STATUS OF DRY SPENT FUEL STORAGE VULNERABILITY ASSESSMENT

6/18/02

SCOPE: Assess the damage to a selected representative dry storage cask system and ISFSI from large and small aircraft threats and to assess damage to these and to assess the damage to other selected dry storage cask systems to a range of threats and scenarios and determine the resulting dispersion and doses for all study cases. An assessment of the costs of property damage and cleanup will also be made. The identification of protective measures that may minimize or eliminate vulnerabilities to terrorist threats including cost/benefit analyses are also to be included.

SELECTED STUDY CASES:

Aircraft Threats: Holtec HI-STORM 100 w/ MPC-32 using a ( ) and a small ( ) aircraft. The damage effects to be studied will include aircraft impact with maximum pay loads/fuel for the ( ) and resulting fire effects, and for small aircraft the aircraft impact with a mix of fuel and ( ) for maximum payload.

Current Status: For the ( ) the contractor has two finite element models developed, one for study of the overall impact effects on a single HI-STORM 100 cask and one for study of local effects from penetrating concentrated mass elements of the aircraft. Initial calculations have begun covering tens of milliseconds into the events with various modeling and computational problems arising. The aircraft model has yet to be reviewed by Boeing. The first letter report documenting the performance of the MPC-32 under the study conditions remains on schedule for 7/31/02. For the small aircraft there has been an extensive database created by the contractor of aircraft generally in this category. NRC staff will provided guidance on selection of aircraft for use in the study. Airframe model development will follow with threat assessment. The first deliverable for a review meeting with NRC scheduled for 6/21/02 that is to cover a broader range of work completion so some schedule slippage on the 6/21/02 date. The schedule for the final report remains on 12/20/02.

Other Threats : Holtec HI-STORM 100 w/MPC-32
Transnuclear NUHOMS w/32PT-DSC
Transnuclear TN-68
BNFL Fuel Solutions VSC-24

The threats and scenarios against these cask systems will be staged with the first stage to be single threat scenarios resulting from

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Ex 2 portions

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Status of Non-Spent Fuel Transportation Vulnerability Study
(Last updated 6/19/2002 - SFPO)

The study will assess damage to selected transportation packages (non-spent fuel) from terrorist threats and determine the resulting dispersion and dose consequences. Identify any additional protective measures which may minimize or eliminate vulnerabilities to terrorist threats including cost/benefit analysis. The team has selected the package designs to be analyzed. A contract with Sandia National Laboratories (SNL) is in place. The work effort is split between NRC and contract work being performed by Sandia National Laboratory(SNL). Cask damage assessments and dispersion of source material being done by SNL. Dose calculations to be done by NRC staff. The analysis is scheduled to be completed by end of Fiscal Year 2003. As a result of the meeting last week (June 10-12, 2002) NRC gave SNL two threats to begin evaluating as soon as possible for the CNS 1-13CII package. SNL will be preparing a methodology to evaluate these threats for NRC concurrence. Portions of the threats given to SNL are analyses that SNL has never performed before, therefore getting them started on the evaluations earlier (i.e., before the threats have been defined by NSIR) rather than later, was imperative.

Status of Spent Fuel Transportation Vulnerability Study
(Last updated 6/19/2002 - SFPO)

The study will assess damage to selected SF transportation casks from terrorist threats and determine the resulting dispersion and dose. Identify additional protective measures which may minimize or eliminate vulnerabilities to terrorist threats including cost/benefit analysis. The team has selected casks to be analyzed. A contract with Sandia National Laboratories (SNL) is in place. The work effort is split between NRC and contract work being performed by Sandia National Laboratory(SNL). Cask damage assessments and dispersion of source material being done by SNL. Dose calculations to be done by NRC staff. The analysis is scheduled to be completed by end of Calendar Year 2002. As a result of the meeting last week (June 10-12, 2002), SNL will be preparing a methodology to evaluate these threats for NRC concurrence. Portions of the threats given to SNL are analyses that SNL has never performed before, therefore getting them started on the evaluations earlier (i.e., before the threats have been defined by NSIR) rather than later, was imperative.

Status of Spent Fuel Storage Vulnerability Study
(Last updated 6/19/2002 - SFPO)

The study will a Assess the damage to a selected representative dry storage cask system and ISFSI from large and small aircraft threats and to assess damage to these and to assess the damage to other selected dry storage cask systems to a range of threats and scenarios and determine the resulting dispersion and doses for all study cases. An assessment of the costs of property damage and cleanup will also be made. The identification of protective measures that may minimize or eliminate vulnerabilities to terrorist threats including cost/benefit analyses are also to be included. The team has selected casks to be analyzed. A contract with Sandia National Laboratories (SNL) is in place. The work effort is split between NRC and contract work being performed by Sandia National Laboratory(SNL). Cask damage assessments and dispersion of source material being done by SNL. Dose calculations to be done by NRC staff.

Ex 2 portions

The aircraft threat will involve using a ( ) and a small ( ) aircraft. The damage effects to be studied will include aircraft impact with maximum pay loads/fuel for the and resulting fire effects, and for small aircraft the aircraft impact with a mix of fuel and for maximum payload. The first contract deliverable is a report documenting the performance of the cask under the study conditions remains on schedule for 7/31/02. For the small aircraft there has been an extensive database created by the contractor of aircraft generally in this category. NRC staff will provided guidance on selection of aircraft for use in the study. Airframe model development will follow with threat assessment. The first deliverable for a review meeting with NRC scheduled for 6/21/02 that is to cover a broader range of work completion so some schedule slippage on the 6/21/02date. The schedule for the final report remains on 12/20/02.

Other threats and scenarios against these cask systems will be staged with the first stage to be single threat scenarios resulting from

Since no specifics for the threats such as the quantity of the and the associated scenario have been specifically defined within NRC, the studies at the current time are to be carried out as single event studies or parametric type studies. The second stage studies will address a larger range of types of threats and threats in combination, both with various scenarios. For example, a combination event to be considered involves ( ) directed on a HI-STORM 100 cask.

The staged concept was just discussed with the contractor during meetings of 6/10-6/12/02 and scheduled dates have not been defined. The contractor is to develop target dates within two weeks for stage one efforts. The second stage efforts for the four cask systems are to be completed in one month intervals beginning the end of March 2003. No specific work has been performed on these tasks except there are currently finite element models of the HI-STORM 100 that may be adequate for reuse for other threats and scenarios.

As a result of the meeting last week (June 10-12, 2002), SNL will be preparing a methodology to evaluate these threats for NRC concurrence. Portions of the threats given to SNL are analyses that SNL has never performed before, therefore getting them started on the evaluations earlier (i.e., before the threats have been defined by NSIR) rather than later, was imperative.

Ex 2 portions

6/18/2002

STATUS OF DRY SPENT FUEL STORAGE VULNERABILITY ASSESSMENT

Scope: Assess vulnerabilities to selected spent fuel dry storage casks at ISFSI's from terrorist threats and determine the resulting dispersion, radiological and economic consequences. Identify protective measures which may minimize or eliminate vulnerabilities to terrorist threats including cost/benefit analysis.

Casks Selected: HI-STORM 100 w/MPC-32 (High Pressurized Canister, Concrete Overpack with Steel Inner and Outer Shell)

Transnuclear NUHOMS w/32PT-DSC (Concrete Bunker Design)

Transnuclear TN-68 (No Canister, Steel Overpack)

BNFL Fuel Solutions VSC-24 (Low Pressurized Canister, Reinforced Concrete Overpack with Steel Inner Shell)

Analyses:

Damage assessment and dispersion calculations to be performed by SNL and SFPO

Radiological/Dose consequence analyses to be performed by SNL and SFPO

Threats:

Airborne: Large aircraft crashing into ISFSI
Schedule: To be completed by end of CY2002

Small aircraft crashing into ISFSI
Schedule: To be completed by end of CY2002

Other Threats: - Initial threat scenarios identified to confirm analytic capabilities and to identify analytic problems/issues. (Coordinating with NSIR)
- Initiated analyses for short-term results.
(Schedule: end of Sept 2002)

Vulnerability Schedule: Sept 2003

NRC Actions:

Determined Scope of work - complete

Ex 2 portions

Selected casks - completed
Developed SOW for contractors - Contract in place, 189 for Rev 1 Proposal in-house
Develop Threats - (Coordinating with NSIR)
Monitor contractor progress & products - Ongoing
Develop NRC Radiological Consequence Criteria - Ongoing
Make recommendations including cost/benefit analysis - TBD

Status:

On June 10 - 12, 2002, the staff met at Albuquerque, NM, with SNL to finalize Rev. 1 of the contract and to define selected analyses to be performed on expedited bases (Coordinated with NSIR).

Aircraft Threats:

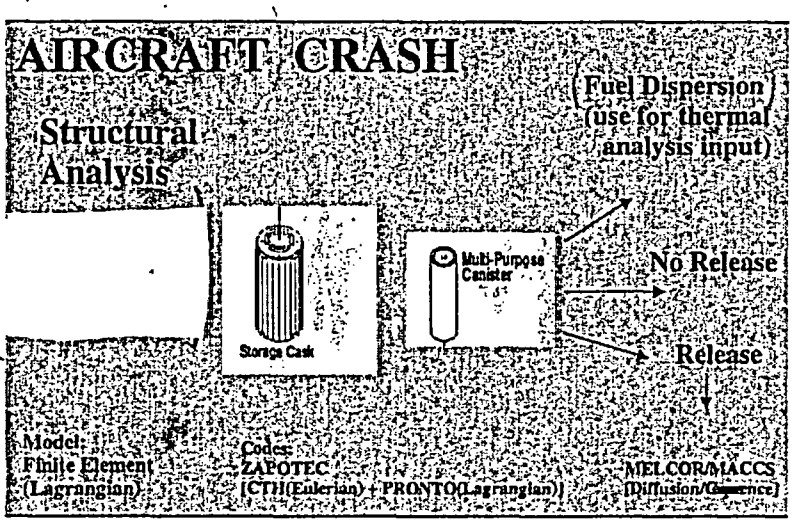
Large Aircrafts: Ongoing analyses to simulate a crash of a aircraft onto an ISFSI consisting of HI-STORM 100 w/ MPC-32 storage casks. The damage effects to be studied will include aircraft impact with maximum pay loads/fuel for the and resulting fire.

SNL has four analytic approaches to assess the consequences of an aircraft crash. These include:

(1) Pronto (Lagrangian) - Momentum transfer limitations. Damage can lead to mass loss. Uses Lagrangian solution techniques.

Ex 2 portions

(3) Zapotec (State of the art - CTH and PRONTO parallel analyses) - overcomes the limitations of each code and incorporates the strengths of both codes.



A fourth analytic approach applies the SNL experimental jet crash correlation.

Initial calculations have begun covering tens of milliseconds into the events with various modeling and computational problems arising (expected - first of a kind analyses). The aircraft model has yet to be reviewed by Boeing for refinements. The first letter report documenting the performance of the MPC-32 under the study conditions remains on schedule for 7/31/02.

Small Aircrafts: An extensive database was developed by SNL on aircrafts with up to ( ) capacity. (Completed)

NRC staff will provided guidance on selection of aircraft for use in the study.

SNL and SFPO are in the process of developing a method of analysis.

A review meeting with NRC is scheduled for 6/21/02. Given ongoing issues that cover a broader range of work, some scheduler slippage may occur.

The schedule for the final report remains on 12/20/02.

Ex 2 portions

New methods for performing such analyses are under development and will be used by RES for their vulnerability assessments, as well.

RES developed aircraft engine models and lessons learned from their initial assessments are implemented in this program.

Excellent coordination between SFPO/RES/SNL.

Other Events:

SNL is in the process of analyzing vulnerability of storage casks to Preliminary results are anticipated in September 2002.

The threats and scenarios against these cask systems are staged.

First Stage Analyses:
The first stage of analyses consists of single threat scenarios resulting from

and the associated scenarios, have been defined by NSIR. Consequently, the initial studies are carried out as single event studies or parametric studies. These studies are coordinated with NSIR.

SNL is to develop target dates within two weeks for stage one efforts.

Second Stage Analyses:
The second stage of studies will address a broader range and categories of threats, as well as various threat combinations. These will include diverse scenarios. For example, a combination of events to be considered involve directed on a cask.

SFPO and NSIR identified first-of-a-king events to be analyzed on storage casks. These events are intended for early identification of modeling capabilities and deficiencies.

The staff is in the process of identifying additional parametric studies that will be consistent and complement the final identification of the threat (coordinated with NSIR).

The second stage efforts for the four cask systems are to be completed in one month intervals beginning the end of March 2003. To date, no specific work has been performed on these tasks. However, the contractor has existing finite element models of the HI-STORM 100 that may be adequate for use on

Ex 3 portions

SFPO VULNERABILITY ASSESSMENTS

✔ SHORT TERM (SEPTEMBER 2002)

I EFFECTS ON SPENT FUEL STORAGE, TRANSPORT AND NON-SPENT FUEL TRANSPORTATION PACKAGES
- COMPILATION OF HISTORICAL ASSESSMENTS
- PRELIMINARY CALCULATIONS ON NEWER DESIGNS FOR RANGE OF

II EFFECTS OF ON STORAGE AND TRANSPORT OF SPENT NUCLEAR FUEL
- ANALYSIS OF HISTORICAL ASSESSMENTS
- CALCULATIONS USING CERTIFIED CASK DESIGNS AND THREATS

III DEVELOPMENT OF A DYNAMIC MODEL AND COMPUTATIONAL METHODS OF A LARGE AIRCRAFT

IV COMPILATION OF SMALL AIRCRAFTS

V ESTABLISHMENT OF AN EXPERT GROUP ON FUEL / MATERIAL PERFORMANCE UNDER THREAT CONDITIONS FOR SOURCE TERM ASSESSMENTS

VI SELECTED ANALYSES FOR IDENTIFICATION OF MODELING CAPABILITIES AND LIMITATIONS UNDER FIRST-OF-A-KIND EVALUATIONS (e.g., ETC.)

Ex 2-portions

✔ **INTERMEDIATE TERM** (DECEMBER 2002)

I LARGE AIRCRAFT CRASHES ONTO ISFSI AND TRANSPORTATION CASK

II SMALL AIRCRAFT CRASHES ONTO ISFSI AND TRANSPORTATION CASK

✔ **INTERMEDIATE TERM** (APRIL 2003)

- SMALL AIRCRAFT CRASHES ONTO NON-SPENT FUEL PACKAGES

✔ **LONG TERM** -

I EXPANDING CALCULATIONS FOR A BROADER RANGE OF THREATS

- ( )

II REFINING SOURCE TERMS AND SOURCE CALCULATIONS

III PERFORM ECONOMIC CONSEQUENCE MODELS (?)

IV IDENTIFY ACCEPTANCE CRITERIA (e.g., DOSE CRITERIA, DAMAGE CRITERIA, ETC.)

IV PERFORM COST/BENEFIT EVALUATIONS

V IDENTIFY PROTECTIVE MEASURES

Ex 2 portions