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to: Bernard White
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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 [redacted] The angle of attack was narrowed as the program progressed [redacted] 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 [redacted] was used to evaluate the maximum exit velocity (the attack on the Pentagon demonstrated the ability for a nearly [redacted] An analysis of a case where the jetliner impacts the cask closer [redacted] was also performed and demonstrates the variability of exit velocity with impact location on the cask (this analysis is referred to as the [redacted] 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 [redacted] and the [redacted], and give an indication of the results (or list relevant notes).

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Figure 2. υ vs. Distance, (OUO)Figure 4. υ 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)			

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(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 (11ft) is considered random

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Table 2 The contents of this table are OUO

	Local Analyses		
	Corresponding Pad Separation Distance	Result	
	1.2 m (4 ft) for both the		1
	3.4 m (11 ft) for Beyond 3.4 m (11 ft) for		2
	Beyond 3.4 m (11 ft) for		3
	3.4 m (11 ft) for Beyond 3.4 m (11 ft) for		4
	Beyond 3.4 m (11 ft) for		5

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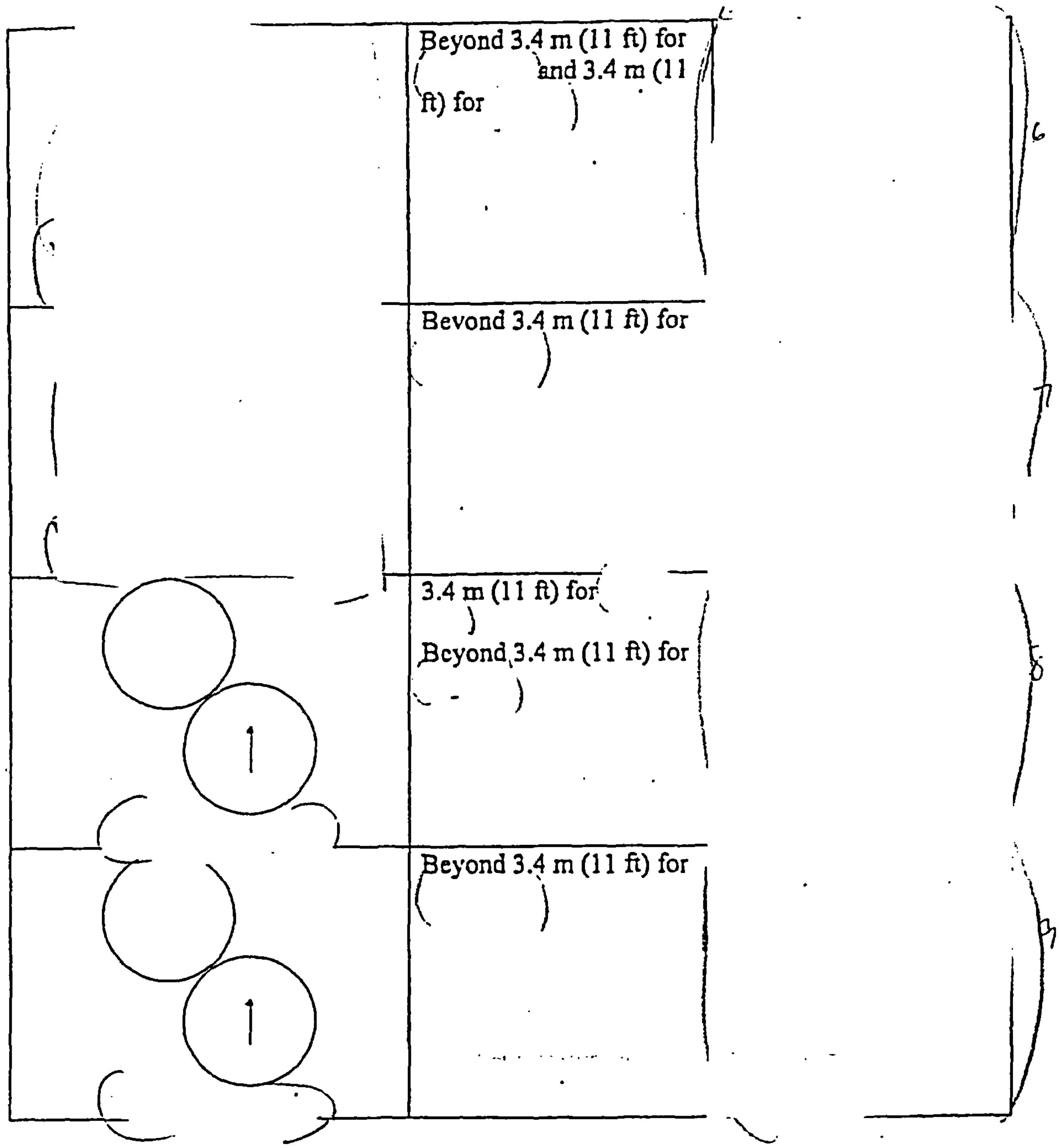

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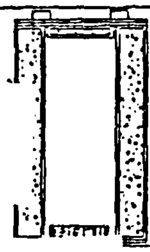
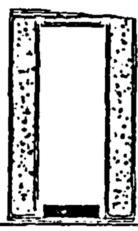
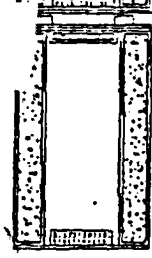
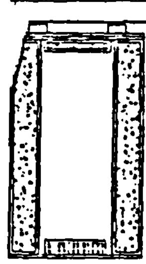
Table 2 Continued

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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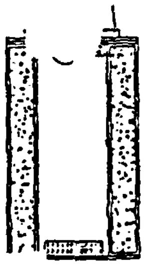
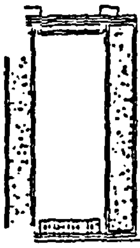
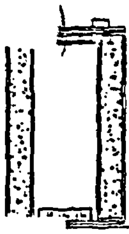
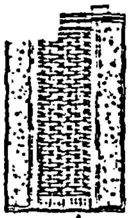
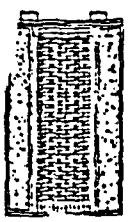
	Direct Hit		15
			16
			17
 Strut impacting at( )(w/ MPC)		Analysis crashing	18
 Strut impacting at (w/ MPC)		Analysis crashing	19

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Table 2 continued

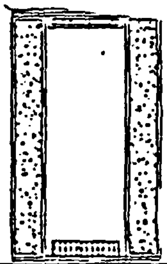
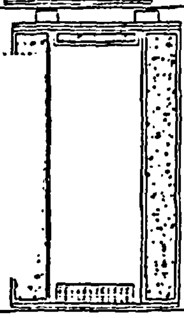
Riera Loading	Complete Jetliner	Riera load From Livermore Report. Complete Aircraft loading applied to fuselage tributary area.	
			20
			21

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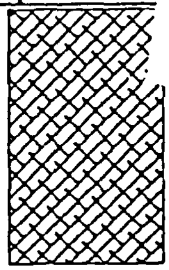
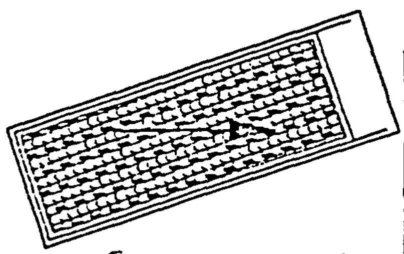
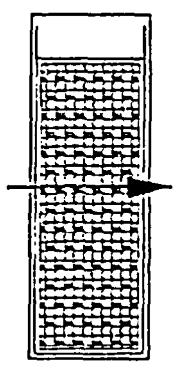
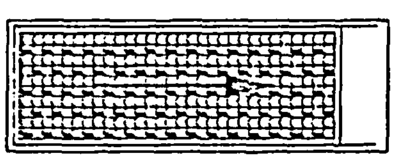
Table 2 Continued

Tip-Over Analysis	Orientation Notes	Results and/or Notes	
 Engine Loading			22
MPC Failure Analyses			
			23
			24
		Analysis being conducted. At the strains in the MPC	25

Portions Ex2