a very selective basis, included some limited Part 61 siting criteria, in an effort to provide additional guidance to the applicant. Alternative approaches may be acceptable, but clearly the requirements governing the siting of an AIF should be less restrictive than for a Part 61 disposal facility. This, in turn, should make more sites appropriate for an AIF, than for a disposal facility.

4.2.2 Disposal Site Design (10 CFR § 61.51)

The primary purpose of these requirements is to ensure that site “design features [are] directed toward long term isolation and avoidance of the need for continuing active maintenance after site closure.” 10 CFR § 61.51. This aspect of the regulation is not relevant to an AIF license application because an AIF will be continuously and actively monitored and maintained. Design features to assure compliance with Part 20 requirements are included in this guidance document.

4.2.3 Disposal Facility Operation and Site Closure (10 CFR § 61.52)

This regulation describes requirements for disposal facility operation and closure. Most of these requirements are not applicable to an AIF license application because the applicant is not seeking authority to close the facility and terminate active maintenance. Certain aspects of this regulation that apply to an AIF and are incorporated into this guidance document include:

- Emplacing waste in a manner that maintains the package integrity during emplacement;
- Emplacing waste containers in a manner that limits radiation exposures to applicable limits (but directed primarily at limiting occupational exposures and not addressing post-operational exposures to members of the public as does Part 61);
- Accepting wastes that are only radioactive.

4.2.4 Environmental Monitoring (10 CFR § 61.53)

This regulation describes environmental monitoring requirements prior to site operations, during facility construction and operation, and during the closure of the disposal facility after the site is no longer accepting waste. The main emphasis of the monitoring program for a disposal facility is to provide early warning of releases of radionuclides before they leave the site boundary. This is generally done by taking groundwater and air samples at selected locations surrounding the waste cells. Indirect detection of this type is done for closed disposal facilities because the waste cells are no longer accessible for direct inspection.

For an AIF, applicable provisions of this regulation are incorporated into this guidance to ensure that a program is in place that can directly detect releases from individual waste containers. In an AIF, individual waste containers will be emplaced with sufficient space from the vault walls to allow for direct monitoring and maintenance of the actual waste containers. This will ensure that any releases from individual containers will be identified, contained and remediated prior to any external release from the vault. As a secondary safeguard, the AIF will also include design

features directed at leachate collection and leakage detection systems to verify that any potential releases are not escaping the assured isolation units.

4.2.5 Alternative Requirements (10 CFR § 61.54)

This regulation authorizes the NRC to approve alternatives for facility design and operation other than those set forth in 10 CFR §§ 61.51 - 61.53. Although it does not prescribe any particular substantive requirements that must be addressed in an AIF license application, section 61.54 provides flexibility to an applicant to prepare different facility design or operational alternatives than those set forth in the regulations.

4.2.6 Waste Classification (10 CFR § 61.55)

This regulation provides detailed requirements for the classification of waste as either Class A, B or C, or as waste not generally acceptable for near surface disposal. For the reasons discussed below, application of this section of the regulations to an AIF is considered appropriate and necessary.

Effective March 1, 1998, 10 CFR § 20.2006(b)(2) requires that:

Any licensee shipping radioactive waste intended for ultimate disposal at a licensed disposal facility must document the information required on NRC's Uniform Low-Level Radioactive Waste Manifest . . . in accordance with appendix G to 10 CFR part 20. (Emphasis added).

Appendix G, referenced in the regulation, applies to waste generators, collectors, processors and disposal facilities. Appendix G, Section III.A, provides general requirements for licensees who transfer waste to collectors, processors or disposal facilities. Licensees that transfer waste to a disposal facility or a "collector" must, among other things:

1. Prepare all wastes so that the waste is classified according to § 61.55 and meets the characteristics requirements in § 61.56 . . . [and]
2. Label each disposal container . . . of waste to identify whether it is Class A waste, Class B waste, Class C waste, or greater than Class C waste, in accordance with § 61.55 . . .

An AIF would appear to fit the definition of a "waste collector," which is defined in Appendix G as follows:

Waste collector means an entity . . . whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without

processing or repackaging . . . to another licensed waste collector, licensed waste processor, or licensed land disposal facility.

Waste shipped to an AIF would, in fact, be intended for "ultimate" disposal within the meaning of 10 CFR § 20.2006(b)(2); whether within the AIF itself, or at a disposal facility operating elsewhere, or a combination of the two. Within the scope of the activities of an AIF used as the reference case for this report, no additional processing or repackaging of the waste would be intended prior to its "ultimate" disposal. As a result, it is reasonable to conclude that such waste would be required to be classified in accordance with 10 CFR § 61.55.

4.2.7 Waste Characteristics (10 CFR § 61.56)

This regulation provides detailed requirements for the characteristics or form of the waste to be disposed of at a disposal facility, primarily to provide protection to personnel at the disposal site; and to ensure stability of the waste in order to avoid the need for long term active maintenance and to protect inadvertent intruders. Because waste characteristics must be provided as part of the NRC's uniform manifest (see 4.2.6, "Waste Classification"), this guidance document includes criteria to assure that LLW received at the AIF meets the waste characteristics described for disposal in this regulation.

4.2.8 Labeling (10 CFR § 61.57)

This regulation requires waste packages to be labeled as Class A, B or C waste. Regulatory criteria implementing this provision have been included in this guidance document for the reasons discussed in 4.2.6, "Waste Classification," above.

4.2.9 Alternative Classification and Characteristic Requirements (10 CFR § 61.58)

This regulation authorizes the NRC to approve alternative approaches to waste classification or characteristics. Although it does not prescribe any particular substantive requirements that must be addressed in an AIF license application, section 61.58 provides flexibility to an applicant to propose different waste classification or characteristic alternatives than those set forth in the regulations.

4.2.10 Institutional Requirements (10 CFR § 61.59)

This regulation requires that disposal of waste only be permitted on land owned in fee by the federal or state government, and that the land owner or custodian carry out an institutional control program following transfer of control of the site from the operator. A primary purpose of the requirement is to provide a safeguard, in addition to the financial assurance arrangements, that institutions and resources will be available to monitor, maintain and control the site over a long institutional control period. A corollary purpose is to ensure that the land on which the closed disposal site is located does not inadvertently fall under the control of persons unaware of

the facility's presence (See discussion at 60 FR 6570, February 2, 1995). Regulatory criteria addressing these requirements have not been included in this guidance document because there is no requirement that an actively-monitored and maintained facility for the isolation of waste be sited on government-owned land, and because the scope of the AIF license application does not include transfer of the site for long term institutional control.

4.3 Dose Pathways

For a disposal facility, computer models are used to determine whether doses to the general population remain within regulatory limits after the cessation of institutional controls. Because near surface disposal relies upon natural site characteristics, groundwater is, by far, the most prominent potential pathway in such analyses. In an AIF, the waste containers themselves would be accessible for ongoing inspection from within the facility, eliminating the possibility of radionuclide release through the groundwater pathway. During the term of the license, however, a licensee would need to evaluate dose pathways from direct gamma radiation, from atmospheric transport, and under accident or abnormal conditions, from surface water. These would be of primary importance to facility workers who come into proximity with the waste containers, and would be of less impact to the general population. Based on the foregoing, only those portions of Part 61 guidance documents that address direct gamma radiation, atmospheric transport, and to a lesser extent, surface water are included in this guidance document.

4.4 Selection of Financial Assurance Guidelines

Under 10 CFR Parts 30, 40 and 70, the NRC has established certain acceptable methods for providing adequate financial assurance for decommissioning, any of which may be suitable for application to an AIF (10 CFR §§ 30.35, 40.36 and 70.25). Four basic methods are available.

First, an AIF license applicant could provide financial assurance for decommissioning by the "prepayment" method, which requires a deposit of funds prior to the start of operations into an account segregated from the applicant's other assets and outside its administrative control. The prepayment may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities and must be sufficient to pay projected decommissioning costs. Funding would be accrued as waste is received, so that at any time during the license term, sufficient funds are available to decommission and dispose of the actual waste inventory.

The prepayment method, however, may not be economically feasible, either for the AIF customers or the AIF licensee itself. This is because a necessary component of the prepayment method is that the full sum actually required to enable the licensee to dispose of the waste in an offsite, commercial disposal facility must be accrued. Thus, hundreds of dollars per cubic foot of waste received at the AIF would have to be accrued just to cover ultimate offsite disposal costs.

A second funding alternative, also acceptable under the NRC's rules, appears more feasible. That alternative permits the use of a "surety" method, insurance, or other guarantee method, that will guarantee that decommissioning costs will be paid. A surety method may be in the form of a surety bond, letter of credit, line of credit, parent company guarantee, or self-guarantee. An AIF applicant using a surety bond, letter of credit, or line of credit would not need to actually accrue the funds necessary to provide for the offsite disposal of the waste, and would instead only be required to pay the charges associated with the maintenance of such mechanisms (typically a small percentage of the amount of the bond or credit line). Similarly, if the applicant has a parent company that can satisfy the financial tests set forth in 10 CFR Part 30, Appendix A, then that method of funding assurance may be used, although not in combination with any other financial assurance method. In addition, the applicant, itself, may provide a self-guarantee so long as it meets the applicable financial tests set forth in 10 CFR Part 30, Appendix C. A self-guarantee also may not be used in combination with any other financial assurance method or when the applicant has a parent company holding majority control of its voting stock. If a surety method or insurance is utilized, it must be payable to a trust ("standby trust") acceptable to the NRC.

The third funding method is an external sinking fund in which deposits are made at least annually, coupled with a surety method of insurance, the value of which may decrease by the amount being accumulated in the sinking fund. The fund must be segregated from the applicant's assets and outside of its administrative control and may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.

Finally, the fourth acceptable funding assurance method is only available to federal, state or local government licensees. Such licensees may simply prepare a "statement of intent" containing a decommissioning cost estimate and indicating that funds for decommissioning will be obtained when necessary.

4.5 Term of the License

The guidance provided in Volume 2 of this Report does not address the term of the AIF license. Nothing in the Atomic Energy Act or the NRC's regulations defines a precise term for such a license. In February of 1997, the NRC adopted the policy of granting essentially all materials licenses for a ten-year term, and Louisiana Energy Services requested a 30-year license for its proposed gas centrifuge uranium enrichment facility.

An AIF license applicant may wish to seek a license term of at least ten years based upon the current practice for materials licensees. Indeed, the relatively passive nature of an AIF (no active processing or industrial operations) suggests that AIF operations could be safely licensed for an extended period of time -- perhaps 30 or more years as was proposed for the Louisiana Energy Services facility.

4.6 Physical Protection and Criticality Safety

Physical protection and criticality safety requirements have been established by the NRC to protect special nuclear material from diversion, and to prevent the inadvertent occurrence of a nuclear chain reaction. While these requirements are not expected to be of major concern at an AIF, they must be considered.

Under 10 CFR § 61.23(I), a disposal facility license applicant must provide reasonable assurance that:

“the requirements of Part 73 . . . will be met, insofar as they are applicable to special nuclear material to be possessed before disposal under the license.”

This guidance document has been prepared on the assumption that the AIF will possess special nuclear material of low strategic significance as defined in 10 CFR § 73.2 and that therefore, the physical protection requirements of 10 CFR § 73.67, “Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance,” will apply. More stringent requirements exist for “formula” quantities of special nuclear material and “strategic” special nuclear material as defined in 10 CFR § 73.2.

Similarly, under 10 CFR § 61.23(j), a disposal facility license applicant must show that its:

“criticality safety procedures are adequate to protect public health and safety and provide reasonable assurance that the requirements of § 70.24, criticality accident requirements, of Part 70 . . . will be met, insofar as they are applicable to special nuclear material to be possessed before disposal under the license.”

Under 10 CFR § 70.24, each licensee authorized to possess special nuclear material in a quantity:

“exceeding 700 grams of contained uranium-235, 520 grams of uranium-233, 450 grams of plutonium, 1,500 grams of contained uranium-235 if no uranium enriched to more than 4 percent by weight of uranium-235 is present, 450 grams of any combination thereof, or one-half such quantities if massive moderators or reflectors made of graphite, heavy water or beryllium may be present,” is required to maintain a criticality accident monitoring and alarm system.

This guidance document has been prepared on the assumption that the AIF will not possess sufficient quantities of special nuclear material to require such a monitoring and alarm system. If such quantities will be possessed, it is recommended that the AIF applicant not only consult 10 CFR § 70.24, but also the latest NRC Staff draft or final guidance on criticality safety for fuel cycle and special nuclear materials licenses. Current drafts of such guidance contain considerable additional criteria governing not only criticality monitoring, but also criticality analyses and protection.

4.7 National Environmental Policy Act Requirements

Under the National Environmental Policy Act (NEPA) and the NRC's NEPA - implementing regulations (10 CFR Part 51), the AIF applicant may be required to submit an Environmental Report (ER) to the NRC and the NRC's review of the application will trigger its preparation of either an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI), or a full Environmental Impact Statement.

Pursuant to 10 CFR § 51.60, an ER must be prepared and submitted to the NRC for, among other things, the issuance of licenses for receipt and disposal of radioactive waste from other persons pursuant to Part 61, and for "[a]ny other licensing action for which the Commission determines an Environmental Report is necessary." The guidance provided in this Report presumes that the NRC will require that an AIF applicant submit an ER, and provides information on the basic format and content of such an ER. However, the provision of that information in this Report should not be construed as a legal determination that an ER is necessary under NEPA and Part 51.

4.8 Emergency Planning Guidelines

The emergency planning guidelines set forth in this Report are drawn from the NRC regulations themselves -- in particular 10 CFR § 30.32(I) applicable to byproduct material licensees. They have been modified to refer to "radioactive" material in general, rather than "byproduct" material in particular. Use of the Part 30 regulations is a significant departure from the existing Part 61 licensing guidance. The rationale for this approach is described below.

Part 61 itself does not contain any detailed emergency planning requirements or criteria. Instead, it simply provides that the radiation safety program address accident conditions, and that analyses for the protection of individuals during accidents be provided. See 10 CFR §§ 61.12(k) and 61.13(c). The Part 61 SF&CG and SRP (NUREG-1199 and NUREG-1200) do contain specific emergency planning criteria. In particular, those documents anticipate that a Part 61 license applicant will prepare an Emergency Plan regardless of the projected maximum dose to a member of the public as a result of a potential accident. In addition, NUREG-1199 and NUREG-1200 specify that the applicant should demonstrate that an offsite release from an accident will yield an offsite dose equivalent of less than 0.01 rem to the whole body and 0.05 rem to the lungs.³ If doses exceed these levels, NUREG-1199 and NUREG-1200 appear to require not only offsite emergency plans and procedures, but also Federal Emergency Management Agency (FEMA) review of, and findings regarding, the adequacy of such offsite plans and procedures.

³ NUREG-1199 requests a demonstration that these dose levels will not be exceeded for "the most credible accident . . . consistent with the projected source term," while NUREG-1200 requests such a demonstration for "the most severe credible accident consistent with the projected source term . . ." Emphasis added. These statements appear to be inconsistent.

This set of emergency planning criteria has no explicit basis within the Part 61 regulations. Furthermore, it establishes guidelines that go well beyond the NRC's materials licensing regulations and licensing practices.

In particular, Part 30, 40 and 70 license applicants are not required to prepare an Emergency Plan if projected accident doses or exposures are below certain established levels. Under 10 CFR § 30.32(I), a byproduct material license applicant need not prepare an Emergency Plan if it has submitted an evaluation showing that:

the maximum dose to a person offsite due to a release of radioactive materials would not exceed 1 rem effective dose equivalent or 5 rems to the thyroid.

Similar provisions are found: (1) in 10 CFR § 40.31(j) for source material license applicants (requiring applicants possessing certain quantities of uranium hexafluoride to submit an Emergency Plan only if evaluation shows a maximum intake of uranium by a member of the public due to a release in excess of 2 milligrams); and (2) in 10 CFR § 70.22(I) (requiring certain applicants possessing specified quantities of enriched uranium or plutonium, uranium hexafluoride, or plutonium in unsealed form to submit an Emergency Plan only if evaluation shows a maximum dose to a member of the public offsite exceeding 1 rem effective dose equivalent (EDE) or an intake of 2 milligrams or more of soluble uranium). Therefore, a requirement to prepare an Emergency Plan, regardless of projected accident doses from the AIF, appears to be unnecessary and inappropriate.

In addition, the dose criteria contained in NUREG-1199 and NUREG-1200 are far more stringent than those contained in the existing materials licensing regulations -- indeed they are one hundredth of those set forth in 10 CFR § 30.32(I) for byproduct material licenses. There is no apparent reason why the existing Part 30 regulatory requirements should not apply to the licensing of an AIF.

Furthermore, the criteria in NUREG-1199 and NUREG-1200 addressing the preparation and FEMA review of offsite emergency plans appear unprecedented outside the area of 10 CFR Part 50 licensing of commercial nuclear power plants. NRC materials licensees who must develop emergency plans must have their own plans and procedures for coordinating with offsite authorities such as state and local governments, fire, police, emergency medical service, etc., but they are not required to develop (or assure that the offsite authorities develop) offsite plans and procedures, and there is no requirement for FEMA review. These aspects of the Part 61 guidance documents appear to go well beyond what is needed for an AIF.

Therefore, in this Report we have adopted the Part 30 emergency planning requirements as appropriate for an AIF. Because of the relative level of detail contained in 10 CFR § 30.32(I) itself, the regulation has been adopted and slightly modified as the "Application Contents" guidance.

5.0 METHODOLOGY AND EXTERNAL REVIEW

5.1 Methodology

In developing Volume 2 of this report, the following methodology was used:

(1) **Compile Reference Materials:** First, the primary NRC guidance documents potentially relevant to the analysis were identified and compiled into a set of reference materials. Although NRC regulations and various guidance documents were consulted, four key documents were central to the preparation of Volume 2. Those four documents were:

- NUREG-1199, Rev. 2 "Standard Format and Content of a Licensee Application for a Low-Level Radioactive Waste Disposal Facility" (January 1991);
- NUREG-1200, Rev. 3 "Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility" (April, 1994);
- Draft Regulatory Guide 3.52, Rev. 2 "Standard Format and Content for the Health and Safety Sections of License Applications for Fuel Cycle Facilities" (January 1995); and
- Draft NUREG-1520 "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility" (February 21, 1995).

(2) **Generate License Application Table of Contents:** Second, using the compiled guidance, a first draft of a full table of contents for an AIF license application was prepared to serve as an outline of the individual topics that would have to be addressed in such an application. The table of contents is provided at the beginning of Volume 2.

(3) **Develop License Application Content Guidance:** Next, NUREG-1199, draft Reg. Guide 3.52 and other relevant materials were reviewed for each topic in the application table of contents. The applicable NRC guidance was analyzed for relevance and applicability to an AIF license application and appropriate elements of the NRC guidance were selected for each topic. An effort was made to select the most appropriate guidance, to eliminate regulatory criteria that related to unique aspects of traditional Part 61 disposal facilities not shared by an AIF, to be conservative in retaining criteria from NRC guidance documents, and to avoid complex criteria that may be more suitable for fuel cycle facilities than for an AIF.

(4) **Develop Agency Review Guidance:** At the same time that the NRC SF&CGs were reviewed to develop the AIF license application guidance for a given topic, the related SRP elements from NUREG-1200 and draft NUREG-1520 were also reviewed and used to prepare proposed Agency Review Guidance. A significant effort was made to streamline the Agency Review Guidance to reduce the amount of information contained within the SRPs. It was often found that the SRPs

restated the criteria in the SF&CGs (sometimes verbatim) and that substantial portions of the SRP content could be deleted without reducing the level of information provided.

(5) Prepare Summary Description of Analysis Results: Finally, once the proposed Application Contents and Agency Review Guidance for a given topic were prepared, a brief summary description of how the existing NRC guidance documents were utilized was developed for each topic. The summaries provide sufficient detail to generally identify the NRC guidance that was excluded and the basis for such exclusion, and are contained in the portions of Volume 2 entitled "Bases for Selection of Application Contents/Agency Review Guidance."

5.2 External Review

A Peer Review Workshop was held in Charlotte, North Carolina on January 28, 1998, to review the first draft of this report. Comments were received during and subsequent to the Workshop on both the content and format of the report, and those comments were addressed in the second draft. Representatives from LMITCO, Agreement State Agencies, a low-level radioactive waste disposal compact, state low-level radioactive waste disposal facility development authorities, and waste generators participated in the Workshop.

The second draft was provided to a number of state and state low-level radioactive waste compact authorities, industry personnel, and the NRC. Upon receipt of comments on the second draft, a third draft was prepared. A meeting was held with representatives of the NRC on June 3, 1998 to discuss the report, and it was then finalized.

Appendix A - Glossary of Terms, Abbreviations, and Acronyms

Active Maintenance - Any improvements or repairs to the physical features of an AIF that are intended to preserve the ability of the facility to perform its function of isolating radioactive waste.

Agreement State - A state that has entered into an agreement with the Nuclear Regulatory Commission, or predecessor agencies, under subsection 274b of the Atomic Energy Act of 1954.

AIF - Assured Isolation Facility

ALARA - As Low as Is Reasonably Achievable. That regulatory concept by which every reasonable effort is made to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

As Low as Is Reasonably Achievable - See ALARA.

Assured Isolation - An integrated management system for isolating waste, while preserving options for its long-term management, through (a) robust, accessible facilities, (b) planned, preventive maintenance, and (c) sureties adequate to address contingencies or implement future alternatives.

Assured Isolation Facility (AIF) - Structures and land containing the operational components of a site for Assured Isolation. Includes, but may not be limited to, Assured Isolation Units, support and administrative facilities, roads, and staging areas.

Assured Isolation Site - The entire plot of land on which an AIF is located, including that portion of the earth underlying the facility which is of significance to its structural stability, or is related to the environmental monitoring of the facility.

Assured Isolation Units (or Vaults) - In plural form, the array of structures of an AIF in which waste is emplaced for indefinite isolation. In singular form, each cell or room in the array in which waste is housed.

Byproduct Material - (1) Any radioactive material (except nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special

nuclear material; and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content.

Custodial Agency - An agency of the federal or a state government designated to act on behalf of the government owner of a disposal site in monitoring and maintaining the site following termination of the license.

Decommission - To remove a facility or site safely from service and reduce residual radioactivity to a level that permits termination of the license and release of the property for restricted or unrestricted use in accordance with applicable regulations.

Disposal - Emplacement of waste in a facility intended and designed for permanent isolation.

Dose Equivalent - The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest.

Effective Dose Equivalent - The sum of the products of the dose equivalent to the organ or tissue and the weighing factors applicable to each of the body organs or tissues that are irradiated.

Inadvertent Intruder - A person who occupies a disposal site after the end of active institutional control and is unknowingly exposed to radiation from the waste through normal activities, such as agriculture, construction of dwellings, or other pursuits.

Isolation - Segregation and impoundment of waste in a manner intended to protect the biosphere inhabited by man and containing his food chains.

Low-Level Radioactive Waste (LLW) - Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by product material as defined in section 11e(2) of the Atomic Energy Act (tailings and waste from uranium or thorium).

Materials License Facility - A facility licensed under 10 CFR Parts 30, 40, or 70.

Mixed Waste - Low-level radioactive waste that contains listed hazardous waste or exhibits a hazardous characteristic identified in Subpart C of 40 CFR Part 261.

Monitoring - Evaluating the characteristics or performance of a facility or a site through systematic measurement and analysis of specific parameters. See also Surveillance.

Naturally-Occurring Radioactive Material (NORM) - Radioactive material that is naturally present in the earth's crust.

Near-Surface Disposal Facility - A land disposal facility in which radioactive waste is disposed of in or within the upper 30 meters of the earth's surface.

Site Closure and Stabilization - Actions taken upon completion of operations that prepare a site for custodial care and that are intended to assure that the disposal site will remain stable and will not need ongoing active maintenance.

Source Material - (1) Uranium, thorium or any other material which is determined by the Nuclear Regulatory Commission, pursuant to the provisions of section 61 of the Atomic Energy Act of 1954, as amended, to be source material, or (2) ores containing one or more of the foregoing materials in such concentrations as the Nuclear Regulatory Commission may by regulation determine from time to time.

Special Nuclear Material - (1) Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Nuclear Regulatory Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material, or (2) any material, except source material, that is artificially enriched by any of the foregoing.

Surveillance - Observation of the physical features and structures of a site or a facility to determine the need for maintenance or custodial care; or to detect potential noncompliance with license and regulatory requirements. See also Monitoring.

Uranium Mill Tailings - The wastes remaining after uranium has been extracted or concentrated through the processing of uranium ore.

Appendix B - Experience Profiles

Donald J. Silverman

Donald J. Silverman is a partner in the Government Regulation Section of the law firm of Morgan, Lewis & Bockius LLP, resident in the Washington, D.C., office. Mr. Silverman represents utilities, fuel cycle companies, and industrial and medical materials licensees before the Nuclear Regulatory Commission (NRC), as well as in related proceedings in other agencies and the federal courts. Mr. Silverman's experience in the area of radioactive and mixed waste management includes his representation of a national industry organization devoted to nuclear waste issues. As counsel to that group, he actively participated in the development and passage of the 1985 Low-Level Radioactive Waste Policy Amendments Act. He has provided legal counsel on a broad range of issues associated with the regulation of radioactive waste storage, treatment and disposal to utilities and materials licensees. Mr. Silverman represented a group of *amicus curiae* utility and non-utility low-level waste generators in litigation in federal District Court, the Second Circuit Court of Appeals, and the Supreme Court involving the constitutionality of the 1985 Low-Level Radioactive Waste Policy Amendments Act.

Michael A. Bauser

Michael Bauser is Of Counsel in the Government Regulation Section of the law firm of Morgan, Lewis & Bockius LLP, resident in the Washington office. He represents electric utilities in regulatory proceedings before the Nuclear Regulatory Commission, including those involving nuclear power plant licensing. Mr. Bauser also represents the nuclear industry's waste program within the Nuclear Energy Institute, which provides oversight concerning the development and implementation of federal statutes and regulations involving radioactive waste management. In this capacity he was active in the development of nuclear waste legislation, including the Low-Level Radioactive Waste Policy Act of 1980, and the Nuclear Waste Policy Act of 1982. He has also represented utilities in numerous court actions involving radioactive waste management and disposal.

Robert D. Baird

Robert Baird, a vice president at Rogers and Associates Engineering Corporation and registered professional engineer, has over 20 years' experience with radioactive waste management facilities, processes, and lifetime cost analyses. As a facility engineer, Mr. Baird has extensive experience with the various components of waste management facilities, including waste handling, treatment, storage, and disposal. He has led numerous evaluations of the feasibility and performance of radioactive waste disposal facilities, including facilities in North Carolina, Texas, California, Utah, and Vermont. For these facilities, he has determined applicable regulatory constraints, developed detailed operating procedures, characterized site conditions, developed preliminary and conceptual designs, and estimated radiological impacts.

Bret C. Rogers

Bret Rogers has six years experience in an array of areas pertaining to radioactive and hazardous waste management, including regulatory analysis and support, risk assessment and performance assessment, and laboratory and field analyses. He has reviewed and evaluated models used for the Waste Isolation Pilot Plant's performance assessment, and has compared the capabilities of several risk and dose assessment codes that model the contaminant transport and exposure pathways. In addition, he has assessed the radiological and nonradiological risks of normal transportation activities and potential accidents associated with constructing, operating, and closing a proposed low-level radioactive waste disposal facility in Pennsylvania.