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POLICY ISSUE
NOTATION

March 28, 2005 SECY-05-0051

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: DETAILS AND PROJECTED COST OF A DEMONSTRATION TEST OF A FULL-SCALE SPENT NUCLEAR FUEL RAIL TRANSPORTATION CASK UNDER THE PACKAGE PERFORMANCE STUDY

PURPOSE:

To provide the Commission with information concerning the details, projected costs, and schedule for a demonstration test of a full-scale spent nuclear fuel rail transportation cask, as directed in the Staff Requirements Memorandum (SRM) for SECY-04-0135, dated December 10, 2004.

SUMMARY:

This paper provides a brief background discussion concerning the history of staff and Commission actions for the Package Performance Study (PPS). The discussion then turns to the details, projected costs, and schedule for the proposed demonstration test of a full-scale spent nuclear fuel rail transportation cask, as directed in the SRM for SECY-04-0135. The proposed test scenario will involve a fully assembled spent nuclear fuel cask, with surrogate fuel assemblies, tied to and supported on a carrier railcar that is impacted by another train, traveling at 60 MPH, at a 90-degree angle at a simulated rail crossing. The total projected cost for the demonstration test is $11.2 million. However, a firm price for the demonstration test cannot be determined until after the Chairman's approval to proceed with the procurement actions for the demonstration test. The planned activities for the demonstration test are scheduled to be completed within 192 weeks after the Commission's approval to proceed with the project.

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BACKGROUND:

Over the past 26 years, the staff of the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Regulatory Research (RES), has conducted (or sponsored) and published a series of studies assessing the risks associated with transporting spent nuclear fuel. The latest study, known as the Package Performance Study (or PPS), proposed a full-scale test to demonstrate the robustness of spent nuclear fuel transportation casks. This confirmatory research study is grounded in an enhanced public participatory process.

In February 2003, the staff published NUREG-1768, "Package Performance Study Test Protocols," which documented a proposed plan for performing extra-regulatory impact and fire tests (i.e., testing beyond the regulatory criteria) on certified spent fuel rail and truck transportation casks. Through extensive public meetings and comments, a wide range of stakeholders provided input for staff consideration of how the tests should be conducted. On the basis of that input, the staff identified additional testing approaches and developed a Commission paper (SECY-04-0029), dated February 23, 2004, which summarized the major public comment themes and presented testing options for the Commission's review and approval.

In response to SECY-04-0029, the Commission issued an SRM, dated May 11, 2004, in which the Commission approved the testing of a full-scale, certified rail cask of a type that is currently being used, or is expected to be used in the foreseeable future to transport spent fuel. The Commission also directed the staff to commence procurement of such a cask and, prior to publishing a request for bids, inform the Commission of the specific details of the cask design and the related justification. The staff provided that information in a memorandum to the Chairman, dated July 2, 2004, requesting authorization to enter into a procurement exceeding $3 million.

Additionally, the SRM for SECY-04-0029 directed the staff to submit, for Commission approval, a plan for a demonstration test with sufficient instrumentation to collect data to confirm the validity of key analytical methods and assumptions, including scaling. In particular, the Commission specified that the demonstration test should be realistically conservative and should include exposure to a fully engulfing fire. The Commission further directed the staff to interact with the U.S. Department of Energy (DOE) to determine whether DOE will provide funding for the demonstration test and to inform DOE that the PPS could be expanded in the future to include testing of a certified truck cask.

The staff subsequently submitted a Commission Paper (SECY-04-0135), dated July 27, 2004, to request the Commission's approval of a demonstration test plan. As a result, in the SRM for SECY-04-0135, dated December 10, 2004, the Commission directed the staff to prepare an information paper outlining the details and projected costs of a demonstration test that represents a viable transportation accident, and not necessarily the "worst case" scenario or a hypothetical accident requiring multiple events to occur simultaneously. The SRM specifically directed that the demonstration test should consist of a simulated crossing with a train traveling at an appropriate speed colliding at a 90-degree angle with a transportation cask on its rail carrier car in a normal transportation configuration. This paper provides the requested information.

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DISCUSSION:

The staff's process for developing the demonstration test plan, projected costs, and a proposed schedule involved (1) developing a test plan that is consistent with the direction provided by the Commission, (2) reviewing the applicability of the test data from the full-scale drop tests recently performed at the German Federal Institute for Materials Research and Testing (BAM) facility to reduce the scope of the demonstration test, and (3) determining the cost estimate and schedule for the demonstration test with input from transportation cask suppliers and the Federal Railroad Administration (FRA).

Demonstration Test Plan

The demonstration test will be performed in accordance with the Commission's direction in the SRM for SECY-04-0135. A fully assembled transportation cask with surrogate fuel assemblies tied to and supported on a carrier railcar will be impacted by a train at a 90-degree angle at a simulated rail crossing. The train to be used for the demonstration test will consist of a locomotive with several freight railcars. Structural analysis will be performed prior to the demonstration test to determine the number of freight railcars, and the loads in each railcar required to simulate the relevant momentum and energy of an average length train. The locomotive will be similar to the one that the various railroads use for hauling freight trains. The transportation cask to be used for the demonstration test will be one that DOE is likely to use to transport nuclear fuel to the potential high-level waste repository at Yucca Mountain, Nevada. In addition, the transportation cask will have a current NRC certificate of compliance to transport commercial spent nuclear fuel, in accordance with Title 10, Part 71, of the *Code of Federal Regulations* (10 CFR Part 71).

It is likely that the spent nuclear fuel transportation casks will be shipped to a potential Yucca Mountain repository using railcars that are manufactured and certified in accordance with Standard S-2043, "Performance Specification for Trains Used To Carry High-Level Radioactive Material," which the Association of American Railroads (AAR) issued for transporting spent nuclear fuel. This standard includes special requirements for railcar coupling systems, brakes, nondestructive examination, and dynamic load tests. However, the structural design requirements for the AAR Standard S-2043 railcar for the spent fuel transportation trains are the same as those for regular center depressed freight cars. Since the demonstration test is intended to determine the structural response of a transportation cask on a freight railcar, a regular freight railcar of equivalent/similar structural design will be used in the test.

The spent nuclear fuel transportation cask will likely be tied to the railcar in accordance with the retention requirements of AAR Rule 88A during transportation to a potential Yucca Mountain repository. Therefore, the mounting system for the demonstration test will also be designed to conform to AAR Rule 88A.

Before performing the demonstration test, a detailed pretest structural analysis will be performed to predict the behavior of the locomotive, railcars, and the transportation cask after impact. Based on that pretest analysis, a detailed instrumentation plan will be developed to record the stresses and deformations in the transportation cask, locomotive, and railcars. Different parts of the locomotive, transportation cask, and railcars will be painted in different colors to facilitate identification after the test.

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After the demonstration test, a post-test structural analysis will be performed to address any discrepancies between the predicted and actual test results, which may be attributable to variation in train impact speed, material properties of the transportation cask, locomotive, and railcars. This will include analyses required to address the actual train impact speed and material properties of the different components.

The Commission's approval to procure the transportation cask, locomotive, and railcars is a prerequisite to begin pretest analysis. The pretest analysis cannot be performed until the structural drawings and details of transportation cask, locomotive, and railcars are available.

Train Impact Speed

The train speed at a rail-to-rail crossing depends on the type of track, railroad operating procedures, and hardware installed to protect the rails at the crossing. The three types of rail-to-rail crossings currently in use are as follows:

- standard diamond
- one-way low-speed flange-bearing frog (OWLSFBF) diamond
- two-way flange-bearing frog (TWFBF) diamond

The rails at a standard diamond crossing do not have any special reinforcements at the track intersections. The flange-bearing frog diamond crossings provide a special track structure at track intersections to provide support for the train wheels to reduce railroad maintenance costs. The OWLSFBF diamond crossings have flange bearings for one direction, while the TWFBF crossings provide support for train wheels in both directions.

The FRA does not impose any special speed restrictions at standard diamond crossings, but requires that the maximum train speed must not exceed the maximum allowable speed for the class of track at the crossing. The railroads have to conform to certain speed restrictions and/or obtain a waiver from the FRA to install flange-bearing frog diamond crossings. However, both the FRA and the AAR have informed the staff that the individual railroads' operating procedures limit the speed at all three types of rail-to rail crossings to 45 – 50 MPH for maintenance reasons.

The speed at which the demonstration test can be performed depends on the type and layout of track at the test facility, and the maximum locomotive operating speed. FRA personnel have informed the NRC staff that a track layout at the facility in Pueblo, Colorado, can be modified to perform the demonstration test at a maximum speed of 60 – 70 MPH. This is considerably more than the maximum speed of 50 MPH at rail-to rail crossing on U.S. railroads, as described above. Therefore, during the development of the detailed test plan, the staff will target an impact speed of 60 MPH to represent a viable, realistic, and conservative scenario, but not a "worst case" accident.

Fire and Immersion Testing

In accordance with the Commission's direction in the SRM for SECY-04-0135, the demonstration test will not include any fire or immersion testing. The staff will continue to follow and review the results of fire and immersion tests performed by the nuclear industry and regulatory agencies in other countries.

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Full-Scale Drop Tests at the BAM Facility

The staff is currently negotiating a cooperative agreement with BAM to gain access to the detailed results for the full-scale and scale model drop tests performed on the two transportation casks at the BAM facility in Germany. The cooperative agreement will also provide access to the additional drop tests that will be performed in the future at the BAM facility. The staff will perform an independent detailed structural finite element analysis of the drop scenario and compare the results to those of the BAM drop tests. This will establish the magnitude of uncertainty in finite element analysis, and may address the use of scaling methods in the structural analysis of the spent nuclear fuel casks. However, the drop test results may not provide sufficient information about the behavior of transportation casks during a collision with a train.

The staff will submit a separate paper to the Commission to address the scope, price, and schedule for the analysis and review of the BAM drop test results.

Projected Cost of the Demonstration Test

The total cost to perform the demonstration test depends on the cost of acquiring a transportation cask with a supporting railcar, locomotive, freight railcars, and test instrumentation, as well as the cost of pretest and post-test structural analyses and the cost of conducting the actual demonstration test. The staff will not be able to obtain a firm price for these items until after the bidding process is complete. Approval to enter into contracts for these proposed procurement contracts will be requested in accordance with the Commission's approved procedures.

The staff has obtained cost estimates for the transportation cask supported on its rail carrier car in a normal transportation configuration from several potential suppliers. In addition, the FRA has supplied cost estimates for a locomotive and railcars, pretest and post-test analyses, and use of the facility in Pueblo, Colorado, to conduct the demonstration test. The staff has also estimated the full-time equivalents (FTEs) required to support and coordinate the demonstration test activities. On the basis of this information, the total projected cost of the demonstration test is $11.2 million. A non-public attachment to this paper shows the projected FTE requirements, cost breakdown for various activities, and cash flow.

Proposed Schedule

The staff has prepared a proposed schedule for performing the demonstration test on a transportation cask that already has a NRC certificate of compliance. This schedule is based on the assumption that DOE will award contracts for the supply of spent nuclear fuel transportation casks within 6 months after the Commission gives its approval to proceed with the demonstration test. The current published DOE schedule states that the contracts for the supply of transportation casks will be awarded by December 31, 2005. During the Spent Fuel Management Session of the Regulatory Information Conference on March 8, 2005, a representative from the Department of Energy (DOE) discussed their activities related to soliciting input from cask vendors and railcar vendors that would help in DOE's decision for the acquisition of casks and transportation railcars. NRC staff will continue to maintain cognizance of this development and keep the Commission informed.

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Another assumption underlying the proposed schedule is that the railcar used to transport the spent nuclear fuel transportation cask will be a regular freight car of a structural configuration equivalent to a railcar that complies with ARA Standard S-2043. This will ensure that the demonstration test schedule is not constrained by the availability of a certified railcar because, according to AAR personnel, none of the railcar suppliers has submitted an application for certification in accordance with AAR Standard S-2043.

The proposed schedule includes the following major milestones, which are listed in cumulative succession. Upon Commission approval to proceed with the demonstration test outlined in this paper, staff will initiate development of the statements of work and other necessary supporting documentation to begin the acquisition process.

Award contract for procurement of the locomotive, railcars, and test facility:	36 weeks
Award contract for procurement of a transportation cask:	40 weeks
Award contract for pretest and post-test structural analyses:	50 weeks
Receive manufactured cask delivered to testing facility:	126 weeks
Prepare test facility, install instrumentation, and perform pretest trials:	150 weeks
Perform the demonstration test:	154 weeks
Complete post-test analysis:	186 weeks
Issue the demonstration test Final Report:	192 weeks

RESOURCES:

There is a total of $13,420K and 2.4 FTE in the Nuclear Waste Fund available for the Package Performance Study ($9,225K and 1.2 FTE in FY 2005 and $4,195K and 1.2 FTE in FY 2006). The proposed project schedule for the demonstration test is for the period FY 2006 – FY 2009. Based on this schedule, it is anticipated that funding available in FY 2005 will not be needed. As a result, this funding will be carried over from FY 2005 to FY 2006 and can be utilized to cover the projected shortfall in FY 2006 of $1,105K, pending Commission approval. Future funding requirements (FY 2007 - FY 2009) will be addressed in the NRC's FY 2007 Planning, Budgeting, and Performance Management (PBPM) process.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objections. The Office of the Chief Financial Officer has also reviewed this paper for resource implications and has no objections.

CONCLUSION:

The demonstration test will be performed in accordance with the Commission's direction in the SRM for SECY-04-0135. A fully assembled transportation cask with surrogate fuel assemblies tied to and supported on a carrier railcar will be impacted by a train traveling at 60 MPH colliding at a 90-degree angle at a simulated rail crossing. The projected cost and schedule of the demonstration test are based on inputs from several cask vendors and the FRA. The total projected cost for the demonstration test is $11.2 million. However, a firm price for the demonstration test cannot be determined until after the Chairman's approval to proceed with

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the procurement actions for the demonstration test. The planned activities for the demonstration test are scheduled to be completed within 192 weeks after the Commission's approval to proceed with the project.

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Attachments: 1. FTEs Required for the Package Performance Study
2. Projected Cost of the Package Performance Study in $K