STATEMENT OF WORK

Project Title:	DETERMINATION OF DISPERSAL CHARACTERISTICS OF SPENT NUCLEAR FUEL AND OTHER NRC-LICENSED MATERIAL
Job Code Number:	W 0397
B&R No.:	311-15-315-397
Technical Project Manager (TPM):	Francis Young, NSIR:DNS (301) 415-6396
Project Manager (TAPM):	Lars Solander, NSIR (301) 415-6080
Performing Organization:	Sandia National Laboratories (SNL)
Fee Recoverable:	No

1.0 Background

In recent years, concerns about the possibility of radiological sabotage against spent nuclear fuel shipping and storage casks within the United States have rekindled. This increased interest is particularly due to the proposed increase in transport of spent fuel, increased number of proposed independent spent fuel storage installations, and the increased availability of explosives technology and materials. As a result, an international meeting was convened in July 1999 to discuss the adequacy of the supporting technical basis and to identify areas in need of further evaluation.

To support the development of the regulations associated with transport and storage of spent nuclear fuel in the late 1970's, the NRC determined an experimental program was needed to validate the analyses used to develop the regulations. Battelle Columbus National Laboratory and Sandia National Laboratories conduct several evaluations including selected testing in the 1980's. The results were limited to developing insights to the consequences of an attack using explosives on spent nuclear fuel.

The international working group concluded that a more detailed analysis was needed to better understand the possible impacts of potential terrorist acts on spent fuel shipments and other radioactive materials. While there is some experimental data on surrogate spent fuel in response to High Energy Density Device (HEDD) attack, relatively few experiments have been performed on actual spent fuel to determine its behavior relative to that of surrogate materials. The small number of experiments, as well as non-similar experimental configurations, have provided only a general understanding of the relative behaviors of the two materials in the potential high energy environments that could exist in an attack. The lack of a detailed analysis has thus required estimates of potential consequences of an attack to be very conservative. Therefore, the NRC requires technical assistance to obtain data on the generation of respriable aerosols formed from HEDD attack against spent nuclear fuel and other radioactive materials .

Initial work for this project was included in SNL project entitled, "Revalidation of NUREG-0170 Spent Fuel Shipment Risk Assessments," Job Code Number: J5160, B&R No.25015308270. Because of increase work scope and NRC organizational changes, this task needs to be tracked independently.

2.0 Objectives

The objectives of this project are provided below.

A. **Conduct experiments and supporting analyses to obtain detailed data on the generation of respirable aerosols from actual spent fuel rods with various fuel characteristics subject to HEDD.**

B. Provide technology transfer to NRC of computer modeling of HEDD attacks against nuclear materials.

Where possible, the use of the international working group resources should be used to accomplish these tasks.

3.0 **Completion Date**

The completion date for this task is December 30, 2006. Depending on level of effort, the performance period may be extended.

4.0 Expertise and Disciplines Required

The performing organization shall assure that the project team has the proper mix of nationally and internationally recognized technical experts, i.e., scientists and engineers with training and experience in radiological and non-radiological transportation risk assessment under routine and accident conditions. Specific disciplines required include, but are not limited to, chemical, structural and thermal engineering, and health physics. The principal and other senior investigators shall have the professional credentials to qualify as expert witnesses at public hearings.

Personnel conducting safeguards work shall have technical experience in determining radiological source terms and in performing radiological impact analyses for adverse conditions. The personnel working on this part of this project must have, as a minimum, a Department of Energy L-clearance or equivalent (Department of Defense).

The principal investigator shall provide technical oversight and continuity over all work performed on this project.

5.0 Work to be Performed

The performing organization shall provide the NRC with a technical report that documents the results of the radiological consequences and assumptions used in the analyses. Detailed work for the task is as follows:

To the extent possible, this effort should use the resources of the “international partnership” for materials, instrumentation, and technical expertise that have been offered in meetings that have occurred over the last 2 years. Resources within the U.S. should be used to supplement the international resources. The work required under this statement of work is described in detail below.

Task A

Revalidate and update previous feasibility study to determine if radioactive material, specifically spent fuel/surrogates' aerosol measurements can be performed within the existing facilities of SNL. The study results shall be provided to the NRC TPM in a technical report. The feasibility study shall address the following:

- Preliminary experiment design (involves explosive device and containment chamber conceptual design, analysis of hazards, and working with laboratories in Germany and France on aerosol chamber design and sample preparation)
- Feasibility planning for proof testing of explosive containment chamber
- Feasibility of attaining safety and National Environmental Policy Act (NEPA) approvals, if necessary, and making waste management of residues effective (disposal of hazardous residues)

Task B

Based on the updated feasibility study, SNL shall provide a proposal for spent fuel/surrogate aerosol measurements testing program to the NRC. Previous work conducted as part of Job Code Number J5160, entitled, " Revalidation of NUREG-0170 Spent Fuel Shipment Risk Assessments," should be used where possible. The proposal must include a discussion of how the following activities will be performed:

1) Conducting a series of experiments to obtain detailed data on the generation of respirable aerosols from actual spent fuel with various fuel characteristics subject to HEDD attacks. Experiments proposed should be at a scale that can provide the needed data in a cost effective manner. Moreover, the experiments proposed should discern any geometric scaling effects relating to HEDD or the characteristics of spent fuel pellets. The experimental testing program proposed should be designed to define two important features of the interaction of HEDDs with spent fuel. These two features are as follows.

- Mass and physical characteristics of the particles produced – AEDs up to 100 microns with special emphasis on the respirable fraction (<10 micron AED).
- Enrichment of volatile nuclides like cesium and ruthenium in specific particle size fractions.

2) The testing program must be divided into three stages (non-radioactive, depleted uranium, and spent fuel). In addition, subtasks should be included in the proposal for the non-radioactive stage.

If the proposal is acceptable as submitted, an NRC form 173 will be issued for SNL to proceed with the testing program.

6.0 Deliverables and Schedule (including meetings)

The deliverables required under each phase with the anticipated time for delivery are provided below. All deliverables shall be provided to the NRC TPM.

MILESTONE	MONTHS FROM INITIATION
Kickoff meeting	0

Schedule/Deliverable Description	Schedule Date
(a) Sandia starts update to feasibility study	
(b)Sandia completes update to feasibility study	2 weeks
(c) Onsite meeting to discuss draft findings from feasibility study	3 weeks
(d) Updated Feasibility study submitted to the NRC TPM	4 weeks
(e) Provide proposal for conducting Testing and analytical work (Task B) to the NRC TPM.	4 weeks
(f) Conduct task B if proposal is accepted	TBD

The performing organization shall prepare a comprehensive final report in NUREG/CR format, summarizing all work performed under this project. The report shall include an executive summary of the findings of this project. It shall also include a complete description of the shipment models developed and rationale for the use of data and assumptions.

All reports shall be edited and reviewed by the performing organization and checked in accordance with the quality assurance requirements addressed under Section 13.0 and reviewed for document classification. The NSIR TPM will provide comments to the performing organization to be considered in the preparation of the final task report. These comments will identify potential problem areas, discrepancies, and technical insights on the draft report. The comments will be for the purpose of clarification only and will not be construed as to prejudge the performing organization's work or technical findings. Within the above schedule and after receipt of NRC comments, the performing organization shall revise the draft report, incorporating resolution of comments, and submit a camera-ready copy and an NRC-compatible, electronic media copy of the final report.

7.0 Estimated Level of Effort

The estimated level of effort for this project is identified below.

Task A 5 person weeks
Task B 250 person weeks

8.0 Meetings and Travel

The location of the meetings are expected to be at SNL, NRC HQ and international partners locations. It is expected that the meetings to be held at NRC and foreign meetings will need no more than two performing organization staff members attending each meeting.

9.0 Project Status Reports

The performing organization shall submit a Monthly Letter Status Report (MLSR) by the 20th day of each month with distribution as shown below. The MLSR should contain, at a minimum,

all of the required information as shown MD 11.7, Exhibit 12, "Monthly Letter Status Report Requirements." **All other reports shall be submitted by the 20th day of each month.**

12.0 Technical/Project Direction

The NSIR TAPM is the focal point for all contract-related activities. All work assignments and program funding actions are initiated by the NSIR TAPM. All proposed work scope or schedule changes must be processed through the NSIR TAPM.

The NSIR TPM is responsible for providing technical guidance to the performing organization regarding staff interpretations of the technical aspects of regulatory requirements along with copies of relevant documents (e.g. Regulatory Guides) when requested by the performing organization. All work products must be reviewed and approved by the NSIR TPM before they are submitted as final documents. All technical direction given to the performing organization must be consistent with the work scope and schedule. The NSIR TPM is not authorized to unilaterally make changes to the approved work scope or schedule or give the performing organization any direction that would increase costs over approved levels.

Directions for changes in cost or period of performance will be provided by the DOE Operations Office after receipt of an approved Standard Order for DOE Work (SOEW) (NRC Form 173) from the Office of Nuclear Security and Incident Response. If the performing organization receives guidance which is believed to be invalid under the criteria cited above, the performing organization shall immediately notify the NSIR TAPM. If the NSIR TAPM and the performing organization are unable to resolve the question within five days, the performing organization shall notify the DOE Operations Office.

13.0 Quality Assurance

For all draft and final reports delivered under this agreement, the performing organization shall assure that an independent review and verification of all numerical computations and mathematical equations and derivations are verified by qualified personnel other than the original author(s) of the reports. If the performing organization proposes to verify/check less than 100 percent of all computations and mathematical equations and derivations in the report(s) (such as might be the case when there are a large number of routine, repetitive calculations), the performing organization must first obtain written approval from the NSIR TPM. Computer generated calculations will not require verification where the computer program has already been verified. The NSIR TPM has the option of auditing all documentation including project correspondence, drafts, calculations and unrefined data.

In addition, all reports, including those which do not contain numerical analyses, must be reviewed by the performing organization's management and approved with two signatures, one of which is for the performing organization's management at a level above the program manager.

When revisions for the reports are issued, a section must be included in the revised report to document dates of, reasons for, and the scope of all changes made since the issuance of the first performing organization's approved report.

14.0 Disposal of Property

Management of property purchased under this Interagency Agreement will follow the procedures as stated in Part VIII of MD 11.7.

15.0 DOE-Acquired Material

The performing organization must notify the Office of Nuclear Security and Incident Response (Attn: Chief, PMDA) and the NSIR TPM prior to acquisition of any capital Federal Information Processing (FIP), or word processing equipment.

16.0 NRC-Furnished Material

None

17.0 Unclassified Safeguards Information

Activities under this work order involves Safeguards Information. The U.S. Department of Energy (DOE) shall handle the Safeguards Information in accordance with applicable legal and DOE requirements.

In performance of the work under this order, DOE shall assure that the DOE laboratory shall mark and protect all documents, materials, and equipment originated, generated, or received by the performing organization in accordance with the provisions of Section 147 of the Atomic Energy Act of 1954, as amended, its implementing regulations (10 CFR 73.21), and NRC guidance (NUREG-0794, "Protection of Unclassified Safeguards Information: Criteria and Guidance")." Further guidance on the protection of unclassified Safeguards Information and examples of proper marking of cover, title page, and back cover are contained in NRC Management Directive (MD) 12.6, "NRC Sensitive Unclassified Information Security Program."

It is the responsibility of the office originating the work to indicate whether the work will involve unclassified Safeguards Information or unescorted access to protected and vital areas of nuclear power plants. An NRC Form 187, "Security/Classification Requirements," shall be completed to indicate such access.