8.0 OPERATING PROCEDURES

I. Objective

In this portion of the dry cask storage system (DCSS) review, the NRC seeks to ensure that the applicant's safety analysis report (SAR) presents acceptable operating sequences, guidance, and generic procedures for three key operations:

1. cask loading
2. cask handling and storage operations
3. cask unloading

The operating sequences described in the SAR should provide an effective basis for the development of the more detailed operating and test procedures required by the cask user. The user will then use applicant supplied procedures as guidance when preparing and implementing detailed site-specific procedures, as required by the licensee's quality assurance (QA) and procedure writing programs. The NRC normally inspects selected site-specific procedures.

II. Areas of Review

This chapter of the DCSS Standard Review Plan (SRP) provides guidance in evaluating the applicant's general operating sequences, and generic procedures related to cask operations (i.e., cask loading, cask handling, storage operations, and cask unloading). A comprehensive evaluation of this generic guidance may also encompass those areas of review, as defined in Section V, "Review Procedures." Within each area, the NRC staff assesses the effectiveness of the applicant's generic guidance on a technical and safety basis for the subsequent development of operating detailed procedures. As required by the regulations, [10 CFR 72.234(f)] these procedures are to be provided to each cask user, for the subsequent preparation and implementation of detailed site-specific procedures by the ISFSI licensee.

The purpose of this review,

- loading operations include the selection and placement of fuel into the cask, cask draining and drying, cask decontamination, inerting the cask and sealing the cask
- ISFSI operations include transferring the cask to the ISFSI site and any maintenance or surveillance activities required to ensure the safe storage of the radioactive materials
- Unloading operations required in response to currently unforseen problems that may be encountered during storage or prior to final disposal, including retrieving the cask and preparations for transfer off site
- to recover from an unforeseen problem during storage or to prepare the fuel for offsite transportation or ultimate disposition.

III. Regulatory Requirements

1. The applicant must develop operating procedures that adequately protect health and minimize danger to life or property. [10 CFR 72.40(a)(5)[1]]

2. The applicant must establish operational restrictions to meet the regulatory requirements of 10 CFR Part 20[2] and objective limits that are as low as is reasonably achievable (ALARA) for radioactive materials in effluents and direct radiation levels associated with ISFSI operations. [10 CFR 72.104(b) and 10 CFR 72.24(e)]

3. The applicant must describe all equipment and processes used to maintain control of radioactive effluents. [10 CFR 72.24(l)(2)]

4. The general licensee shall conduct activities related to storage of spent fuel in accordance with written procedures. [10 CFR 72.212(b)(9)]

5. Vendors seeking approval of a cask design shall ensure that written procedures and appropriate tests are established before initial use of the casks. In addition, the vendor must provide a copy of these

procedures and tests to each prospective cask user. [10 CFR 72.234(f)]

6. The cask must be compatible with wet or dry spent fuel loading and unloading facilities. [10 CFR 72.236(h)]

7. To the extent practicable, the design of the cask must facilitate decontamination. [10 CFR 72.236(i)]

8. The design of storage systems must allow ready retrieval of spent fuel for further processing or disposal. [10 CFR 72.122(l)]

9. The design of the cask must minimize the quantity of radioactive waste generated. [10 CFR 72.128(a)(5) and 10 CFR 72.24(f)]

10. The design of structures, systems, and components (SSCs) that are important to safety must permit inspection, maintenance, and testing. [10 CFR 72.122(f)]

IV. Acceptance Criteria

This SAR section should present a description and identify the sequence of significant operations and actions that are important to safety (i.e., cask loading, cask handling, storage operations, and cask unloading). This section is intended to provide the technical and safety basis for development of the detailed operating procedures prepared by the cask user. Therefore, a sufficient level of detail is needed for the reviewer to conclude that operating procedures derived from the information provided in this section will adequately protect health and minimize danger to life or property, protect the fuel from significant damage or degradation, and provide for the safe performance of tasks and DCSS operations.

To facilitate this conclusion, this portion of the DCSS review seeks to ensure that the generic procedure descriptions and guidance in the SAR include at least the following information:

1. Major operating procedures apply to the principal activities expected to occur during dry cask storage. The expected scope of activities for the SAR operating procedure descriptions is described in Section II, "Areas of Review" (above), as well as Section 8 of Regulatory Guide 3.61[3]. Operating procedure descriptions should be submitted to address the cask design features and planned operations.

2. Operating procedure descriptions should identify measures to control processes and mitigate potential hazards that may be present during planned normal operations. Section V, "Review Procedures" (below), discusses previously identified processes and potential hazards.

3. Operating procedure descriptions should ensure conformance with the applicable operating controls and limits described in the technical specifications provided in SAR Section 12.

4. Operating procedure descriptions should reflect planning to ensure that operations will fulfill the following acceptance criteria:

   a. Occupational radiation exposures will remain ALARA

   b. Effective measures will be taken to preclude potential unplanned and uncontrolled releases of radioactive materials

   c. Offsite dose rates will be maintained within the limits of 10 CFR Part 20 and 10 CFR 72.104 for normal operations, and 10 CFR 72.106 for accident conditions.

      In addition, the operating procedure descriptions should support and be consistent with the bases used to estimate radiation exposures and total doses. (Refer to Chapter 10 of this SRP).

5. Operating procedure descriptions should include provisions for the following activities:

   a. testing, surveillance, and monitoring of the stored material and casks during storage and loading and unloading operations

   b. maintenance of casks and cask functions during storage

c. contingency actions triggered by inspections, checks, observations, instrument readings, and so forth. (Some of these may involve off-normal conditions addressed in SAR Section 11.)

6. As required by 10 CFR 72.122(h)(1), the operating procedure descriptions should facilitate reducing the amount of water vapor and oxidizing material within the confinement cask to an acceptable level to protect the spent fuel cladding against degradation that might otherwise lead to gross ruptures.

V. Review Procedures

The review procedures described in this section are presented in a format intended to facilitate an independent review. Even though several individual(s) may actually be tasked with preparing the section of the safety evaluation report (SER) related to operating procedures, all review team members should examine the operating procedure descriptions presented in the SAR. If the descriptions included in the SAR are not sufficiently detailed to allow a complete evaluation concerning fulfillment of the acceptance criteria, reviewers should request additional information from the applicant.

The operating procedure sequences are described in Section 8 of the SAR, and the direct dose rate information in SAR Section 5 is used to assess compliance with radiation protection requirements in SAR Section 10. The reviewer should verify that the evaluation of Chapter 8 (operating procedures) is coordinated with the shielding and radiation protection evaluations covered in Chapters 5 and 10 of this SRP.

In addition, the following review procedures are based on the assumption that the ISFSI will be located at a reactor facility licensed under 10 CFR Part 50[4] and that loading and unloading activities will be performed in the facility's spent fuel pool. Review procedures for dry fuel transfers and/or ISFSI operations at sites away from a reactor will be developed at a later date.

Reviewers should be familiar with ANSI/ANS 57.9[5] (particularly Appendix A to that standard), which applies to DCSS operating procedures. Background information is available in NUREG/CR-4775[6], which provides guidance on preparing operating procedures for shipping packages. Although NUREG/CR-4775 specifically addresses 10 CFR Part 71[7], most of the guidance can be adapted for storage casks which are governed by 10 CFR Part 72. Consequently, reviewers should be familiar with this information before initiating the DCSS operating procedures review.

Since many of the detailed procedures may be developed by facilities licensed under 10 CFR Part 50 or 72, further background information on site specific procedure requirements may be found in Regulatory Guide 1.33[8] and its associated standard ANSI N18.7/AND 3.2 [9].

In general, reviewers should perform the following steps in the process of evaluating all of the operating procedure descriptions and generic guidance provided in the SAR:

- Verify that the proposed operating procedure descriptions incorporate and are compatible with the applicable operating limits and controls in SAR Section 12, "Conditions for Cask Use." Coordinate with the review of operating controls and limits, as described in Chapter 12 of this SRP.

- Ensure that the proposed operating procedure descriptions properly consider the prevention of hydrogen gas generation from any cause (including the reaction of zinc primer coating with acidic pool water, radiolysis, or other causes). Prevention of hydrogen generation or adequate purging of hydrogen is essential during loading and unloading operations that involve seal welding, seal cutting, grinding, or other forms of hot work.

- Determine whether the descriptions include appropriate precautions to minimize occupational radiation exposures in accordance with ALARA policy and the limits given in 10 CFR Part 20, as mandated by 10 CFR 72.24(e) and 72.126(a)(5). Provisions may include use of remotely controlled equipment, monitoring, and use of portable shielding.

- Verify that the operating procedure descriptions include a general listing of the major tools and equipment needed to support ISFSI loading, storage, and, unloading operations (including those at the pool facility). The descriptions should also address installation, use, and removal of the cask, fuel, tools, equipment. In addition, the descriptions should describe any specialized tools and equipment in sufficient detail to enable users to understand their use and operation.

(Examples include lifting yokes, transporter equipment, welding and cutting equipment, and vacuum drying equipment.) The use of any such equipment, that is classified as being important to safety, is subject to approval as part of the application review. Such equipment should be identified and described in detail; its performance characteristics should be defined; and the design should be evaluated.

In addition to these generic review procedures, reviewers should evaluate each of the specific areas of operating procedure review as described in the following subsections:

1. Cask Loading

The operating procedure descriptions in the SAR should present the activities sequentially in the anticipated order of performance. Review the generic procedures in SAR Section 8 to ensure that they include appropriate key prerequisite, preparation, and receipt inspection activities to be accomplished before cask loading. Also verify that tests, inspections, verifications, and cleaning procedures required in preparation for cask loading are specified. In addition, where applicable, verify that the procedure descriptions include actions needed to ensure that any fluids, such as shield water and primary coolants, fill their respective cavities according to design specifications.

Fuel Specifications

Review the spent fuel specifications (e.g., burnup, cooling period, source terms, heat generation, cladding damage, etc.) in SAR Sections 2 and 12, and verify that the loading procedure description appropriately addresses these specifications. Depending on the types and specifications of fuel assemblies stored in the reactor spent fuel pool, detailed site-specific procedures may be necessary to ensure that all fuel loaded in the cask meets the fuel specifications for the cask design. These procedures can be evaluated only on a site-specific basis and will be generally be evaluated through inspections rather than during the licensing review. The SAR should indicate, however, that such procedures may be necessary.

ALARA

Verify that the procedure descriptions incorporate ALARA principles and practices. These may include provisions to perform radiological surveys, as well as exposure and contamination control measures, temporary shielding, and suggested caution statements related to actions that could change radiological conditions. Verify that any recommended surveys incorporate the applicable operating controls and limits described in SAR Section 12.

Off-site Release

Where applicable, verify that the SAR describes methods to minimize offsite releases such as decontamination, filtered ventilation, temporary containments (tents), and so forth. The procedure descriptions should also provide for minimizing generation of radioactive waste.

Draining and Drying

Evaluate the descriptions related to methods for use in draining and drying the cask. In particular, determine whether they clearly describe the procedures for removing water vapor and oxidizing material to an acceptable level, and assess whether those procedures are appropriate.

The staff has accepted vacuum drying methods comparable to those recommended in PNL-6365[10]. This report evaluates the effects of oxidizing impurities on the dry storage of light-water reactor (LWR) fuel and recommends limiting the maximum quantity of oxidizing gasses (such as O_2, CO_2[a], and CO) to a total of 1 gram-mole per cask. (This corresponds to a concentration of 0.25 volume % of the total gases for a 7.0-m^3 cask gas volume at a pressure of about 0.15 MPa (1.5 atm) at 300°K.) This 1 gram-mole limit reduces the amount of oxidants below levels where any cladding degradation is expected.

Moisture removal is inherent in the vacuum drying process, and levels at or below those evaluated in PNL-6365 (about 0.43 gram-mole H_2O) are expected if adequate vacuum drying is performed. If methods other than vacuum drying are used, review additional analyses to confirm that cover gas

[a] Can be broken down by radiolysis

moisture and impurity levels will not result in unacceptable cladding degradation.

The following examples illustrate the accepted methods for cask draining and vacuum drying, in accordance with the recommendations of PNL-6365:

- The cask should be drained of as much water as practicable and evacuated to less than or equal to 4E-4 MPa (3.0 mm Hg or Torr). After evacuation, adequate moisture removal should be verified by maintaining a constant pressure over a period of about 30 minutes without vacuum pump operation. The cask is then backfilled with an inert gas (e.g., helium) for applicable pressure and leak testing. The cask is then re-evacuated and re-backfilled with inert gas before final closure. Care should be taken to preserve the purity of the cover gas and, after backfilling, cover gas purity should be verified by sampling.

- The procedures should reflect the potential for blockage of the evacuation system as a result of icing during evacuation. Icing can occur from the cooling effects of water vaporization and system depressurization during evacuation. Icing is more likely to occur in the evacuation system lines than in the cask because of decay heat from the fuel. A staged draw down or other means of preventing ice blockage of the cask evacuation path may be used (e.g., measurement of cask pressure not involving the line through which the cask is evacuated).

- A suitable inert cover gas (with quality specification that ensures a known maximum of impurities) should be specified to minimize this source of contaminants.

- The process should provide for repetition of the evacuation and repressurization cycles if the cask interior is opened to an oxidizing atmosphere following the evacuation and repressurization cycles (as may occur in conjunction with remedial welding, seal repairs, etc.).

Reviewers should ensure that the vacuum drying specifications are consistent with the proposed operating controls and limits described in the technical specifications provided in SAR Section 12. In addition, reviewers should assess the need for any additional technical specifications.

Filling and Pressurization

Verify that the procedure recommendations address steps to fill and pressurize the cask with inert gas. Also ascertain that the procedure recommendations include the requirements of SAR Section 12.

Ensure that the SAR specifies the leak rate criteria (e.g., total leakage, leakage per closure, sensitivities of tests, and so forth) and that these criteria are consistent with those presented in SAR Sections 2, 9, and 12. Assess whether the general methods of leak testing (e.g., pressure rise, mass spectrometry) apply to the leak rate being tested. Pay particular attention to the possible use of quick-disconnect fittings for draining and filling operations. Although no credit is usually taken for these devices as part of the confinement boundary, their presence can negate the results of the leak test and guidance regarding their use should be provided. In addition, the guidelines presented in the SAR should note that leak testing should be in accordance with ANSI N14.5[11].

Ensure that the SAR presents applicable pressure testing criteria (e.g., test pressure, hold periods, inspections) and that these criteria are consistent with those presented in SAR Section 9.

Welding and Sealing

For seal-welded confinement cask closures, and to ensure ALARA, verify that the SAR specifies the use of a remotely operated welder to make seal welds of the confinement closures. Also verify that the procedures provide for acceptable non-destructive examination of these welds. In addition to leak testing discussed above, the NRC accepts dye penetrant tests on both the root and cover pass of the seal welds on the confinement cask closures (including inner closure; any closure over vent accesses for draining, evacuating, purging, and backfilling the cask interior; and the outer closure).

Verify that the SAR includes acceptable provisions for correction of weld defects and any additional drying and purging that may be necessary. Weld tests should be specified, and be in compliance with descriptions for those tests in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV)[12].

Verify that provisions for placing and tightening any closure bolts are consistent with information presented in SAR Sections 2, 3, and 9, which address applicable design criteria, structural evaluation, and the acceptance tests and maintenance program, respectively. The inner seal should be tested using a helium leak test with the interior of the cask pressurized as described above. The outer seal should also be tested using a helium leak test with the between-seal volume pressurized as required by the respective subsection of the ASME B&PV Code, Section III.

2. Cask Handling and Storage Operations

Examine the recommendations associated with procedures necessary to transfer the cask to the storage location . Pay particular attention to ensuring that all accident events applicable to such transfer are bounded by the design events analyzed in SAR Sections 2 and 11. Coordinate with the structural and thermal reviews (Chapters 3 and 4 of this SRP) to ensure that all conditions for lifting and handling methods are bounded by the evaluations in SAR Sections 3 and 4. There may be technical specifications associated with cask transfer operations, such as restricting lift heights and environmental conditions (e.g. high/low temperatures, etc.).

Review the procedure recommendations to verify that they discuss the inspection, surveillance, and maintenance requirements that are applicable during ISFSI storage. Surveillance and monitoring requirements should also be included in SAR Section 12, and maintenance should be included in SAR Section 9. Coordinate with the other reviewers to ensure that the operating procedures include the requirements addressed in other sections of the SAR. Note that if the confinement vessel closure is bolted, the staff generally requires that the successful operation of the seals be demonstrated with an initial leak test and a monitoring system and/or a surveillance program, as discussed in Chapter 7 of this SRP.

3. Cask Unloading

Verify that the SAR adequately describes the necessary unloading procedure recommendations. The unloading procedure descriptions should present the activities sequentially in the anticipated order of performance, including those key prerequisite and preparation tasks that must be accomplished before cask unloading. Where applicable, verify that the procedure guidance ensures that any fluids, such as shield or borated water, fill their respective cavities according to design specifications.

Damaged Fuel

The SAR should include appropriate contingency measures for the presence of damaged or oxidized fuel. Procedures should be designed to maximize worker protection from unanticipated radiation exposures or contaminates due to damaged fuel and should implement ALARA procedures, and to the maximum extent possible, prevent any uncontrolled releases to the environment. The following points outline the relevant safety concerns and an acceptable approach to address sampling and damaged fuel contingencies in cask unloading:

- The procedure descriptions should provide for fuel unloading under normal conditions.
- The unloading process must ensure that the fuel can be safely unloaded with regard to structural, criticality, thermal, and radiation protection considerations. This includes the contingency for safe maintenance of the fuel and cask while any additional measures needed to address suspected damaged fuel are planned and implemented.
- The unloading process should reflect the potential for damaged or oxidized fuel and changing radiological conditions.
- The process should include measures to check for and detect damaged or oxidized fuel conditions (such as atmosphere samples) before opening the cask. (Note that fuel oxidation resulting from exposure to air at temperatures typical for dry cask storage is a known form of fuel degradation. Therefore, the presence of air in a cask designed to maintain an inert atmosphere indicates that the fuel may be degraded. The detection of fission gases is another indicator that the fuel may be degraded.)

The process may establish sample result thresholds, above which degraded fuel is suspected. Other technically sound methods may be used to check for potential air leakage paths. Such methods may

include designs that monitor cask internal pressure or seal integrity and alert the licensee to a problem before oxidation could occur. However, this method may not address detection of potential fuel degradation resulting from other mechanisms (such as a cask drop accident).

- If the sample indicates normal conditions, the normal unloading process should be followed.
- If degraded fuel is suspected, the procedure description should stipulate that additional measures, appropriate for the specific conditions, are to be planned, reviewed and approved by the designated approval authority, and implemented to minimize exposures to workers and radiological releases to the environment. These additional measures may include provision of filters, respiratory protection, and other methods to control releases and exposures ALARA.

Cooling Venting & Reflooding

Verify that the SAR describes applicable operational measures to control cask cooling, venting, and reflooding. Also verify that these measures are consistent with the results of the structural and thermal evaluations in SAR Sections 3 and 4, respectively. Those evaluations should quantify the applicable design-basis temperatures, allowable pressures, stresses, and material strengths from which the operating controls can be defined.

Coordinate the review of cask cooling, venting, and reflooding measures with the thermal and structural reviews addressed in Chapters 3 and 4 of this SRP. Cask cooling, venting, and reflooding should not cause gross cladding damage. Operational measures may include, but are not limited to, external cooling of the confinement cask for initial temperature reduction, restricting reflood flow rates to control and limit internal cask pressure from steam formation, and limiting cooldown rates.

Special attention should be devoted to reviews in this area, since analysis of existing designs have predicted fuel temperatures during storage and transfer in excess of 500°F for design-basis heat loads. Operational controls may be required to address the following potential effects during a cooldown and reflood evolution:

- Cask pressurization may occur as a result of steam formation as reflood water contacts hot surfaces.
- Excessive cooling rates may cause fuel cladding and fuel rod component damage and release of radioactive material as a result of stress (thermal, internal pressure, etc.) beyond material strengths.
- Excessive cooling rates may induce thermal stress that causes gross deformation of the fuel assembly components and subsequent binding with the basket.
- Cask supply and vent line failures from inadequate design for pressure and temperature could result in radiological exposures and personnel hazards (e.g., steam burns).

Fuel Crud

Verify that the procedure descriptions include contingencies for protection from fuel crud particulate material. Appendix B to ANSI/AND 57.9 provides a short discussion of crud with respect to dry transfer systems. However, experience with wet unloading of boiling-water reactor (BWR) fuel after transportation has involved handling significant amounts of crud. This fine crud, includes ^{60}Co and ^{55}Fe, and will remain suspended in water or air for extended periods. The dry cask reflood process during unloading of BWR fuel has the potential to disperse crud into the fuel transfer pool and the pool area atmosphere, thereby creating airborne exposure and personnel contamination hazards. By contrast, no significant crud dispersal problems have been observed in handling pressurized-water reactor (PWR) fuel, because of differences in the characteristics of crud on this type of fuel.

ALARA

Verify that the procedure descriptions incorporate ALARA principles and practices. These may include provisions to perform radiological surveys, exposure and contamination control measures, temporary shielding, and suggested caution statements related to specific actions that could change radiological

conditions. Verify that any recommended surveys incorporate the applicable operating controls and limits described in SAR Section 12.

Other

Where applicable, verify that the SAR describes methods (such as filtered ventilation or temporary containments) to minimize offsite releases. The procedures should also provide for minimizing generation of radioactive waste.

VI. Evaluation Findings

Review the 10 CFR Part 72 acceptance criteria and provide a summary statement for each. These statements should be similar to the following model, as applicable:

- The [cask designation] is compatible with [wet/dry] loading and unloading. General procedure descriptions for these operations are summarized in Section(s) _____ of the applicant's safety analysis report (SAR). Detailed procedures will need to be developed and evaluated on a site-specific basis.

- The [bolted lids/other features] of the cask allow ready retrieval of the spent fuel for further processing or disposal as required.

- The smooth surface [or other feature] of the cask is designed to facilitate decontamination. Only routine decontamination will be necessary after the cask is removed from the spent fuel pool.

- No significant radioactive waste is generated during operations associated with the independent spent fuel storage installation (ISFSI). Contaminated water from the spent fuel pool will be governed by the 10 CFR Part 50 license conditions [if applicable].

- No significant radioactive effluents are produced during storage. Any radioactive effluents generated during the cask loading will be governed by the 10 CFR Part 50 license conditions [if applicable].

- The general operating procedures described in the SAR are adequate to protect health and minimize danger to life and property. Detailed procedures will need to be developed and evaluated on a site-specific basis.

- Section 10 of the safety evaluation report (SER) assesses the operational restrictions to meet the limits of 10 CFR Part 20. Additional site-specific restrictions may also be established by the site licensee.

- The staff concludes that the generic procedures and guidance for the operation of the [cask designation] are in compliance with 10 CFR Part 72 and that the applicable acceptance criteria have been satisfied. The evaluation of the operating procedure descriptions provided in the SAR offers reasonable assurance that the cask will enable safe storage of spent fuel. This finding is based on a review that considered the regulations, appropriate regulatory guides, applicable codes and standards, and accepted practices.

VII. References

1. *U.S. Code of Federal Regulations*, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-level Radioactive Waste," Part 72, Title 10, "Energy."

2. *U.S. Code of Federal Regulations*, Part 20, "Standards for Protection Against Radiation," Title 10, "Energy."

3. U.S. Nuclear Regulatory Commission, "Standard Format and Content for a Topical Safety Analysis Report for a Spent Fuel Dry Storage Cask," Regulatory Guide 3.61, February 1989.

4. *U.S. Code of Federal Regulations*, Part 50, "Domestic Licensing of Production and Utilization Facilities," Title 10, "Energy."

5. American National Standards Institute, American Nuclear Society, “Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type),” ANSI/ANS 57.9, 1984.

6. M.C., Witte, Lawrence Livermore National Laboratory, "Guide for Preparing Operating Procedures for Shipping Packages," UCID-20820, NUREG/CR-4775, July 1988.

7. *U.S. Code of Federal Regulations*, Part 71, “Packaging and Transportation of Radioactive Material,” Title 10, “Energy.”

8. U.S. Nuclear Regulatory Commission, "Quality Assurance Program Requirements (Operation)," Regulatory Guide 1.33, February 1978.

9. American National Standards Institute, American Nuclear Society, “Administrative Controls and Quality Assurance Requirements for the Operational Phase of Nuclear Power Plants,” ANSI N18.7/ANS 3.2, 1976.

10. R.W., Knoll, *et al*., Pacific Northwest Laboratory, "Evaluation of Cover Gas Impurities and Their Effects on the Dry Storage of LWR Spent Fuel," PNL-6365, DE88 003983, November 1987.

11. American National Standards Institute, Institute for Nuclear Materials Management, "American National Standard for Radioactive Materials—Leakage Tests on Packages for Shipment," ANSI N14.5-1987, January 1987.

12. American Society of Mechanical Engineers, “Boiler and Pressure Vessel Code,”