12

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Monthly Letter Status Report

Reporting Period	October 2002
Name and Address	Organization 6141, Mail Stop 0718 Sandia National Laboratories P. O. Box 5800 Albuquerque, NM 87185-0718
JCN	J5412
Title	Vulnerability Assessments for Transportation and Storage of Radioactive Materials
Principal Investigator	Ken B. Sorenson
Project Period of Performance	March 2002 through September 2004

Technical Progress

Jetliner Crash Report. A first draft of the jetliner crash vulnerability study report was completed, portion marked, and transmitted to NRC for review.

Task 1.1: Jetliner Crash into an ISFSI.

CTH and Zapotec Analyses. Zapotec development/debugging continues. Pre-test calculations of the planned water slug test indicated a problem with Zapotec's treatment of mixed Eulerian/Lagrangian cells. The bug appears to have been fixed. Other simple problems are being run (e.g., air blast loading on a thin plate) to further test the algorithm in a systematic manner.

PRONTO Analyses. No work was done this month.

Boeing Contract. The set of questions appended to this MLSR was sent to Boeing.

Computational Support. Performance of 2D and 3D CTH calculations of jetliner engine impacts into reinforced concrete panels using the data of Sugano et al. was continued by ARA personnel. Specifically, the 2D CTH analysis, which modeled the Sugano, et. al. tests SER-9, 10, and 11 were completed and a 3D CTH calculation that models the SER-10 results was begun.. The goal of this study was to bring ARA personnel up to speed with CTH as well as get them focused on data used for future code validation. Once the 3D CTH analysis is complete, ARA will begin modeling the same problem with Zapotec.

Jet Fuel Fire Modeling. The VULCAN calculations that examine windblown fire that partially engulfs the HI-STORM cask were completed. The calculations show that when the fire is

D/12

located on the upwind side of the cask, the wind blows fuel from the vapor dome into the bottom vents of the cask that are located on the upwind side of the cask and sucks air into the vents located on the lee (downwind) side of the cask. Inside the vent channels, the air and fuel vapor mix and then burn directly exposing the canister to the high temperatures produced by the combustion flames. Although this result is of concern, because the modeling of the thermal response of the cask to fire thermal loads was quite conservative, the results previously obtained are still believed to reasonably depict the thermal response of the HI-STORM cask to fires.

Cask Response to Thermal Loads. No Work done this month.

Fission Product Transport. The preliminary NAC UMS MELCOR input model was reviewed by a non-Sandia MELCOR expert. The review identified several code problems that need to be addressed in order to model fission product release from this cask. First, the MELCOR core model treats thermal release of fission products due to core melting and release driven by the oxidation of Zircaloy but it doesn't treat release from spent fuel rods failed by mechanical loads (i.e., release caused by rod blowdown). Second, the PWR core model can not treat fuel tubes and the BWR core model needs steel material properties to model a steel fuel tube. Third, the BWR core model can't conduct heat from the fuel tubes to the cask canister as is done in the NAC UMS cask by the aluminum heat transfer discs. These problems will be discussed further at a meeting to be held in early November.

Consequence Modeling. Discussion of the results of the fire plume rise modeling study led to the conclusion that the Mills fire plume rise model will appropriately treat plume rise by fire smoke plumes provided that rise in the far filed is treated using the formula and coefficient values recommended by Briggs in his article titled "Plume Rise Buoyancy Effects", which was published in Atmospheric Science and Power Production, U.S. Department of Energy, Report TIC-27601.

Stephanie Bush-Goddard and David Chanin discussed three types of work that would support the performance of consequence calculations for the Vulnerability Study: (1) Updated costs for cleanup of contaminated land and buildings, (2) review of the customary input used in MACCS to model plume rise, wind borne transport, dry and wet particle deposition, structure shielding and evacuation, washoff, runoff, and food pathways (but not the input parameter values used in the dosimetry or health effects models), and (3) development of a way to estimate near-field (0 to 500 m) ground contamination levels.

Updating the Chanin and Murfin study of cleanup costs will require a literature search and then probably slight modification of the previous estimates of the decontamination factors and costs associated with specific cleanup methods.

MACCS input parameter values should be developed for a set of five generic locations, three rural locations (range land, farm land, and forest) and also for suburban and big city urban locations). Parameters for a few specific illustrative locations (e.g., someplace in Chicago along a rail corridor) should also be developed. Dosimetry and health effects parameter values need not be examined because the dosimetry data used in MACCS is routinely updated by DOE studies and thus is current and health effect models and model parameter values have always been developed by medical experts under contract to NRC, which would seem to be beyond the scope of the Vulnerability Study. Major changes in parameter values are not expected except for plume rise driven by fires and wind borne dispersion in urban areas.

Estimating near-field radioactive ground contamination needs to be done only if this contamination is not dominated by the deposition of particles so large that their deposition rates are controlled by gravitational settling, which is minimally affected by building wakes, wind channeling, wind profiles, and surface roughness. However, if turbulent deposition of smaller particles contributes significantly to near-field ground contamination, then the highly turbulent environment both inside the failed package and during the initial plume rise and initial downwind transport needs to be examined. Initial downwind transport is complicated by structure wake effects, street canyon effects for urban attack scenarios, the need to know more precisely the large particle (small chunk) end of the particle size distribution to support the estimation of close-in ground contamination levels, and the effects of surface roughness on deposition (surface roughness affects the thickness of the boundary layer at the ground surface and also the vertical velocity profile of the wind and through these the rate of deposition of particles to the ground). These effects could be examined by a limited set of calculations performed using (1) MELCOR and MACCS and (2) a computational fluid dynamics (CFD) code that models particle transport and deposition (e.g., the FLUENT code) so that the we can learn how to adjust MELCOR and MACCS input so that this pair of codes can mimic the results of the CFD calculation. Then, MELCOR and MACCS calculations can be used to estimate near-field contamination for additional problems not in the limited set of problems used in this comparison study.

Task 1.2: Small Plane Crash into an ISFSI.

Small Plane Survey. No work done this month.

Task 1.3: ANSYS/LS-DYNA Jetliner Model. No work done this month.

Task 1.4: Jetliner Crash into a Spent Fuel Rail Cask. No work done this month.

Task 1.5: Small Plane Crash into a Spent Fuel Rail Cask. No work done this month.

Task 1.6: Small Plane Crash into Other Radioactive Material Packages. No work done this month.

Task 2.0: Weapons, Radioactive Materials, Consequences.

Weapons Versus Consequences Spreadsheet. No work done this month.

Expert Panel - Source Term Guidance Document. Sandia has been tasked to produce guidance documents for use by NRC that will assist in the assessment of the impact of specific terrorist activities targeted at a range of nuclear material payloads and transportation or storage packagings. Specifically, the activity will provide guidance for the estimation of the source terms that are required as inputs for consequence analyses (e.g. health effects and economic costs) that NRC may need to perform to evaluate sabotage scenarios. NRC staff has furnished an

11/13/02

package/threat combinations are to be analyzed by this project. Therefore, timely program completion depends on identification by NRC of the package/threat pairs that will be analyzed.

Plans for Next Reporting Period

Work on Tasks 1 through 8 will continue.

Property Acquired

No equipment with a value greater than $500 was purchased during the current month.

Travel

None

Budget Status

The following table presents program costs ($K) by task for the current month and for the fiscal year to date:

Task	Title	Current Month	Fiscal Year to Date
1.1	Jetliner Crash into an ISFSI	129.3	129.3
1.2	Small Plane Crash into an ISFSI	7.8	7.8
1.3	ANSYS/LS-DYNA Jetliner Model	0.4	0.4
1.4	Jetliner Crash into a Spent Fuel Rail Cask	0.0	0.0
1.5	Small Plane Crash into a Spent Fuel Rail Cask	0.0	0.0
1.6	Small Plane Crash into Other Radioactive Material Packages	0.0	0.0
2.0	Weapons, Radioactive Materials, Consequences	25.9	25.9
3.0	Models for Other Spent Fuel Transportation Casks	0.0	0.0
4.0	Models for Other Spent Fuel Storage Casks	0.0	0.0
5.0	Threat Assessment for Sabotage Scenarios Involving Storage Casks	0.0	0.0
6.0	Threat Assessment for Sabotage Scenarios Involving Transportation Casks	17.3	17.3
7.0	Models for Transportation Packages for Other Radioactive Materials	0.0	0.0
8.0	Threat Assessment for Sabotage Scenarios Involving Other Packages	0.0	0.0
	Code Demonstrations	0.0	0.0
	NRC Support	4.1	4.1
	NISAC[a]	0.2	0.2
	DOE Added Factor [b]	0.0	0.0
	TOTAL	185.1	185.1

a. DOE waived this load beginning the month of October 2002; the $0.2 K was incurred the last two days of September.
b. DOE waived this load beginning the month of May 2002.

The financial reporting for this month is based on the 189 submitted at the end of February of 2002. Total FY2002 spending was $1170.1 K. $1741.9 K was carried over into FY2003. $185.1 K was spent during October of FY2003. Total FY2003 spending to date is $185.1 K.