

**Package Licensing In Support of the U.S. Department Of Energy (DOE)
Foreign Research Reactor (FRR) Spent Nuclear Fuel (SNF) Acceptance
Program**

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This paper will describe recent technical developments in the resolution of regulatory issues, and describe DOE actions to expedite the regulatory package licensing process in the USA.

The DOE devotes considerable time and resources to resolving the complex technical issues associated with transportation of SNF to ensure compliance with international and domestic USA package license requirements. The impacts on foreign research reactor operator's and DOE's plans for the transport of the spent nuclear fuel will be examined.

It is the standard policy of the Department of Transportation (DOT) to forward Type-B package revalidation submittals of Safety Analysis Report (SAR) for packages to the Nuclear Regulatory Commission (NRC) for thorough technical review. The NRC is the U.S. agency responsible for the licensing of domestic packages. Since in many cases a single shipment will call for the use of several different types of transport packages, DOE often has multiple package validation review requests being processed with the DOT and the NRC. For example, in October 2000 there are expected to be five FRR package applications under technical review by the NRC that are all requested to be completed in March 2001. DOE works closely with DOT and NRC to prioritize the package validation review list, given shipping schedules, and works to ensure all parties involved are aware of deadlines, actions, potential problems, and unanticipated problems.

The DOE staff reviews the status of the NRC package validation reviews and priorities weekly. The Type-B package approval recommendations by the NRC typically require review periods of three to six months, and even longer if there are any problems with the submittal. If the NRC is not able to provide a complete or timely review, then planned shipments must be postponed or rescheduled. The DOT will not issue the International Atomic Energy Agency (IAEA) certificate, without an approval recommendation from the NRC. A DOE "transport" goal is to synchronize available resources to maximize SNF shipment opportunities.

The paper examines the roles, involvement and interaction between the DOE, NRC and DOT, foreign reactor operators, and package vendor representatives. Improved coordination and communication between the DOE, reactor operators, the licensees, and the competent authorities will result in “more manageable” problems and an increased reliability in the shipment planning and scheduling process.

RECENT TECHNICAL DEVELOPMENTS IN RESOLUTION OF REGULATORY ISSUES

Typical Licensing Challenges

The DOE has substantially improved communications in the licensing process involving FRR SNF packages in the USA by communicating directly with the project managers in NRC Spent Fuel Project Office. Some of the improvements are good business management practices, and some of the problems have required new technical solutions.

Appendix A documents contain fuel dimensions, tolerances, materials descriptions, and pre-irradiation and post-irradiation nuclear data. The dimensional tolerances are based on fuel drawing dimensions, and the tolerances must be conservatively incorporated into the safety analysis calculations and in the computer models. For efficient planning purposes, Appendix A documents should be finalized and accepted by DOE at least nine months in advance, and preferably one year in advance of the package loading date to allow minimal time to revise license submittals and still allow six months minimum for the compulsory NRC review. The timelines currently in DOE contracts with the foreign reactor operators (requiring draft Appendix A within 180 days and final Appendix A to DOE within 90 days of shipment) are based on the DOE receiving facility safety reviews only, and do not address any of the potential package licensing issues.

There have been recent examples where the package SARs and proposed authorized contents in the Certificates of Compliance were revised at the last minute before loading fuel into the transport package. There was one instance in 1998 where a package vendor’s submittal only covered about 60% of the fuel that was planned to be shipped. There are other examples of packages that were shipped to foreign reactors for loading “at risk” that were not licensed in time, were not used, and were returned to the package vendor at DOE’s expense.

The DOE receiving-site contractor is responsible for reviewing the SNF fuel drawings and draft Appendix A documents for consistency with the storage facility’s safety analysis. The DOE site contractor’s review is also sometimes necessary to perform additional safety analysis at the receiving facilities, and to finally confirm the consistency between the Appendix A and the transport package license. Since 1999, all final DOE Appendix A documents are provided to the NRC and to the package vendor (by DOE) after the DOE review is satisfactorily completed. The prudent reactor operator’s representative will work smartly to finalize Appendix A’s and provide them to DOE and the applicable package vendors as soon as possible.

The NRC requires applicants to account for fuel assembly dimensional tolerances in their SAR submittals. The DOE staff and/or DOE contractor reviewers have found inconsistencies between the Appendix A's and some of the applications presented to the NRC. These problems could be avoided if the package licenses were appropriately bounding of many different fuel types. Unfortunately, the package vendors either do not have complete fuels data or do not have the ability to adequately perform bounding analyses for all fuel types in their license.

If pressed by schedule time constraints, the NRC may streamline their technical review process to cover only the specific fuel type as described in the Appendix A files for a planned shipment. The NRC staff must always review the package's safety analysis and perform confirmatory calculations, and the bounding techniques may require less time to complete. A significant problem with this approach is when the next fuel type to be transported in the same package was not previously included in the "authorized contents" of the certificate, and a new application must be submitted that involves another NRC review. The high cost and potential schedule impact of multiple submittals has a cumulative affect the success of the FRR program.

The NRC will formally document all questions about the SAR and application in the form of a document called a Request for Additional Information (RAI). An RAI for a foreign package will be formally addressed to DOT, and the DOT will forward the RAI to the foreign applicant's U.S. representative.

Improvements for Aluminum-Clad Fuel Package Licensing

The DOE complex has accumulated a substantial amount of operational experience in managing a variety of aluminum-based nuclear reactor materials. Prior to 1998, the standard phrase seen in almost all of the NRC's and DOT's Type-B(U)F package certificates stated that "known or suspected failed fuel assemblies (rods) and fuel with cladding defects greater than pin holes and hairline cracks are not authorized." The DOE-Savannah River staff requested a technical report in 1996 from a contractor, the Westinghouse Savannah River Company (WSRC), to document a new technical basis for performing containment analysis for aluminum-clad fuels using the ANSI N14.5 standard methodology recognized by the NRC.

The first significant report by WSRC, "Preliminary Report: Bases for Containment Analysis of Transportation of Aluminum-Based Spent Nuclear Fuel," WSRC-TR-98-00317, (Reference 1) was provided by DOE to the NRC in 1998. The NRC accepted the report conclusions and approved subsequent applications that included the appropriate containment analysis to bound damaged fuels with corroded cladding for fuel meat composed of either U-Al alloy, U_3O_8 -Al dispersion, $U-Al_x$ -Al dispersion, or U_3Si_2 -Al dispersion. Five of the Type-B package designs utilized in the DOE FRR SNF Acceptance Program are licensed for the transport of damaged aluminum-clad SNF materials: GE-2000 (two packages available), NAC-LWT (eight packages available), TN-7/2 (two packages available), GNS-11 (two packages available), and GNS-16 (two packages available).

A second report, "Impact of Degraded RA-3 Fuel Condition on Transportation to and Storage in SRS Basins," WSRC-TR-2000-00152, was issued in August 2000 (Reference 2), that further

demonstrates that mechanical damage may be treated similar to cladding corrosion, and that the dominant variable in the containment analysis is the exposed surface area of the fuel meat. The allowable exposed surface area should be any combination of corrosion and/or mechanical damage. The assemblies will maintain structural integrity to allow the necessary handling/cropping required to transport the assemblies to the Savannah River Site.

The application of the new containment analysis methodology is complimentary with licensing a Material Test Reactor (MTR) fuel “convenience can” for loose plates that have exposed fuel meat. A package application is currently being reviewed by the NRC to allow transport of corroded and/or mechanically damaged fuel assemblies with exposed fuel meat. All fuel materials that have known or suspected structural damage will be canned for handling and transportation. Any failed stainless steel and zircalloy-clad fuels will be canned for transport.

Recurring or Significant Technical Issues

The domestic and foreign package owners have been responsive to NRC concerns raised in recent package reviews for aluminum-clad MTR-type fuel packages. However, there has been a trend of issues from the NRC technical reviews. The logical proof of the acceptability of the package safety analyses is the responsibility of the package owner. The NRC’s responsibility is to review and to confirm the safety documentation presented. Technical issues that were experienced during recent NRC package reviews resulting in formal RAI letters have included:

- Fuel assembly dimensional tolerances are based on fuel drawing dimensions, and the tolerances must be conservatively incorporated into the safety analysis calculations and computer models.
- Thermal loading must be limited so that the maximum normal temperature of the fuel does not exceed 400F where cladding is relied upon for fuel geometry and containment.
- Benchmarking and bias analysis of the criticality code and cross-section library should be on the same platform used for the criticality evaluation.
- Comprehensive specifications, acceptance criteria, and acceptance tests verifying the presence and uniformity of the neutron absorber material if more than 75% credit for Boron-10 is used.
- Mechanical properties of borated aluminum must be demonstrated over a range of temperatures to provide a large margin of safety compared to the stresses in that material.
- Shielding evaluations that were based on highly-enriched fuels must be updated to determine neutron dose rates for the low-enriched fuels.
- Fuel assembly drawing details must be provided, including an evaluation of the interaction of the fuel assemblies with the fuel baskets.

- All drawings, sketches, supporting analysis, safety supplements, and any formula references that are not commonly available in the modern U.S. must be translated into English and provided (with the SAR submittal) for the NRC technical reviewers.

A copy of the foreign competent authority's safety evaluation report (in English) is also sometimes helpful in assisting the NRC staff in understanding the basis for some foreign package analysis techniques or assumptions. This is not a formal requirement for the US application, but the NRC staff has requested that they be provided on a routine basis.

The NRC staff typically reviews modern domestic packages with SARs that conform to standard format and content requirements, and that have a standardized document control system. Some of the older foreign packages have typically required substantially more effort and time to review against the current standards. If a foreign package SAR has never been reviewed by the NRC staff, one could reasonably expect that the NRC technical review would require more time.

RECENT DOE ACTIONS TO EXPEDITE THE USA LICENSING PROCESS

Background Information

The DOE and NRC have a special arrangement in place since 1998 to improve the coordination of the NRC's package validation technical reviews. This is a formal arrangement managed by DOE-Headquarters to provide reasonable involvement by DOE and NRC in the planning and coordination for the technical reviews. The NRC conducts pre-acceptance reviews of the application and SAR. The NRC technical review resources are quite limited and must be scheduled in advance to save time. The NRC maintains that package applications must be submitted at least six months in advance for any licensing review. An emerging issue by any organization involved will require immediate attention and effective communication to all others when schedule changes are necessary. The NRC management and staff resources are the same people who are also responsible for reviews of domestic transportation packages and commercial on-site storage packages, and there is always a backlog of work to be prioritized and managed at the NRC offices.

The NRC and DOT technical reviews are in many cases the critical path that must be completed satisfactorily in parallel with many other final preparations for a DOE shipment. In an attempt to meet schedule commitments, DOE has accepted substantial financial risks in the past by sending packages and loading equipment around the world to load fuels without valid package certificates. Although increasingly rare, some reactor facilities have been forced to load fuel "at risk" awaiting valid certificates from all applicable competent authorities.

Submittals must be delivered "on schedule" consistent with the DOE, DOT and NRC expectations. DOE and NRC have experienced problems in obtaining strong commitments from package vendors on the "date certain" for the USA validation schedule. The DOE requested "certificate need dates" are coordinated with the DOE Program Managers responsible for the overall shipment schedule coordination.

The Routine Management Approach by DOE and NRC

Conference calls with the NRC and DOE representatives are held on a weekly basis to review the status of all FRR ongoing package reviews and to discuss plans for anticipated license amendments. The information provided in the weekly handout for each package submittal includes the package description, the applicant's representative contact(s), the NRC project manager's name, the projected submittal date, the specific actions required by NRC and/or DOT, the projected certificate need date, the country or countries involved, the specific fuel types involved, and any other noteworthy remarks. This level of information quality control is necessary to maintain consistency and direction of the pre-shipment authorizations for the FRR program. DOE has participated in approximately seventy-five of these weekly conference calls to date.

DOE has participated in public meetings between the DOT, NRC, foreign package vendors, foreign reactor facility managers, shipping agents, and interested parties to facilitate timely solutions to unique licensing problems. The package vendors with the oldest packages have experienced analysis documentation problems, or they may not have used the current NRC guidance documents in their analyses. Additional time-consuming analysis and documentation by the applicant, and subsequent additional review by the NRC staff is necessary when that happens. The NRC will normally permit up to two RAI question cycles before rejecting an application for being substantially incomplete. The situation is improving, but there has been a prevalent attitude by some package vendors that DOE has the ability to appeal to the NRC staff to complete the NRC technical reviews on very short notice. The NRC staff has been flexible in assisting DOE with package licensing issues, but NRC also holds DOE accountable for the actions of its contractors.

For assistance with the IAEA regulations and international regulatory policy matters, the DOE staff will consult with the Chief of the Radioactive Materials Branch, U. S. Department of Transportation, in Washington, DC. He currently receives a copy of the weekly handout for the NRC/DOE conference call, and he has provided invaluable support for the DOE FRR SNF Acceptance Program over the past few years. In the past two years, the DOT has issued approximately forty competent authority certificates for SNF packages in support of the DOE FRR SNF program.

It is the standard policy of the DOT to forward all foreign Type-B package revalidation submittals of SARs to the NRC for thorough technical review against IAEA regulations. The foreign-licensed package applicants must request revalidation and provide five (5) copies of the Safety Analysis Report, completely translated in English, to the DOT. The SARs should be directed to: Radioactive Materials Branch, DHM-23, Room 8430, U. S. Department of Transportation, 400 Seventh Street SW, Washington, DC 20590. When an NRC technical review is completed, a Safety Evaluation Report is prepared by the NRC staff project manager that is the basis for the Approval Recommendation letter from NRC management to the DOT. The NRC licenses the domestic (US) packages and the request for revalidation of a domestic package by the DOT will include a copy of the valid NRC package license. The Competent Authority Certification by the DOT is issued approximately 1-2 weeks from the date of the receipt of the NRC's approval recommendation letter.

Some additional schedule time is usually necessary for the foreign regulatory competent authorities (in the shipment's transitory countries) to complete their revalidation reviews. Although there may be adequate technical justification to authorize additional contents, the NRC approval recommendation to the DOT will not allow more than the authorized contents as described in a foreign package certificate. In some cases, the authorized contents in the DOT certification may be reduced or may have additional restrictions, if a thorough NRC technical review cannot be completed. In the past two years, the NRC staff has provided dedicated support and extra effort when needed by DOE, and potential negative consequences to the DOE's shipment schedules have been frequently avoided.

CONCLUSIONS AND CHALLENGES

Improved coordination and communication between the DOE, reactor operators, package licensees, the NRC staff, and the competent authorities will result in "more manageable" dilemmas and an increased reliability in the shipment planning and scheduling process. As the DOE program matures, the DOE's ability to manage unique and difficult situations has changed, and DOE will continue to change with time.

All organizations involved should benefit from improved understanding and confidence in the long-range plans and schedules. With the increased communication, there is an expectation of an increase in the initial quality of the license applications to minimize or eliminate last-minute question cycles with the NRC staff. A significant challenge during the remainder of the DOE FRR SNF acceptance program is the ability to integrate substantial information to accurately forecast the shipment schedules. To be highly successful in the DOE FRR SNF Acceptance Program, all participants should initiate shipment technical preparations and establish package licensing plans as early as possible.

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REFERENCES

- 1 Vinson, D. W., Blanton, P. S., Sindelar, R. L., and Iyer, N. C., "*Preliminary Report: Bases for Containment Analysis of Transportation of Aluminum-Based Spent Nuclear Fuel*," WSRC-TR-98-00317 (October 1998).
- 2 Vinson, D. W., Blanton, P. S., Sindelar, R. L., and Iyer, N. C., "*Impact of Degraded RA-3 Fuel Condition on Transportation to and Storage in SRS Basins*," WSRC-TR-2000-20152 (August 2000).