Task 1 - Terrorist Events and Source Term ~~Consequence~~ Analyses from Aircraft Crashes

Subtask 1.1: ( ) Airplane Crashing Into an ISFSI Ex 2

Develop computer models that simulate the consequences of a ( ) 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 ~~and MELCOR~~ models of the HI-STORM cask, these models shall be applied in the following analyses. Ex 2

1.1.a. Structural Analyses (TPM - - Mahendra Shah (301) 415-8537)

I. Provide a description and justification 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 cask. [Deliverable Date: March 15, 2002.]

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

IV. Provide detailed documentation of the analysis and all structural behaviors of the cask and plane. [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 may be modified to perform up to two additional threat assessments. [Deliverable Date: to be determined]

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

1.1.b. Fuel Canister Performance (Source Term) Analyses - - (TPM: Kenneth Erwin (301)415-2443)

I. Provide a description and justification of the ~~MELCOR model~~ methodology, including codes and assumptions, to be used to evaluate the releasable source term from the cask 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 ISFSI ~~property~~ damage estimates. [Deliverable Date: May 1, 2002]

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

[Deliverable Date: June ~~14~~1, 2002] I

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

[Deliverable Date: July 314, 2002] I

V. 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]

VI. Provide training for two to three SFPO staff personnel on performing ~~MELCOR~~ the source term calculations for the above event. (Schedule to be coordinated between SNL and the SFPO TPM.) I I

1.1.c. Thermal Analyses -- **(TPM: Christopher Bajwa (301)415-1237)**

I. Provide a description and justification of the thermal model for staff approval prior to performing calculations. I

[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: July 31, 2002]

V. 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]

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 the SFPO TPM.)

[Deliverable Date: to be determined]

1.1.d Radiological Dispersion Analyses - - (TPM: ~~Adelaide Giantelli (301)415-3521~~)

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, and
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 calculations.

[Deliverable Date: April 15, 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: May 1, 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: July 31, 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.)

~~1.1.d. Radiological Consequence Analyses – (TPM: Adelaide Giantelli (301)415-3521)~~

~~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 forces, plate-out and settling.~~

~~[Deliverable Date: July 31, 2002]~~

~~v. 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]~~

~~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 the SFPO TPM.)~~

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 into an ISFSI. Research the various and being projected to the front, side, etc.) for various scenarios. Pros and cons should be provided on the need to Ex 2

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model the dynamics of the plane.

[Deliverable Date: May 10, 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 crashing a passenger airplane onto the ISFSI identified in Task 1.1, above.

[Deliverable Date: October 21, 2002]

Subtask 1.3 Simplified Computer model (desktop model running on ANSYS/LS-DYNA) Structural Analyses
(TPM - - Mahendra Shah (301)415-8537)

1.3.a. Provide a description of the simplified structural model for staff approval prior to developing the analytic model.

[Deliverable Date: May 10, 2002.]

1.3.b. Validate the simplified model with the analyses performed under sub-task 1.1.

[Deliverable Date: October 14, 2002.]

1.3.c. Submit letter report with benchmark analyses and electronic copy of the simplified computer model to the SFPO TPM.

[Deliverable Date: November 18, 2002.]

Subtask 1.4: Airplane Crashing Into a Spent Fuel Rail Transportation Cask

Develop computer models that simulate the consequences of a into a spent fuel transportation cask. 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 NAC-UMS transportation cask safety analysis report (SAR) dated January 2002. An ANSYS model of the NAC-UMS transportaion cask will be provided to SNL.

1.4.a. **Structural Analyses (TPM - - Mahendra Shah (301) 415-8537)**

i. Provide a description and justification 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 cask. [Deliverable Date: March 15, 2002.]

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

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

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Task Number	Estimated FY-02 FTE	Estimated FY-03 FTE	Estimated FY-04 FTE
1.1 ( )Plane Crash)	1.5	0	0
1.2 (Small Plane Crash)	1.0	0	0
1.3 (Simple( )Model)	0.6	0	0
2.1 (Table of Weapons vs Consequence)	0.1	0	0
2.2 (Guidance Document)	0.3	0	0
3 (Truck/Rail Casks Model Development)	0.6	0	0
4 (Storage Cask Model Development)	0.6	0	0
5 (Event-X Storage)	0.5	3.0	0.3
6 (Event-X Transportation)	0.5	3.0	0.3
NRC Personnel Training	0.3	0.2	0
Total FTE	6.0	7.5	0.6

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 the required information as shown MD 11.7, Exhibit 12, "Monthly Letter Status Report Requirements."

11.0 Distribution of Deliverables

The following summarizes the required report distribution under this SOW. The NMSS TPM shall provide the performing organization with current NRC mailing addresses for this

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