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Monthly Letter Status Report

Reporting Period	June 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

Task 1.1: Jetliner Crash into an ISFSI.

CTH Analyses. A simplified CTH analysis has been conducted to provide a "quick-look" at damage to the HI-STORM cask resulting from impact of a jetliner. This analysis considered a "simplified" aircraft, which was composed of the aircraft center section (i.e., the main body), the front wheel section, and center fuel section. A(of the aircraft against the cask was assumed and is thought to provide a worst-case scenario. The analysis has been completed and a letter report summarizing the results was provided for submission to NRC in the project status report for results through June.

Zapotec Analyses. During the course of performing Zapotec calculations, problems were encountered with restarts. Following a restart, CTH processor boundary information was lost resulting in removal from the problem of material donated to the CTH Eulerian grid. This appears to be a long-standing bug in the code, which was not obvious for other classes of problems. The bug appears to be fixed and the Zapotec calculations are continuing. Currently, a jetliner crash similar to the crash being examined using the CTH code is being run. This will provide a means to compare and contrast results obtained using Zapotec to those obtained using CTH.

PRONTO Analyses. The impact analyses of the HI-STORM dry storage cask continues, and progress in both the type and direction of attack has been made this month. Centerline and top directed impact analyses have shown differing levels of severity, which is being quantified for internal reaction of components at this time. For these two impact locations, engine impact momentum deposition and cylinder impacts have been contrasted as to severity. Also, cask-to-cask impact using velocities from CTH analyses of momentum have also been performed, and these results are being compared with a conservative momentum distribution of a plane to insure

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viability of both results. Future work planned includes modeling the internal canister for reaction of these components, as well as refinement of the preliminary results listed above.

Boeing Contract. Sandia legal has informed Boeing that a "total indemnification" clause can only be added to the proposed Boeing contract if DOE approves and that DOE approval is almost certain not to be given. No response from Boeing has been received regarding how to try to proceed.

Computational Support. A contract was placed with ARA for the services of analysts able to perform Zapotec, PRONTO, and CTH calculations in support of Vulnerability.

Jet Fuel Fire Modeling. A three-dimensional, quarter symmetry, fire simulation of the Hi-Storm storage container was prepared in the Vulcan CFD code. The simulation consists of a standing cask subjected to an engulfing fire. The problem domain extends approximately 25m in all three dimensions and is discretized into approximately 450,000 nodes. Zero-wind boundary conditions were applied to the vertical and top boundaries, and a standard solid wall boundary was used for the ground. The fuel bed was placed at ground level. The bed surrounds the cask and extends approximately 4.5m away from the edge of the cask. The fuel is JP8.

Preliminary results of simulation runs at 45 seconds showed temperatures in the range of 800 to 1400 K at the outer perimeter of the cask. Maximum temperatures were observed near the top of the cask, close to the mouth of the ducts. Temperatures within the first 0.2m of the upper ducts range between 500 and 1300 K. Fire conditions inside the cask are still developing. Temperatures in this region are currently below 500 K.

In summary, current temperature range results may not be indicative of the maximum temperatures that may be attained inside of the Hi-Storm cask. The current plans are to run the fire simulation for at least another 60 seconds or until quasi-steady state flow conditions are reached inside the cask. Temperature and heat flux results obtained from this simulation will be used for heat transfer analysis of the MPC canister.

Cask Response to Thermal Loads. A one dimensional cylindrical model of the undamaged NAC UMS shipping cask was formulated. This model simulates heat transfer through the cask walls via conduction. The fuel rod region inside of the cask (basket and fuel assemblies) is modeled via an effective conductivity and an effective heat capacitance. This one-dimensional model was validated by simulation of the NRC regulatory fire, and comparison of the predictions obtained for this fire to multi-dimensional results for the regulatory fire presented in the NAC UMS SAR. This model can now be used to quickly evaluate a variety the response of the undamaged cask to a variety of fire boundary conditions that might result from an airplane crash fuel fire and an undamaged cask.

Since the Hi-Storm cask model developed previously cannot simulate the natural convective flows in the annular space between the MPC and the concrete overpack, it may not be directly used in modeling thermal transients of the Hi-Storm container. However, the model may be used to approximate the thermal transient of the Hi-Storm container if the heat transfer due to these convective flows can be estimated from VULCAN. This model may also be applied to the Hi-storm cask if one postulates the removal of the concrete shield while leaving the inner cask undamaged. However, this is an unlikely scenario.

Fission Product Transport. Work developing a MELCOR model of an undamaged NAC-UMS cask, canister, basket and fuel assemblies was initiated by reviewing cask drawings to determine the geometry of the cask system. The review allowed key heat transfer mechanisms to be identified. NRC was asked whether PWR or BWR fuel should be modeled. NRC stated that PWR fuel should be modeled. Development of MELCOR input for the cask loaded with PWR fuel will begin next month.

Consequence Modeling. A brief literature review was performed to identify recent data on cleanup of contaminated property (effectiveness of cleanup methods, regulatory guidance on cleanup levels) and two reference books covering these topics were purchased.

Task 1.2: Small Plane Crash into an ISFSI.

Small Plane Survey. The development of a nomograph, that would correlate the following three measures of the [redacted] of small aircraft, 1) impact kinetic energy of the fully loaded plane, 2) conflagration/deflagration with respect to the full fuel carrying capability of the plane, and 3) [redacted] referenced to [redacted] as a function of maximum aircraft useful load, was suspended because trial nomographs produced misleading predictions. NRC requested that SNL select a representative small plane for use in the sabotage scenarios where a small plane packed with [redacted] is crashed into a RAM package.

Task 1.3: ANSYS/LS-DYNA Jetliner Model. During June, the model of the HI-STORM cask provided by the NRC (from Southwest Research) was loaded onto the SNL computer and the SNL version of the ANSYS/LS-DYNA code. The model was modified to run a case similar to what is being analyzed using the PRONTO code for Task 1.1A. However, there are hardware/software problems with ANSYS/LS-DYNA. This problems have been submitted to ANSYS and we are currently exploring running ANSYS/LS-DYNA on a LINUX system to resolve the problems. Current plans for the next month are to resolve the hardware/software problems and begin preliminary scoping calculations to examine what kind of analyses can be run on a PC based system.

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. The table that summarizes the results (package damage, dispersal of particulates, radiological consequences) of prior studies of sabotage events involving radioactive material packages was completed and sent to NRC for comment. Because the table was designated as Official Use Only, the identities of the weapons examined by each past study were deleted from the table. A paper by R.E. Luna and K. B.

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	119.5	294.6
1.2	Small Plane Crash into an ISFSI	13.4	18.3
1.3	ANSYS/LS-DYNA Jetliner Model	14.3	84.9
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	17.5	44.4
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	0.0	0.0
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	7.2	90.7
	NISAC	14.6	17.0
	DOE Added Factor [a]	0.0	4.8
	TOTAL	186.5	554.7

a. 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. $186.5 K was spent during June of FY2002. Total FY2002 spending to date is $554.7 K.