3.0 Purpose

The purpose of this SOW is to perform studies of vulnerability of transportation and storage of nuclear materials to terrorist events and to train SFPO personnel to perform independent evaluations of similar events.

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 dynamic structural analysis, source term assessments resulting from terrorist events, and radiological consequence assessments from those events. Specific disciplines required include, but are not limited to, 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 conducting this work must have experience in using structural computer models, such as Pronto (detailed analyses) and ANSYS/LS-DYNA (simplified analyses), MELCOR and MACCS computer codes (or equivalent) and experience in estimating the fuel performance for the conditions under consideration. The personnel working on this project part 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 staff will define the new design basis threat following receipt of Commission guidance. Initial work will focus activities designed to respond to Congressional inquires, in specific, aircraft crashes into storage and transportation casks. Other activities will be defined and transmitted to SNL as resources permit.

Task 1 - Terrorist Events and Consequence Analyses from Aircraft Crashes

The following Subtasks are grouped in terms of technical specialties. Each Subtask event is comprised of a structural analysis, fuel performance analysis and resulting radiological consequences.

Task 1.1( )Crashing Into an ISFSI Ex 2

Develop computer models that simulate the consequences of a( ) crashing into an ISFSI of a 100 by 100 cask array. Two structural computer models should be developed for the( ) one model is a detailed mode requiring a super computer and the second model is a simplified model (on ANSYS/LS-DYNA) that can be executed on a desktop computer. Dimensions and cask design should be consistent with the HI-STORM SER. The HI-STORM cask is selected because SNL has readily available structural and MELCOR models of the HI-STORM cask. These models should be applied in the following analyses. Ex 2

 Portions Ex 2 E/12

a. Structural Analyses (Technical Monitor - - Mahendra Shah)

ii Provide a description of the structural model for staff approval prior to performing calculations. [Deliverable Date: February 28, 2002.]

ii Prior to performing the calculations, provide, for staff review and approval, recommendations for angle of trajectory and speed of plane crashing into the casks. [Deliverable Date: March 15, 2002.]

ii Following staff approval of the analytic assumptions, perform the specific analyses.

ii Provide detailed documentation of the analysis and all structural behaviors of the cask and plane. [Deliverable Date: June 14, 2002]

ii Develop a simplified structural model of the aircraft that will execute on a desk-top computer using the ANSYS-LS/DYNA computer program. [Deliverable Date: Aug 8, 2002]

ii Following Commission identification of the new design basis threats and lessons learned from the above analysis, this sub-task will be modified to perform up to two additional threat assessments, if needed. [Deliverable Date: to be determined]

ii Provide training for two to three SFPO staff personnel on performing the structural analyses. (Schedule to be coordinated between SNL and SFPO.)

b. Fuel Canister Performance (Source Term) Analyses - - (Technical Monitor: TBD)

i. Provide a description of the MELCOR model for staff approval prior to performing calculations. [Deliverable Date: April 15, 2002]

ii. Prior to performing the calculations, provide, for staff review and approval, recommendations for modeling the fuel, source term calculations, and property damage estimates. [Deliverable Date: May 1, 2002]

iii. Following staff approval of the analytic assumptions, perform the specific analyses.

iv. Provide detailed documentation of the analysis and all structural source terms within and exiting the cask. [Deliverable Date: June 14, 2002]

v. Following Commission identification of the new design basis threats and lessons learned from the above analysis, this sub-task will be modified to perform up to two additional threat assessments, if needed.
[Deliverable Date: to be determined]

vi. Provide training for two to three SFPO staff personnel on performing MELCOR calculations for the above event. (Schedule to be coordinated between SNL and SFPO.)

c. Thermal Analyses -- (Technical Monitor: Christopher Bajwa)

i. Provide a description of the thermal model for staff approval prior to performing calculations.
[Deliverable Date: April 15, 2002]

ii. Prior to performing the calculations, provide, for staff review and approval, recommendations for modeling the thermal response to the accident.
[Deliverable Date: May 1, 2002]

iii. Following staff approval of the analytic assumptions, perform the specific analyses.

iv. Provide detailed documentation of the analysis and all thermal system responses.
[Deliverable Date: June 14, 2002]

v. Following Commission identification of the new design basis threats and lessons learned from the above analysis, this sub-task will be modified to perform up to two additional threat assessments, if needed.
[Deliverable Date: to be determined]

vi. Provide training for two to three SFPO staff personnel on performing thermal calculations for the above event. (Schedule to be coordinated between SNL and SFPO.)

d. Radiological Consequence Analyses -- (Technical Monitor: Carl Withee)

i. Provide a description of the radiological consequence model for staff approval prior to performing calculations.
[Deliverable Date: April 15, 2002]

ii. Prior to performing the calculations, provide, for staff review and approval, recommendations for modeling the radiological responses to the accident. Include, among other considerations, the assumed meteorology conditions, release height, particle distribution, particle settling (both within and outside the cask), population probability distribution, decontamination and clean-up costs,

uptake pathways, uptake fractions, health effects of uptake and inhalation, ground shine, sky shine, etc.

[Deliverable Date: May 1, 2002]

iii. Following staff approval of the analytic assumptions, perform the specific analyses.

iv. Provide detailed documentation of the analysis and all radiological consequences as a function of distance. The documentation should include, among other information, the extent of the fuel damage, release fraction from the fuel (including the size distribution of the radionuclide particles), migration of isotope out of the fuel matrix, the thermal effects on the fuel, thermal driving foces, plate-out and settling.

[Deliverable Date: June 14, 2002]

v. Following Commission identification of the new design basis threats and lessons learned from the above analysis, this sub-task will be modified to perform up to two additional threat assessments, if needed.

[Deliverable Date: to be determined]

vi. Provide training for two to three SFPO staff personnel on performing radiological consequence analyses for the above event. (Schedule to be coordinated between SNL and SFPO.)

Task 1.2: Crashing Into an ISFSI Ex 2

a. Provide, for staff approval, an analytic approach to model the consequences of a crashing into an ISFSI. Research the various for various Ex 2 scenarios. Pros and cons should be provided on the need to model the alone).

[Deliverable Date: April 14, 2002]

b. Following the staff's review and approval of the proposed guideline developed above, this task will be modified to perform consequence assessments for the above event, as appropriate.

Task 1.3 Simplified Computer model (desktop model running on ANSY/LS-DYNA) Ex 2

Structural Analyses (Technical Monitor - - Mahendra Shah)

Portions Ex 2

The staff has available structural computer models for the HI-STORM storage and the HI-STAR dual-purpose-transportation casks. In order to assess the need for generic regulatory actions on vulnerabilities of dry cask storage facilities to terrorist events, several representative structural models of dry storage casks should be assessed.

a. Develop structural dynamic models for the Advanced NUHOMS, TN-68 and the NAC MPC cask designs.

[Deliverable Date: August 15, 2002]

b. Following Commission identification of the new design basis threats, this task will be modified to perform theat assessments for the above representative four cask designs.

[Deliverable Date: To be Determined]

6.0 Deliverables and Schedule (including meetings)

The deliverables required under each phase with the anticipated time for delivery are provided under each task, above. All deliverables shall be provided to the NRC TPM responsible for each phase of this project.

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. The NMSS 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 Period of Performance

The period of performance for this project shall continue until January 31, 2004.

8.0 Estimated Level of Effort

The estimated level of effort for this project is identified below. 5 FTE total

Task Number	Estimated FTE
1.1 (Plane Crash)	1.5
1.2 (Small Plane Crash)	0.3
1.3 (Simple Model)	0.2
2.1 (Table of Weapons vs Consequence)	0.2

Ex 2

Ex 2 portions

NMSS Terr… …de Analyses

ID	Task Name	Schedule label
1	**Task 1.1**	[illegible]
2	Structural	Jeff Smith[100%]
3	Letter Report on Model	3/20
4	Letter Report on Angle of Trajec	3/15
5	Letter Report on Analyses	6/14
6	Letter Report on Simplified Mod	8/9
7	Fuel	Jeremy Sprung[75%]
8	Letter Report on MELCOR Mod	4/15
9	Letter Report on Modeling	5/1
10	Letter Report on Analyses	6/14
11	Thermal	Carlos Lopez[75%]
12	Letter Report on Model	4/15
13	Letter Report on Analysis Appro	5/1
14	Letter Report on Analyses	6/14
15	Radiological	Jeremy Sprung
16	Letter Report on Model	4/15
17	Letter Report on Approach	5/1
18	Letter Report on Analysis	7/20
19	**Task 1.2: Small Plane/ISFS**	[illegible]
20	Structural	Jeff Smith
21	Letter Report on Approach	5/10
22	Letter Report on Simplified Mod	
23	Letter Report o. Angle of Trajec	
24	Letter Report of Analyses	
25	Fuel	
26	Letter Report on MELCOR Mod	
27	Letter Report on Approach	
28	Letter Report on Analyses	
29	Thermal	
30	Letter Report on Model	
31	Letter Report on Approach	
32	Letter Report on Analyses	
33	Radiological	
34	Letter Report on Model	
35	Letter Report on Approach	
36	Letter Report on Analyses	
37	**Task 1.3: Simplified Struct**	[illegible]
38	Structural	Jeff Smith
39	Letter Report on Model Descrip	5/10
40	Validate Model	10/14
41	Letter Report on Analyses	11/18
42	**Task 2: Weapons v. Conseq**	[illegible]
43	Letter Report	Richard Yoshimura
44	Letter Report on Approach	3/20
45	Letter Report on Evaluation	5/31
46	1st Experts Meeting	3/20
47	2nd Experts Meeting	3/20
48	**Task 3: Additional Cask A**	
49	NAC LWT/TN-BRP	Jeff Smith

Project: name
Date: Sun 1/6/02

Legend: Task; Progress; Milestone; Summary; Rolled Up Task; Rolled Up Milestone; Rolled Up Progress; Split; External Tasks; Project Summary