March29, 2012

MEMORANDUM TO: Brian W. Sheron, Director
Office of Nuclear Regulatory Research

FROM: James T. Wiggins, Director */RA/*
Office of Nuclear Security and Incident Response

SUBJECT: USER NEED REQUEST RELATED TO SPENT FUEL STORAGE CASKS VULNERBILITIES

This memorandum describes the Office of Nuclear Security and Incident Response (NSIR) user need request for evaluating the effects of an improvised attack on spent nuclear fuel (SNF) storage casks. The tasks outlined in this memorandum are not meant to describe a long-term research project, but rather outline issues in need of resolution in the next 9-18 months. This user need request has several independent tasks that includes analytical work and review of previous studies, review of relevant foreign studies, and proof of concept tests on the effectiveness of certain attack modalities against SNF cask surrogates.

This request is comprised of seven independent tasks. Task 5, is composed of several phases. Task 5, Phase 1 is a proof of concept test that will be conducted on flat simple surrogates designed to resemble cask lids and sides and will need to occur as soon as practical. This phase is being used to develop boundary conditions and determine the size of penetrations. Additional details of Task 5, Phase 1 testing are outlined in the draft test plan. Phase 2 of the tests will involve more complex surrogates using the knowledge gained in Tasks 1-3 and Task 5, Phase 1 of the testing. NSIR staff, working closely with the Office of Nuclear Regulatory Research (RES) staff, will have the active role in measuring and evaluating the results of Task 5, Phase 1 testing, which will include various tactical scenarios and timelines. RES will move into the lead role of evaluating results in Phase 2 and beyond.

The outcome of the Task 5, Phase 1 effort will be used to inform a notation vote paper currently scheduled for May 12, 2013, which will request direction for future Independent Spent Fuel Storage Installation (ISFSI) and Monitored Retrievable Storage Installation (MRSI) facilities rulemaking. The results will be used to help resolve stakeholder issues surrounding the Commission's direction to use a dose-based approach verse a design-basis threat approach and whether any additional security requirements including any potential changes to the current ISFSI protective strategy are needed beyond currently implemented security regulations and post 9/11 security orders.

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Although the outcome of the Task 5, Phase 1 effort is focused on informing the Commission Paper, it will also assist in the development of the regulatory basis for the future rulemaking, as well as informing follow-on work in future phases of this user need. A greater understanding of the potential cask vulnerabilities may also be important to the Office of Nuclear Material Safety and Safeguards (NMSS), since it could affect inspection activities and influence future cask certification and ISFSI/MRSI licensing; and can inform future gap-analyses efforts for SNF extended storage and transportation issues. Modifications to this user need or a separate future user need request will be coordinated with RES, if the outcome of these activities indicate that additional analysis, modeling or testing is required to refine the technical bases for the rulemaking.

This new request was discussed with several divisions within RES. We understand from these discussions that the scope and schedule of the tasks described below are achievable. In addition, the Directors and Deputy Directors of the participating Divisions in each of the affected Offices, Michael Layton, Richard Correia, Doug Weaver, Stuart Richards and Michael Case, have discussed and agree with the scope and schedules of the tasks in this request.

It is important that the staff in NSIR, NMSS and RES communicate frequently through periodic meetings and conference calls to ensure the efforts related to this request are meeting NSIR's identified needs and schedules.

BACKGROUND

NSIR is developing a regulatory basis for a proposed rulemaking to update the security requirements for facilities storing SNF and high-level radioactive waste. The rulemaking would establish effectively equivalent regulatory requirements which are currently in the 2002 ISFSI security orders, and also update ISFSI and MRSI security requirements to reflect new perspectives on potential cask vulnerabilities, new adversary characteristics, and lessons learned since the last ISFSI security rulemaking. NSIR issued a draft regulatory basis for public comment in 2009, and a draft adversary characteristics document (Draft Guide (DG)-5033) for cleared stakeholder comment in 2011.

NMSS completed classified ISFSI security (vulnerability) assessments between 2003 and 2006, under a contract with Sandia National Laboratories (SNL). These assessments were intended to evaluate four representative cask designs on whether immediate additional actions (beyond the 2002 ISFSI security orders) were necessary. The assessments (SECY-06-0045) included both aircraft attacks and ground assaults. Based on the assessments, no immediate changes to the security orders were considered necessary; however, the assessments indicated that updates to ISFSI and MRSI security requirements by rulemaking was appropriate (SECY-07-148 and SECY-10-0114).

Following Commission direction, NSIR provided the industry two briefings in 2011 on the classified SNL studies underpinning the proposed security requirements. Industry indicated that excessive reliance was made on analysis, versus experimentation, to validate modeling in the assessments.

NSIR's perspective is that while weapons' effect and Gaussian plume distribution analysis have very solid experimental backgrounds, the understanding of the phenomena that occur inside dry SNF storage casks following an adversary attack is less clear. In order to add some clarity to

the release projections in the assessments and separate from this user need memorandum, NSIR has contracted with SNL to evaluate potential releases from a hypothetical Boiling Water Reactor cask using a non-phenomenological approach.

Recognizing that a regulatory basis may rely on potential radioactive material releases, NSIR staff has determined a user need memorandum is necessary to evaluate the data in the 2003-2006 SNL assessments and conduct phased surrogate testing to provide additional support for the regulatory basis. A better understanding of the adversary attack sequence preceding a potential cask breach, the phenomena that occurs inside a SNF cask following an adversary assault and associated potential release would provide staff and the Commission better information on which to make a regulatory decision. NSIR staff will provide the expertise to evaluate the adversary attack sequence and RES staff will provide the expertise to evaluate the phenomena occurring within the cask and potential radioactive material releases.

In addition to these domestic analysis and experimentation efforts, NSIR staff is attempting to obtain access to relevant foreign SNF security studies, to mitigate industry's concerns on the depth of experimental validation of analytical modeling. If NSIR is successful, RES would integrate such foreign results into this effort.

DELIVERABLES AND SCHEDULE OF REQUESTED TASKS

This user need request is divided into several separate, independent tasks. The results of each of these tasks will provide additional support for the regulatory basis in regard to potential radioactive material releases. Under each task, the following are described: (a) scope of the technical issue; (b) deliverables; and (c) schedule. A projected timeline is included with this memorandum (Enclosure).

Task 1 – Independent evaluation of SNL (2003-2005) ISFSI security ground assault studies.

(a) Scope of the technical issues

This request includes a scientific and technical review of ground assault portions of previous classified studies and recommendations for possible additional analysis to clarify the results. ISFSI security assessments were accomplished by NMSS between 2003 and 2006, under a contract with SNL. These assessments were designed for evaluating the need for additional immediate actions to protect public health and safety and common defense and security beyond the 2002 security orders. Analysis is needed to determine if ground assault studies have sufficient technical depth, aptly consider the thermal and kinetic response of the fuel assembly and are appropriately conservative to support the proposed rulemaking and the potential cost implications. Industry's opinion is that excessive reliance was made on analysis versus experimentation to validate the modeling.

This is an independent task and can be accomplished simultaneously with other tasks. All information related to this task is available within the U.S. Nuclear Regulatory Commission (NRC) Headquarters and has been provided to RES for evaluation of this user need memo.

(b) Deliverables

1. Provide a perspective on how much reliance can be placed on previous assessments designed to evaluate a separate issue in a rulemaking process.
2. Provide a perspective on the presence of potential excessive conservatism in the SNL assessments.
3. Provide recommendations on what additional analysis should be requested from SNL (or another facility) to further clarify or quantify assessment results.
4. Use knowledge gained to inform Phase 2 of Task 5 testing.
5. Present results at closed stakeholder meetings in Calendar Year (CY) 2012 and CY 2013.

(c) Schedule

1. Draft Evaluation Report – October 2012
2. Final Evaluation Report – TBD

Task 2 – Conduct a literature review to determine other studies and research available on these subjects.

(a) Scope of the technical issues

Conduct a literature search, identify and review potential sources of historical information related to testing, experimentation or modeling of security vulnerabilities of SNF storage and transportation casks. Upon evaluation of these resources, RES should determine whether these resources provide additional information that would be valuable to the Commission during this rulemaking.

This is an independent task and can be accomplished simultaneously with other tasks. NSIR has provided contact information for resources within the Department of Defense.

(b) Deliverables

1. Provide a determination on whether the available information has relevance in the development of the regulatory basis.
2. Make recommendation on best use of this information.
3. Use knowledge gained to inform Phase 2 of Task 5 testing.
4. Prepare a letter report on validity and relevance of outside research and studies.

(c) Schedule

1. Draft Letter Report – October 2012
2. Final Letter Report – TBD

Task 3 – Evaluation of relevant classified foreign studies.

(a) Scope of the technical issues

NSIR is in the process of identifying relevant foreign security assessments completed on SNF threat, storage and transportation. NSIR plans to initiate a discussion with foreign partners to obtain information on these studies and their relevance to NRC-regulated processes. Relevant studies and assessments will be provided to RES for review to determine if information could be used as an independent source of scientific information to inform this rulemaking.

This is an independent task and can be accomplished simultaneously with other tasks. NSIR will assist by obtaining copies of the information. NSIR plans to travel to Europe in July 2012, to review the study information and make the necessary arrangements to obtain a copy if the information can assist the NRC regulated processes.

(b) Deliverables

1. Provide a determination whether the information, if available, has relevance to the rulemaking.
2. Prepare a letter report on validity and relevance of international research and studies, if obtained.
3. Use knowledge gained to inform Phase 2 of Task 5 testing.

(c) Schedules

1. Draft Letter Report – TBD
2. Final Letter Report – TBD

Task 4 - Recommendation for additional research or experimentation.

(a) Scope of the technical issues

Based on the information reviewed in Tasks 1, 2 and 3, RES should provide a recommendation on whether additional research or experimentation is warranted to develop a revised technical basis.

(b) Deliverables

1. Provide RES' recommendations on whether NSIR can develop a complete regulatory basis and proceed to rulemaking based on the research reviewed in Tasks 1, 2 and 3. If research in Task 3 is not available, complete your evaluation based on the information available from Tasks 1 and 2.
2. Prepare a letter report on ability of NSIR to develop a complete regulatory basis and proceed to rulemaking based on the research and studies reviewed above.

(c) Schedule

1. Draft Letter Report – No later than (NLT) March 2013
2. Final Letter Report – NLT June 2013

This task is dependent on the results of Tasks 1, 2, and 3, and the schedule of this task can be shifted as long as the draft report is received by March 2013.

Task 5 – This task consists of several subtasks to support phased testing using both simple and complex surrogates for SNF storage casks.

The testing is designed to achieve a better understanding of the adversary attack sequence preceding a potential cask breach, the phenomenon that occurs inside a SNF cask following an adversary assault and any associated potential release of radioactive material. Phase 1 results and evaluation of analytical work under Tasks 1 – 3 will inform the need for Phase 2 testing and the scope of the experimental plan. Prior to Phase 2 testing, a collaborative agreement will need to be established between stakeholder groups and the NRC.

Task 5a – Conduct Phase 1 tests on spent nuclear fuel cask simple surrogates using an attack scenario bounded by DG-5033.

(a) Scope of the technical issues

The Phase 1 test is a proof of concept test. It is to be conducted using simple surrogates and is designed to assess the feasibility of certain attack scenarios. NSIR will be responsible for determining the success of Phase 1 testing and evaluating attack timeline information.

NSIR and RES will, through a contractor, conduct phased testing on simple SNF cask surrogates using an attack scenario bounded by NRC DG-5033. By conducting tests on the effectiveness of certain attacks against SNF cask surrogates, NSIR will be provided the information necessary to determine if there is a need for increased security measures to provide high assurance of reasonable protection of public health and safety and the common defense and security. An initial draft test plan (Official Use Only (OUO)) has been provided for consideration by RES for conducting this test and will continue to be revised to reflect discussions and lessons learned as testing proceeds through various phases. The test plan should be modified as necessary to leverage preparation for Tasks 5c and 5d.

(b) Deliverables

1. RES has no deliverable in Phase 1.
2. NSIR will provide RES an analysis of a security event in Phase 1 testing to ensure results (attack modalities) are not just possible but realistic and credible.
3. NSIR provides RES results of testing as described in the test plan.

(c) Schedule

1. Invite stakeholder observation of Phase 1 testing – June 2012
2. Initiate Phase 1 tests – August 2012
3. Produce draft reports – October 2012
4. Produce final reports – January 2013

Task 5b – Establish a collaborative process with stakeholders, NSIR and NMSS to inform Phase 2 and beyond testing and create the Phase 2 test plan.

(a) Scope of the technical issues

Following Commission direction, NSIR provided the industry two briefings in 2011 on the classified SNL studies underpinning the proposed security requirements. Industry indicated that excessive reliance was made on analysis, versus experimentation, to validate modeling in the assessments. NSIR would like RES to establish a collaborative process with industry, industry groups and related stakeholders to develop mutually acceptable tactics, techniques and constraints for the conduct of Phase 2 and any other follow-on phases of testing.

This is an independent task and can be accomplished simultaneously with other tasks. NSIR will assist by providing points of contacts for interested industry groups.

(b) Deliverables

Establish a collaborative agreement between NRC and industry, industry groups and related stakeholders.

(c) Schedule

1. Coordinate industry participation in Phase 2 testing – September 2012
2. Complete collaborative agreement – January 2013

Task 5c – Identify and quantify phenomena that will need to be captured, measured or tracked within the surrogate during Phase 2 of the test (Task 5d) to support Task 5e.

1) Scope of the technical issues

Using the knowledge from Tasks 1-3 and results of Phase 1 testing, RES should consider the internal phenomenon occurring within the cask and upon the fuel assemblies and determine the thermal and kinetic information to be collected and identify the appropriate methods for collecting this information in order to support analytic modeling of cask internal phenomena.

(b) Deliverables

Establish method(s) to be used to capture and measure data from Phase 2 testing. Provide in the best format to inform Task 5e.

(c) Schedule

1. Identify data to be collected in Phase 2 testing – December 2012
2. Identify methods to capture data – March 2013

Task 5d – Conduct Phase 2 tests on spent nuclear fuel cask surrogates using an attack scenario bounded by DG-5033.

(a) Scope of the technical issues

Phase 2 will be conducted on complex surrogates (3-dimensional) to support the capturing of information identified in Task 5c above. NSIR and RES will, through a contractor, conduct testing on complex SNF cask surrogates using attack scenarios bounded by NRC DG-5033. By conducting tests on the effectiveness of certain attack modalities against SNF cask surrogates, NSIR will be provided the information necessary to determine if there is a need for increased security measures to provide high assurance of reasonable protection of public health and safety and the common defense and security. A draft test plan (OUO) will need to be developed by RES for conducting this test and will continue to be revised to reflect discussions with collaborating stakeholder group and lessons learned as testing proceeds through various phases. The test plan should be modified as necessary to support future tasks.

(b) Deliverables

Capture effects that occur within the cask surrogate following an improvised attack.

(c) Schedule

1. Initiate Phase 2 tests – 2013
2. Produce draft reports – 90 days following test completion
3. Produce final reports – 90 days following draft report

Task 5e – Evaluate inside-cask phenomena and modeling.

(a) Scope of the technical issues

This task follows Phase 2 testing of Task 5d. NSIR's perspective is that while weapons' effect and Gaussian plume distribution analysis have very solid experimental backgrounds, the understanding of the phenomena that occur inside dry SNF storage casks following certain attack modalities is less clear. Identifying, quantifying and analyzing the phenomena within the cask may prove to be invaluable in providing the Commission the information necessary to determine if a need exists for increased security measures. This task will be informed by Tasks 1-3 and the results of Phases 1 and 2 testing in Tasks 5a and 5d.

(b) Deliverables

1. Develop modeling that can be applied to the stored SNF to determine potential releases.
2. Use results to create dose verses distance curves.

(c) Schedule

1. Produce draft reports – TBD 2013
2. Produce final reports – TBD 2014

Task 6 – Charter an NRC Internal Technical Advisory Group (TAG).

(a) Scope of the technical issue

The TAG will provide advice, high-level technical insights, technical consistency, and support to NRC management and the technical staff as we accomplish the testing and modeling described above and outlined in the draft test plan. NSIR's perspective is that peer review fosters confidence in the research products and helps maintain high standards of competence in research programs. It is anticipated that peer reviews will provide critical assessments of this testing, will help judge the technical adequacy of the results, and aid in bringing breadth of knowledge to bear on the quality of the research products. Potential membership would include RES, NSIR, NMSS and support from the Office of Nuclear Reactor Regulation and the Office of Federal and State Materials and Environmental Management Programs.

(b) Deliverable

1. Establish a TAG Charter that includes senior expert technical staff from within NRC who possess the knowledge needed to review the technical results of the testing and make critical judgments. The technical elements required within the TAG include, but are not limited to, the following: data analysis, health effects, and source term analysis.
2. The TAG is also tasked with providing input to help resolve internal and external review comments (e.g., those from industry during Phase 2 and follow-on testing), as well as facilitating the resolution of technical differences that may arise among the analysts performing evaluations in Tasks 1, 2, 3, 4, and 6.

(c) Schedule

1. Identify TAG members and develop draft charter – July 2012
2. Approve draft charter – November 2012
3. Develop an electronic repository within SharePoint, Safeguard Information Local Area Network and Electronic Safe and Homeland Secure Data Network to provide reports, publications, and other technical information as background for all TAG members – November 2012

Task 7 – Provide technical assistance to NSIR in support of meetings with stakeholders held in support of the ISFSI security rulemaking (public and classified).

(a) Scope of the technical issues

In previous meetings, industry has indicated that excessive reliance was made on analysis; versus experimentation to validate modeling. RES should be prepared to discuss any recommendations made and conclusions reached on their analysis of information from Tasks 1-5.

(b) Deliverable

Technical assistance and support through presentations or other participation at meetings with stakeholders to discuss the regulatory basis for the proposed ISFSI and MRSI security rulemaking.

(c) Schedule

As needed. Not anticipated to exceed three meetings through October 2015. Support on this task will occur only after the completion of one of the above tasks. Support on this task will vary with the number of tasks completed and the results produced or conclusions reached.

RESOURCES

NSIR, RES, and NMSS will align on the resource needs and schedule after RES responds to this user need request with cost estimates. Funds are currently available in NSIR Fiscal Year (FY) 2012 and FY 2013 budgets.

PRIORITY

The priority of this request for assistance is a high priority. NSIR staff has used this priority value in their discussions with members of your staff to determine whether your office can support our schedule requirements. These discussions indicated that RES can support the scope and proposed schedule identified in this user need request.

PRODUCT CLASSIFICATION

NSIR notes that work under Tasks 1 to 4 and 6 will involve the creation of classified work products. Additionally, integration of Task 5 results with cask-specific implications may also be classified. Accordingly, RES should develop work products on an NRC classified IT systems pending provisional classification decisions on draft work products using appropriate classification and designation guides, including CG-RDD-1 and DG-SGI-1. NSIR's authorized classifiers and designators are available to assist RES' classification and designation efforts. In addition, NSIR is requesting that UNCLASSIFIED (i.e., redacted) variants of RES' discussions, analyses, conclusions, and recommendations be developed to support engagement with the public and other stakeholders during this rulemaking effort.

POINTS OF CONTACT

The overall NSIR contact for this research is Susan Bagley. The NSIR technical contacts for Phases 1 and 2 testing are Oleg Bukharin and Rebecca Clinton. The NMSS technical point of contact is Kimberly Gambone-Rodriguez.

(c) Schedule

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