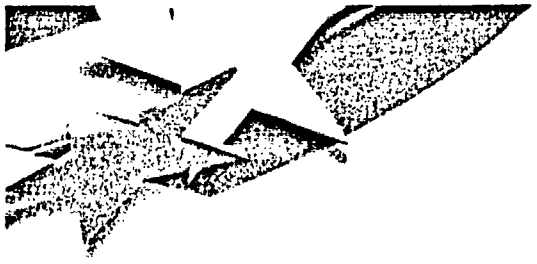


6/18/02

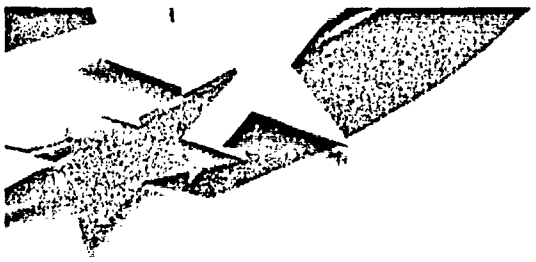
Tentative Itinerary

- **Monday Afternoon:**
  - **Brief overview presentation (J.A. Smith).**
  - **Discussion of individual tasks (M. Shah and J.A. Smith).**
- **Tuesday:**
  - **Visits with (Marlin Kipp, Greg Bessette, and Kenneth Gwinn). Review PRONTO, CTH, and ZAPOTEC analyses for Task 1.1A. Review CTH analysis for Task 3.**
  - **Final review of action items and discussion of direction.**

6/19

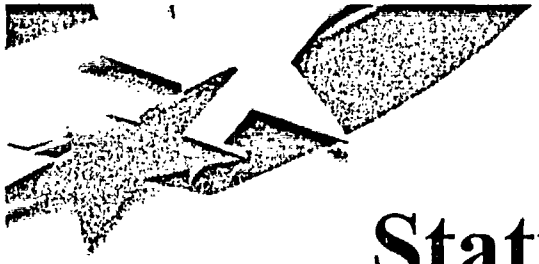
Aircraft into field of casks (Task 1.1A)

- The structural analysis of this event has been divided into two areas.
  - Global analysis: Methods using the ZAPOTEC and CTH codes are being examined to see which will best examine the problem of an aircraft impact into a field of casks.
  - Detailed analysis: The PRONTO finite element code is being used to examine detailed impact of aircraft components into a cask.



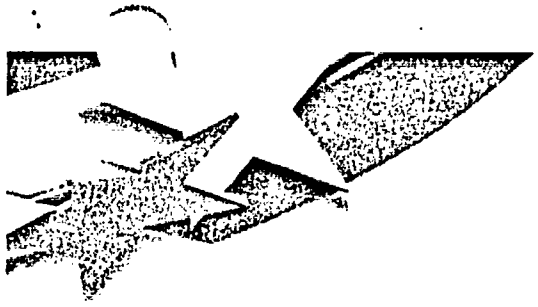
ZAPOTEC approach

- ZAPOTEC was developed mainly for use with weapons type problems. Therefore, this is a new application of the code and it is in the developmental stage for these types of problems. Therefore, there are three approaches which will be examined;
  - 1) the aircraft will be modeled using a Lagrangian approach, letting the contact algorithm handle the threat/target interaction. As elements "die" in the Lagrangian mesh, we will allow them to be donated to the Eulerian mesh so the momentum transfer from threat to target is more accurately modeled;
  - 2) the aircraft will be modeled using a purely Eulerian approach. This will allow ZAPOTEC to evaluate the interaction between the Eulerian threat and Lagrangian target; and
  - 3) a Lagrangian model of the aircraft will be fed into a Eulerian mesh which will then be applied to the Lagrangian model of the cask. This approach could reduce the cost of the calculation by reducing the size of the Eulerian mesh required.



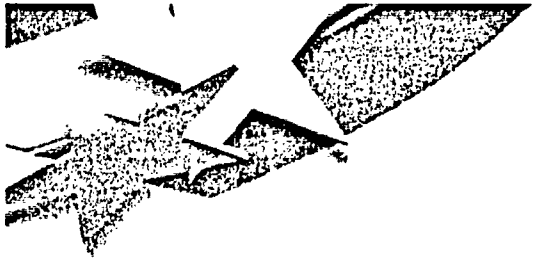
Status of ZAPOTEC analysis

- The ZAPOTEC approach was our first choice to solve the problem. However, our efforts did not produced results in a timely manner. Therefore, a purely CTH approach was initiated.
- Effort is continuing to examine the difficulties with ZAPOTEC (there are difficulties with the massively parallel version of the code for problems as large as this). We believe these difficulties have been resolved and the ZAPOTEC effort has been resumed.
- Initial results looked promising.



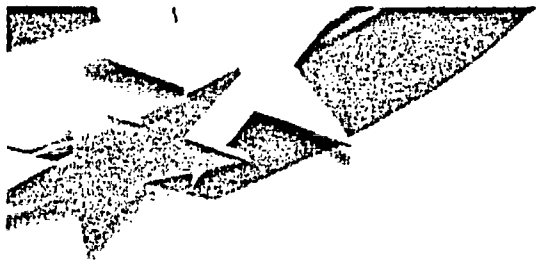
CTH approach cont.

- CTH is being used to examine aircraft impact into a field of casks.
- Initially, the problem is being reduced to the aircraft fuselage (including the landing gear and center fuel tank) impacting a single cask.



Aircraft Model

- Similar Meshes can be used in both CTH and ZAPOTEC.
- Several aircraft models of varying detail exist of the aircraft (approx. 5k to 200k elements).
- The current aircraft model being used in the analyses includes a course representation of the engine, center and wing fuel tanks, landing gear, and the flight deck.
- Efforts are continuing to improve the aircraft models.
- The current ZAPOTEC/CTH cask model contains approximately 4k elements while the PRONTO cask model contains approximately 350,000 elements.



Aircraft Model

Bottoms Ex2

Ex2

~~OUO Sensitive~~

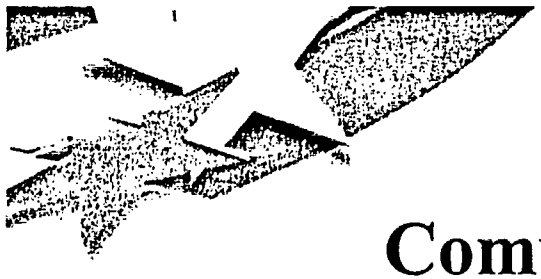
Sandia National Laboratories

Global Analysis (initial results)

Portions Exempt

~~OUO Sensitive~~

Sandia National Laboratories



Comparison of CTH and ZAPOTEC

Ex2

Portions Ex2

Sandia National Laboratories

Detailed Analysis (PRONTO)

- The Pronto finite element code is being used to examine the detailed behavior of the casks under these types of loadings.
- Examining a single cask under several loading scenarios.
  - Hard-point impact (front landing gear and engine).
  - Several angles of impact and impact locations.
  - Apply the Riera Method to cask.
  - Cask on cask impact.

Cylinder Impact into storage cask at centerline

Sandia National Laboratories

Engineering Sciences Center

Karagosian-Case concrete model used for concrete

Steel used 70 ksi yield

Symmetry boundary used at cut plane to model missing material

5 msec of analysis time shown

330,000 elements total in model

Results at 5 msec of analysis time Concrete Cells

Sandia National Laboratories

Engineering Sciences Center

Preliminary results show

Results at 5 msec, continued
Steel Liner

Sandia National Laboratories

~~Official Use Only~~

Future Plans

Finalize definition of impactor,

Include additional momemtum of structure,

Consider additional impact orientations.