

2/11/2003

Sandia National Laboratories

Albuquerque, New Mexico 87185-0718

date: February 11, 2003

to: Bernard White
Nuclear Engineer
Office of Nuclear Materials Safety and Safeguards
Spent Fuel Project Office

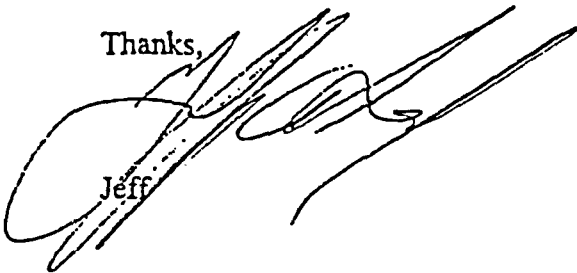
from: Jeffrey Smith
Transportation Risk & Packaging Department
505-845-0299
jasmith@sandia.gov

subject: Memo Regarding Analyses Conducted for Vulnerability Study

Bernie:

The following is an update of the memo faxed to you on February 4, 2003. I have updated the tables.

Thanks,


Jeff

Classified by: Ken B. Sorensen
Title/Org. Manager, Dept. 6141

Portions Ex 2

E/98

The Threat (OUO):

(OUO) The threat definition was a jetliner based on the
The angle of attack was narrowed as the program progressed
There are an infinite number of possible directions and impact
locations on the field of casks. The structural analyses were conducted to explore all of
the structural vulnerabilities. The analyses provide guidance on impacts that range from
likely to unlikely.

The Analyses and Results (OUO):

(OUO) Global analyses of a jetliner impacting a cask were performed to examine cask
damage due to the jetliner and to determine the exit velocity of a cask due to the impact.
After substantial effort to establish the methodology, several analyses were conducted to
determine the exit velocity of the cask for two different impact locations on the cask. A
was used to evaluate the maximum exit velocity (the attack on the Pentagon
demonstrated the ability for a nearly
An analysis of a case where the
jetliner impacts the cask closer
was also performed and
demonstrates the variability of exit velocity with impact location on the cask (this
analysis is referred to as the
The results of these analyses are shown in Figures
1 to 4. At the end of this memo, Tables 3 and 4, list the global analyses run using CTH.
The results in Figures 1 to 4 are from the runs listed in Table 4. These tables are drafts of
what will be in the final report (and consequently refer to report sections that are not
included here).

(OUO) The global analyses were used to establish velocities for cask-on-cask impacts.
Table 1 summarizes the velocities that were explored. The cask-on-cask impacts can be
divided into three basic zones. Based on the layout of the storage facility, the separation
distance of the casks can be 1.2 m (4 ft), 3.4 m (11 ft), or greater. Table 1 lists the
calculated velocities at these distances. The time to reach these velocities is also listed.
The total jetliner impact takes approximately 300 msec. Therefore, as can be deduced
from the times listed, the impact has not completed at point that these velocities are
reached.

(OUO) The global analysis was followed by detailed analyses of hard components
impacting the casks and cask-on-cask impact cases. These analyses explored numerous
possible cases (some more likely than others). The structural vulnerabilities were
explored with these analyses. Table 2 lists the analysis, the respective separation distance
associated with that analysis (note that some analyses cover cases for both the
and the
) and give an indication of the results (or list relevant notes).

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Figure 2. v vs. Distance

(OUO) Figure 4. v vs. Distance,

(OUO)

(OUO) Using these figures 1 to 4, one can establish the velocity as a function of cask separation distance as shown in Table 1 below.

Table 1: Cask velocity as a function of separation distance

The contents of this table are OUO

Separation Distance
1.2 m (4 ft)
3.4 m (11 ft)
Beyond 3.4 m (11 ft) (max velocity distance)



Portions Ex 2

(OUO) These values are instrumental in determining which analyses guide the interpretation of Table 2 below lists the local analyses with the applicable separation distances and an indication of damage.

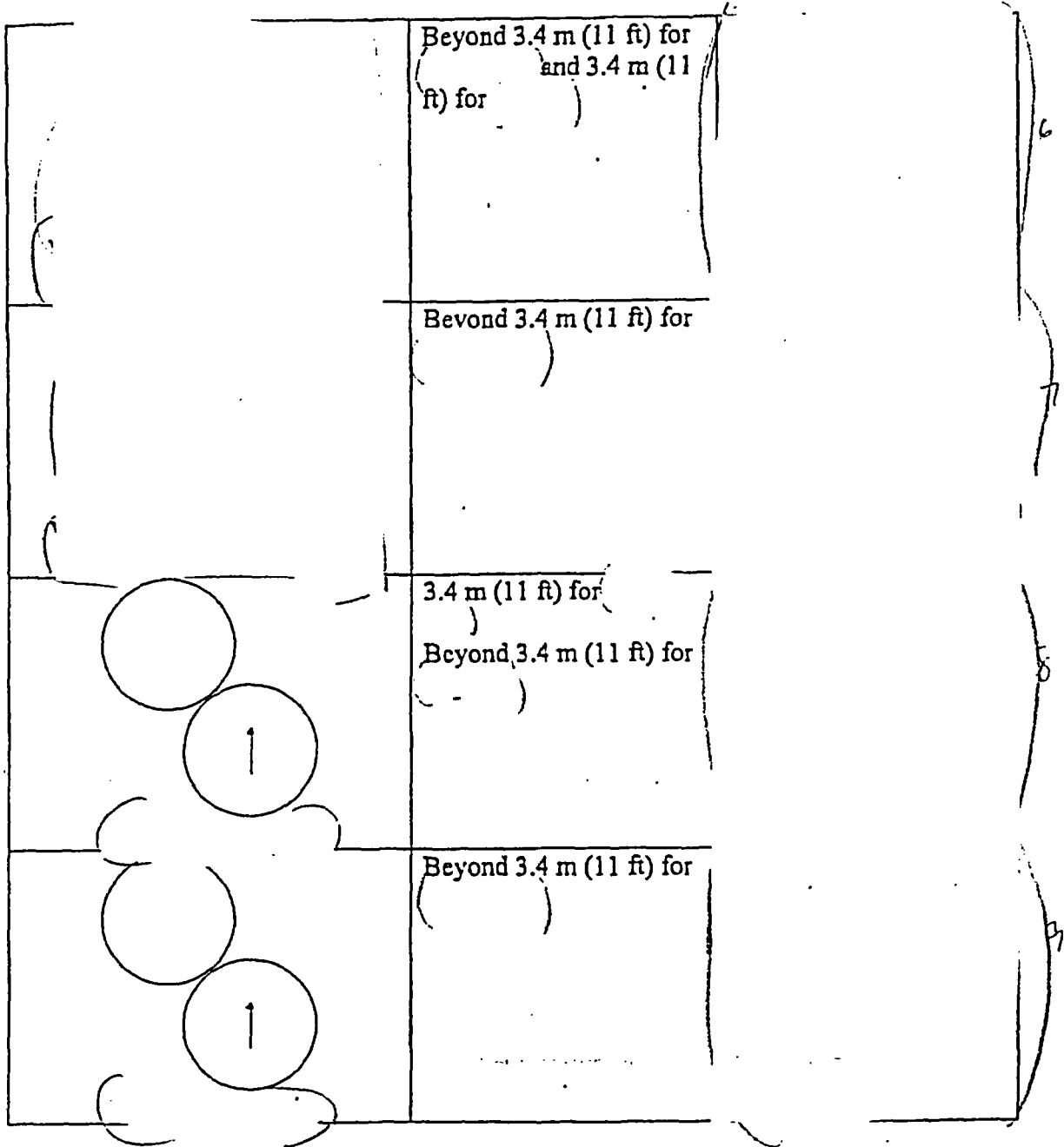
(OUO) For the separation distances of 1.2 m (4 ft) and 3.4 m (11 ft), However, it should be noted that at this point (once the impacted cask has translated 1.2 m (4 ft) or 3.4 m (11 ft)) there is a The translating cask(s) now has substantial kinetic energy, along with the kinetic energy of the Also, due to the chaotic nature of the event the orientation of the impacting cask for cases beyond 3.4 m (11 ft) is considered random

Portions Ex 2

Table 2 The contents of this table are OOU


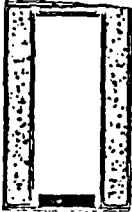


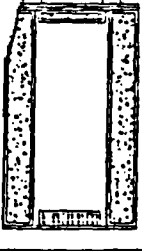
Local Analyses	
Corresponding Pad Separation Distance	Result
1.2 m (4 ft) for both the	
3.4 m (11 ft) for Beyond 3.4 m (11 ft) for	
Beyond 3.4 m (11 ft) for	
3.4 m (11 ft) for Beyond 3.4 m (11 ft) for	
Beyond 3.4 m (11 ft) for	

Portions Ex 2

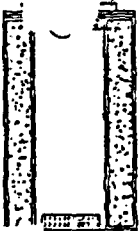
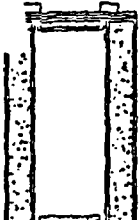
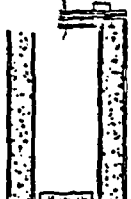
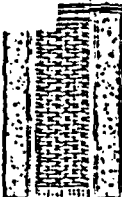
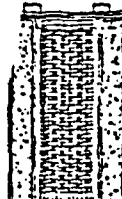


Portions Ex 2

Table 2 Continued

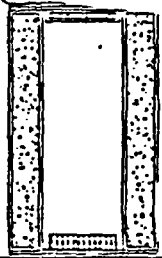
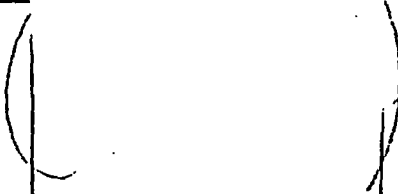
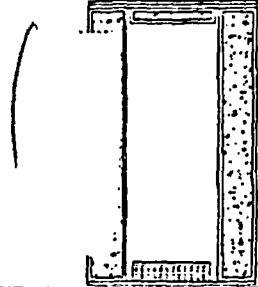
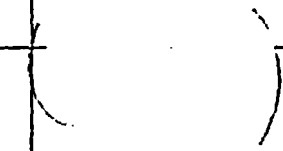
Hard Component Analyses	Engine Pressure Loading	Results and/or Notes
		Analysis complete summary of results pending 10
		Analysis complete summary of results pending 11
Hard Component Analyses	Landing Gear Strut Simulation	Results and/or Notes
		12
		13
		14

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	Direct Hit		5
			16
			17
 Strut impacting at MPC) (w/		Analysis crashing	18
 Strut impacting at MPC) (w/		Analysis crashing	19

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Table 2 continued

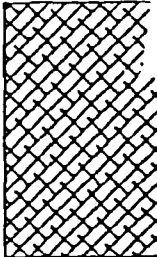
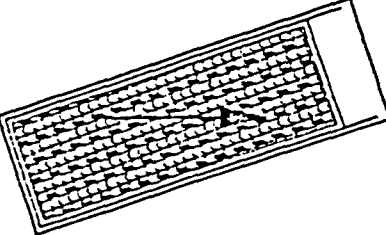
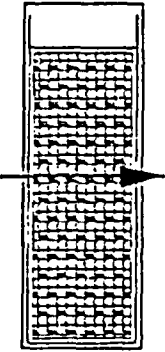
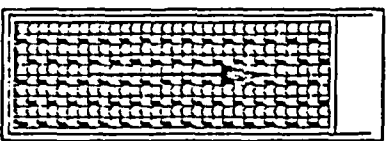
Riera Loading	Complete Jetliner	Riera load From Livermore Report. Complete Aircraft loading applied to fuselage tributary area.
		
		

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Table 2 Continued

Tip-Over Analysis	Orientation Notes	Results and/or Notes
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MPC Failure Analyses		
		
		
		<p data-bbox="1049 1393 1371 1500">Analysis being conducted. At the strains in the MPC</p>

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