12/26/02

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. 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), source term and dispersion analysis computer codes (or equivalent) and experience in estimating the fuel performance for the conditions under consideration. Except for persons developing input data for dispersion analysis computer codes or performing consequence calculations using these codes, the personnel working on 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

Initial work to be performed is identified under the tasks below and is focused on activities designed to respond to Congressional inquires, in specific, aircraft crashes into storage and transportation casks. Once Commission guidance is received, new design basis threat requirements will be defined and a revised statement of work (SOW) will be transmitted to SNL for review and preparing an updated proposal.

For tasks that involve safeguards information, such as theoretical safeguards scenarios that simulate dynamic loading on spent fuel storage casks (SFSC), those tasks should be handled in accordance with the security requirements for *unclassified safeguards information* discussed in Section 17.0 of this agreement and Part XI of Handbook 11.7 - NRC Procedures for Placement and Monitoring of Work with the U.S. Department of Energy (DOE). Aircraft crashes should be handled in accordance with *proprietary information* requirements discussed in Section 18.0 and in Part XI of Handbook 11.7.

The following tasks and subtasks, which shall be completed by the performing organization, are grouped in terms of technical specialties. Each subtask event is comprised of a structural analysis, fuel performance analysis and resulting radiological source term and dispersion analysis. The deliverables required with anticipated dates for submission to each TPM have also been indicated under each subtask.

Portions, Ex 2

E/NS

Task 1.0: Terrorist Events and Source Term Analyses from Aircraft Crashes

Subtask 1.1: Airplane Crashing Into an ISFSI

Develop computer models that simulate the consequences of a aircraft crashing into an independent spent fuel storage installation (ISFSI) of a 100 by 100 cask array. Two structural computer models shall be developed for the one model is a detailed model 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 safety evaluation report (SER). Since SNL has readily available structural models of the HI-STORM cask, these models shall be revised, if necessary, and be applied in the following analyses.

1.1.a. Structural Analyses

(TPM: Mahendra Shah (301) 415-8537)

I. Provide a description and justification of the structural model including recommendations for the angle of trajectory and speed of the plane crashing into the cask for staff approval prior to performing final calculations.

[Deliverable Date: April 30, 2002.]

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

[Deliverable Date: May 30, 2002]

III. Provide detailed documentation of the analysis and all structural behaviors of the cask and plane.

[Deliverable Date: June 14, 2002]

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

[Deliverable Date: to be determined]

V. Provide training for two to three SFPO staff personnel on all necessary steps performing the structural analyses. (Schedule to be coordinated between SNL and the SFPO TPM.)

[Deliverable Date: to be determined]

1.1.b. Fuel Canister Performance (Source Term) Analyses

(TPM: Kenneth Erwin (301)415-2443)

I. Provide a description and justification of the methodology, including any computer codes and assumptions, to be used to evaluate the releasable source term from the cask model containing the greatest source term (worst condition) for staff approval prior to performing calculations. Include for staff review and

approval, recommendations for modeling the fuel, source term calculations, and ISFSI damage estimates.

[Deliverable Date: June 30, 2002]

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

[Deliverable Date: July 15, 2002]

III. Provide detailed documentation of the analysis and all structural source terms within and exiting the cask.

[Deliverable Date: August 7, 2002]

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

[Deliverable Date: to be determined]

V. Provide training for two to three SFPO staff personnel on performing the source term calculations and other considerations for the above event. (Schedule to be coordinated between SNL and the SFPO TPM.)

[Deliverable Date: to be determined]

1.1.c. Thermal Analyses

(TPM: Christopher Bajwa (301)415-1237)

I. Provide the recommendations for modeling the thermal response to the accident and a description and justification of the thermal model being used for staff approval prior to performing final calculations.

[Deliverable Date: May 15, 2002]

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

[Deliverable Date: June 14, 2002]

III. Provide detailed documentation of the analysis and all thermal system responses.

[Deliverable Date: July 31, 2002]

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

[Deliverable Date: to be determined]

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

[Deliverable Date: to be determined]

1.1.d Radiological Dispersion Analyses

(TPM: Elaine Keegan (301)415-8517)

I. For each cask or package analyzed, the dispersion analysis shall include the following information in a form that is compatible for use in SFPO computer codes such as MCNP and MCBend.

A. The fraction and isotope listing of radioactive material released,
B. Thermal and pressure driving forces for particulate release, and temperatures at which the source term becomes less dispersible (such as solidification into fragments that fallout quickly). Note that some canisters, i.e. Holtec, are pressurized initially to 5 atmospheres with helium and the impact of that initial pressurization shall be included as part of the evaluated particulate release.
C. The fraction of RAM aerosolized and dispersion of the respirable cloud.
D. The total amount of RAM released from the cask (or package),
E. Dispersion analysis which estimates the fraction that plates out and settles on the ground and an estimate of the area over which such settling takes place.
F. An estimate of the particle size distribution in the release, including larger fragments which contribute to the dose outside the package.

II. Provide a description of the radiological dispersion model(s) for staff approval prior to performing final calculations.

[Deliverable Date: July 30, 2002]

III. Prior to performing the calculations, provide for staff review and approval, recommendations for modeling the radiological dispersion of material in the accident. The model should consider dispersion of material from the initial impact and from any subsequent fire that may ensue. Include, among other considerations, the assumed meteorology conditions, particle distribution (including fragments), particle settling (both within and outside the cask), etc.

[Deliverable Date: August 15, 2002]

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

V. Provide detailed documentation of the analysis and all radiological dispersion as a function of distance. The documentation should include, among other information, extent of damage to cask, basket and contents (i.e., hole size in the cask and fuel damage for evaluating the streaming dose from the package), 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 forces, plate-out and settling.

[Deliverable Date: September 1, 2002]

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

[Deliverable Date: to be determined]

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

[Deliverable Date: to be determined]

Subtask 1.2: Airplane Crashing Into an ISFSI Ex 2
(TPM: Mahendra Shah (301)415-8537)

1.2.a. Provide, for staff approval, an analytic approach for a model to use in determining the consequences of a [redacted] into an ISFSI. Research the various [redacted] and postulated trajectories [redacted] for various scenarios. Pros and cons should be provided on the need to model the dynamics of the plane, its [redacted] and the effect of neglecting the dynamic contributions of the [redacted] Ex 2

[Deliverable Date: June 7, 2002]

1.2.b. Following the staff's review and approval of the proposed guideline developed above, develop computer models for assessing the consequences of [redacted] (amount to be provided by the SFPO TPM) onto the ISFSI identified in Task 1.1 above. Ex 2

[Deliverable Date: October 21, 2002]

1.2.c Perform structural, thermal, source term and dispersion analyses and provide detailed documentation of these analyses (as was done in Subtask 1.1).

[Deliverable Date: November 30, 2002]

Portions Ex 2

8.0 Estimated Level of Effort

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

Task Number	Estimated FY-02 FTE	Estimated FY-03 FTE	Estimated FY-04 FTE
1.1 [redacted] Plane Crash into ISFSI)	1.5	0	0
1.2 (Small Plane Crash into ISFSI)	1.0	0	0
1.3 (Simple [redacted] Model)	0.6	0	00
1.4 [redacted] Plane Crash in to SNF Cask)	1.5	0	0
1.5 (Small Plane Crash into SNF Cask)	1.0	0	0
1.6 (Small Plane Crash into non-SNF Cask)	1.0	0	0
2.1 (Table of Weapons vs Consequence)	0.1	0	0
2.2 (Guidance Document)	0.3	0	0
2.3 (Literature Search Report)	0	0.2	0
3 (Truck/Rail Casks Model Development)	0.6	0	0
4 (Storage Cask Model Development)	0.6	0	0
5 (Threat Assessment for Storage)	0.5	2.0	0.3
6 (Threat Assessment for SNF Transportation)	0.5	2.0	0.3
7 (Non-SNF Package Model Development)	0.6	0	0
8 (Threat Assessment for non-SNF Transport)	0.5	2.0	0.3
9 (Technical Assistance)	0.0	0.5	0.25
NRC Personnel Training	0.3	0.2	0
Total FTE	10.6	6.9	1.15

9.0 Meetings and Travel

The NRC anticipates conducting three meetings at NRC headquarters per fiscal year with no more than four of SNL personnel/contractors attending each meeting.

In addition, NRC personnel anticipates meeting with SNL personnel/contractors, at SNL, at least twice per fiscal year to review ongoing activities. All training for SFPO personnel will be conducted at SNL. Meeting notes shall be taken by SNL personnel and distributed in accordance with Section 11.0 of this SOW.

10.0 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