



**K.B. Sorenson, Manager (kbsoren@sandia.gov)**

# Who We Are

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- **Sandia's Transportation Risk & Assessment's people develop innovative solutions to solve transportation and packaging problems for DOE and other federal agencies.**
- **These solutions cover a broad spectrum of activities ranging from new package design to package testing and from regulatory standard development to transportation risk/safety assessments.**
- **Our goal is to provide the technology to achieve safe, efficient, and economical packaging and transportation of nuclear and other hazardous materials.**

**[www.sandia.gov/tp/tp.htm](http://www.sandia.gov/tp/tp.htm)**

# What We Do

- Strong talents in two complementary transportation program areas are **Risk Assessment & Packaging** give Sandia unique synergistic capabilities.



# Our People

Name	Discipline	Degree	Yrs	Project
Douglas J. Ammerman	Engineering Sciences R&D	PhD Civil Engr	12	Structural Analysis
Mona L. Aragon	Computer Systems Analysis	MA Art	12	Advanced Visualization
Michael Arviso	Engineering Support	BS Electronic Engr	12	Testing Facilities
Dennis L. Bolton	Engineering Support	AA Electronic Technology	26	Testing
Gina L. Fresquez	Office Admin Asst	BA Business Admin	12	Office Admin Asst
Glenn Hohnstreiter	Program Development	PhD Mechanical Engr	34	Program Development
David Chanin	Programming/Analysis	BS Math	21	TRANSNET
Jorman A. Koski	Engineering Sciences	PhD Mechanical Engr	21	Thermal Analysis
Carlos Lopez	Mechanical Engineering	MS Mechanical Engr	3	Thermal Analysis
Robert Luna	Risk Analysis	PhD Mechanical Engr	34	Risk Analysis
Mark E. McAllaster	Systems Engineering	AA Drafting Technology	31	Packaging Technologies
G. Scott Mills	Risk Analysis	PhD Physics	21	Risk - GIS
K. Sieglinde Neuhauser	Risk Analysis	PhD Biology	25	Risk - RADTRAN
Paul McConnell	Material Science	MS Metallurgy	10	Materials Characterization
Leslie Orear Jr.	Laboratory Support	BS Electronic Engr	25	Chemical/Material Analysis
Jim D. Pierce	Tech Prog/Proj Mgmt & Plan	AA Electronic Technology	31	Packaging Technologies
Ken B. Sorenson	General Technical Mgmt	MS Structural Engr	18	Manager
Jeremy L. Sprung	Risk Analysis	PhD Physical Organic Chem	25	Risk Analysis
Laurel J. Taylor	Prog/Proj Admin	BA Procurement Mgmt	18	Prog/Proj Admin
Patricia P. Tode	Office Admin Asst	BA University Studies	37	Office Admin Asst
Richard H. Yoshimura	Packaging Design	MS Mechanical Engr	34	Risk Analysis
Ruth Weiner	Risk Analysis	PhD Chemistry	37	Risk Analysis

# Our Customers

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- **DOE NTP - National Transportation Program**
- **DOE EM - Environmental Management**
- **DOE/AL- Albuquerque Operations Office**
- **DP - Defense Programs**
- **SNL and other laboratories**
- **Work For Others**
  - **ARMY, EONC**
  - **BECHTEL BETTIS**
  - **BNFL - British Nuclear Fuels Limited**
  - **DOT/MARAD - Maritime Administration, DOT**
  - **JNC - Japan Nuclear Cycle Development Institute**
  - **NRC - Nuclear Regulatory Commission**

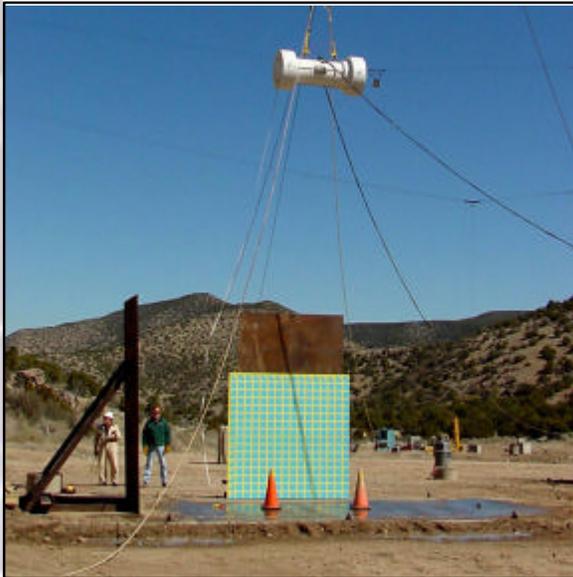
# Packaging

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- **Capabilities include computer modeling and analysis, coupled with physical testing.**
  - **Full-scale testing**
  - **Scale-model testing**
  - **Structural computer analysis**
  - **Thermal computer analysis**
  - **Packaging systems concepts**
  - **Package development**

# Full-Scale Testing

## Free Drop Test



**Free dropping a package from 30-feet onto an unyielding target.**

**The speed on impact is 44-feet per second or 30 miles per hour.**

## Puncture Test



**Dropping a package from 40-inches onto a 6-inch diameter, welded steel spike that is bolted to the unyielding target.**

**The speed on impact is 14.6-feet per second or 10 miles per hour.**

## Thermal Test



**Placing a package 40-inches above a fully engulfing pool of burning fuel for 30-minutes at 800 degrees Celsius or 1475 degrees Fahrenheit..**

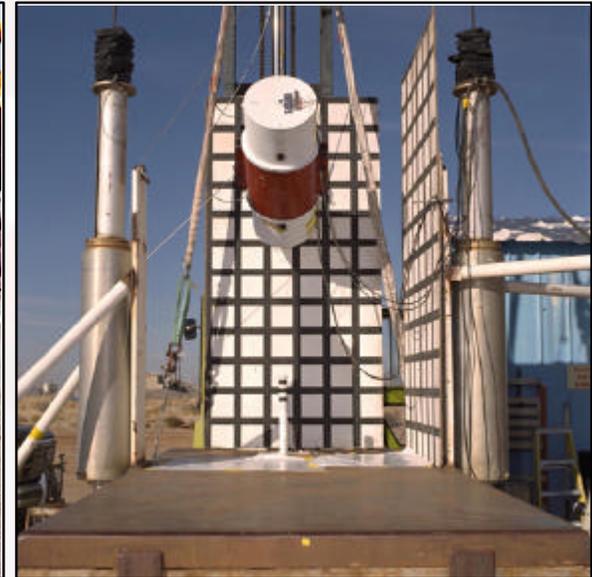
# Scale-Model Testing



**1/4 scale-model  
free drop test**

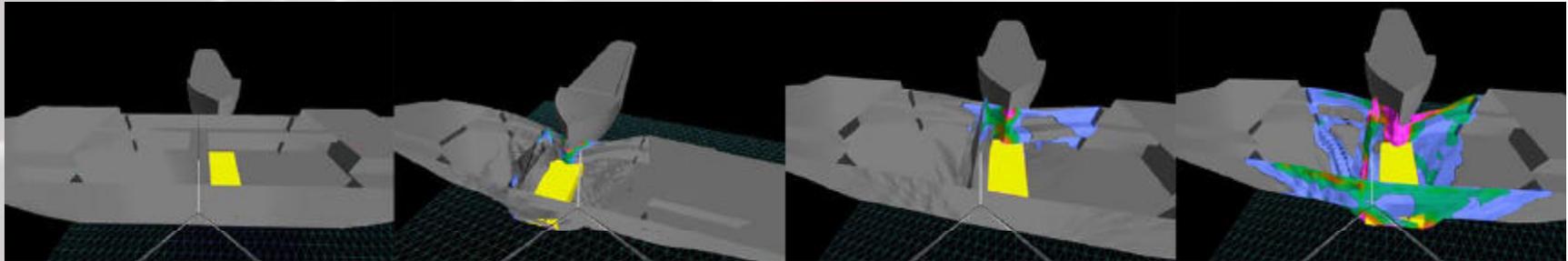


**1/8 scale-model  
highway/railroad  
impact**

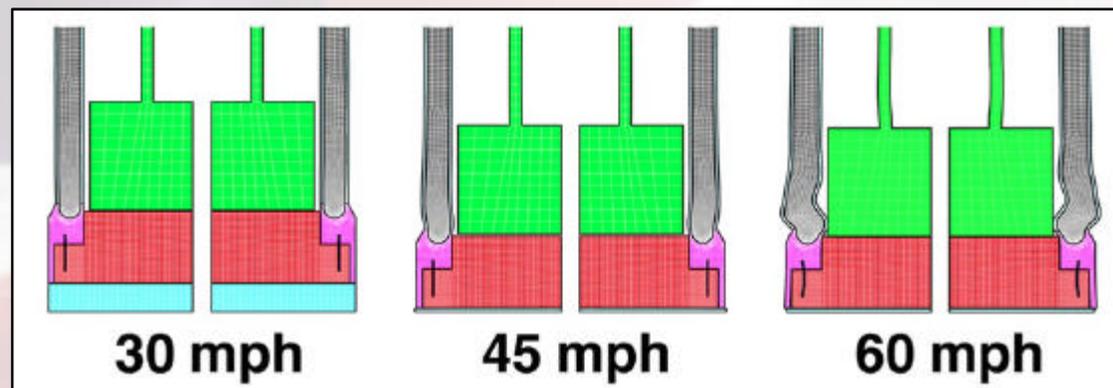


**1/3 scale-model  
puncture test**

# Structural Computer Analysis



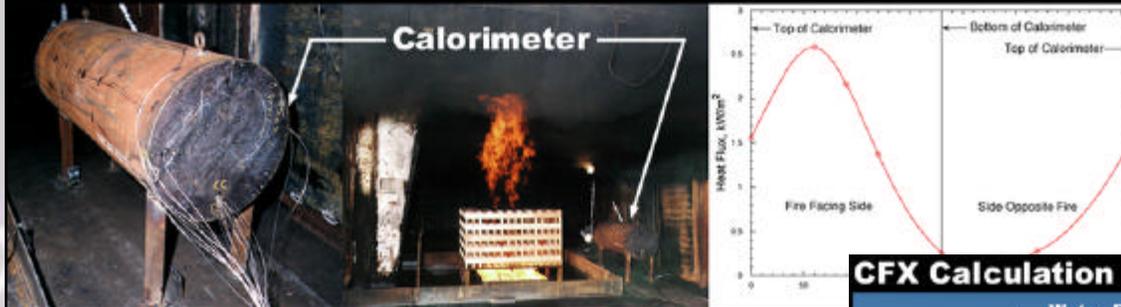
Computer analysis was used to determine a ship & package structural response to a ship-to-ship collision. The package (in yellow) gets pushed through the ship hull and drops into the sea. There would be no release of material from the package.



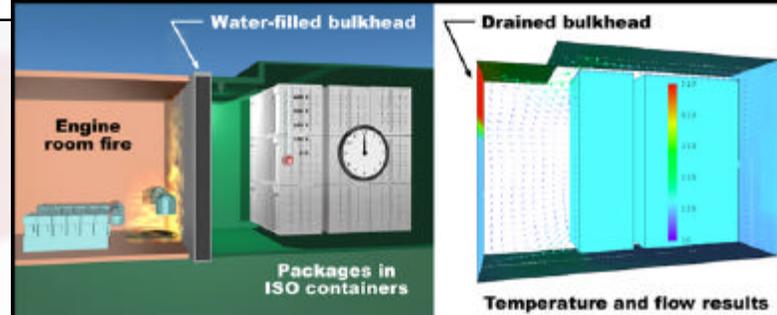
Computer analysis was used to determine a high-speed impact simulation response of a generic spent fuel package in a series of accidents.

# Thermal Computer Analysis

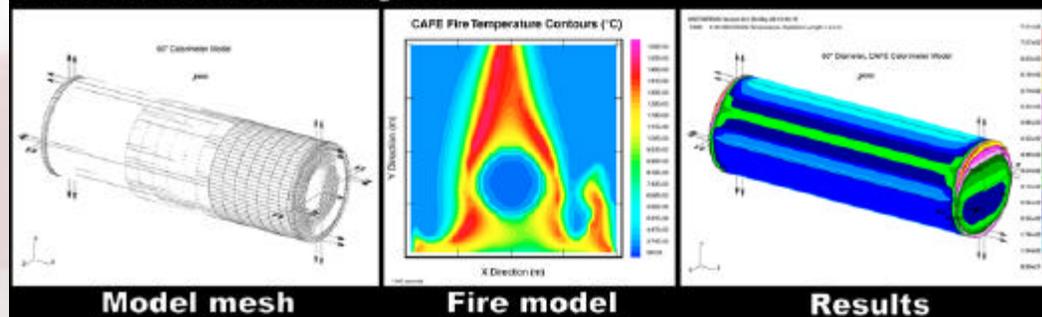
## SODDIT Inverse Heat Conduction



## CFX Calculation



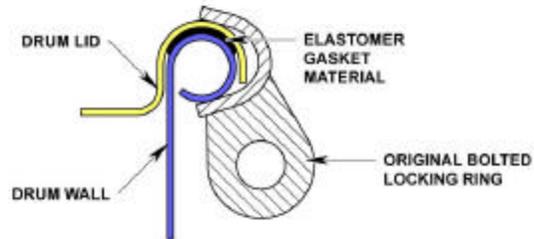
## CAFE Thermal Analysis



# Packaging Systems Concepts

## DOT 17-C DRUM CONTAINMENT WITH NEW **CRIMPED CLOSURE LID**

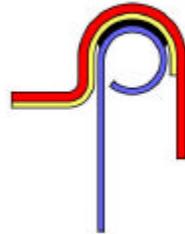
DOT 17-C DRUM CONTAINMENT WITH ORIGINAL BOLTED LOCKING RING



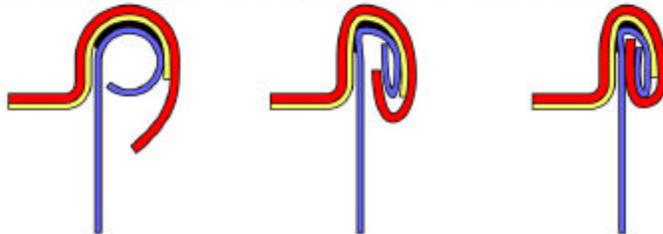
STEP 1. REMOVE ORIGINAL  
BOLTED LOCKING RING



STEP 2. EMPLACE NEW  
**CRIMPED CLOSURE LID**

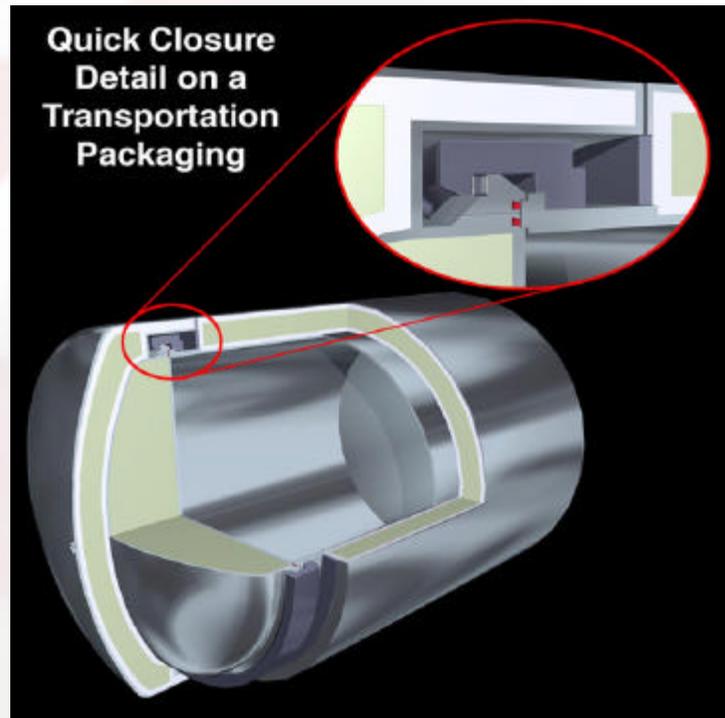


STEP 3. PERFORM CRIMPING PROCESS WITH NEW **CRIMPED CLOSURE LID**



- Crimped closure on 55-gallon drums
- Quick closure
- Wire mesh

Quick Closure  
Detail on a  
Transportation  
Packaging



# Package Development



**BUSS**



**ONC**



**PAT**

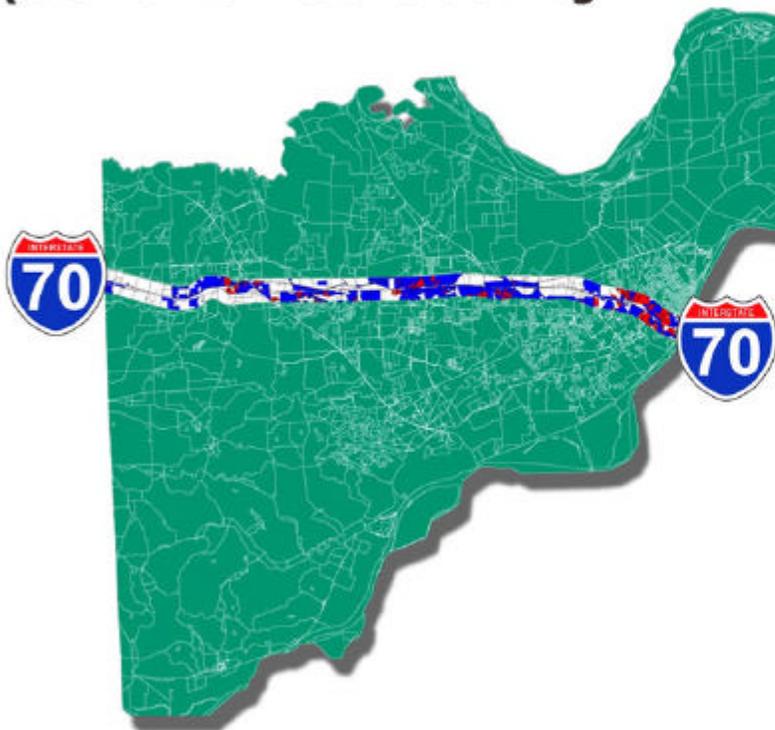
# Risk Assessment

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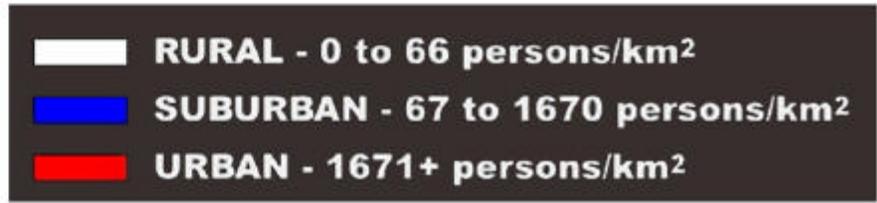
- **Our capability includes conducting risk assessments of transportation of RAM, risk assessment tools, data development, and applications of the tools and data.**
- **The Risk Assessment program has supported essentially every transportation environmental impact assessment (EA) and transportation environmental impact statement (EIS) that has been published to date.**
  - **Geographical Information Systems (GIS)**
  - **TRANSNET**
  - **RADTRAN**
  - **Transportation Risk Assessments**

# Geographical Information System (GIS)

## GIS Interstate Route example (St. Charles county in Missouri)



SECTID	NUMBER OF CENSUS BLOCKS IN SECTID	AVERAGE OF BLOCK POPULATION DENSITIES	DENSITY ZONE	CUMULATIVE LINK DISTANCE, KM	LINK AVERAGE POPULATION DENSITY	LINK ID
45	82	8339.8388	U	1.00000		
46	41	2649.0642	U	2.00000		
47	48	1972.2647	U	3.00000	1504.48000	18.00000
48	32	1443.5222	U	1.00000	1641.00000	19.00000
49	68	2182.2791	U	1.00000		
50	40	1021.6649	U	2.00000	3001.00000	20.00000
51	12	438.0861	S	1.00000		
52	32	441.2214	S	2.00000		
53	24	152.7862	S	1.00000		
54	12	79.6747	S	1.00000	535.67000	21.00000
55	11	159.2874	S	1.00000		
56	19	211.7889	S	2.00000		
57	27	434.4644	S	3.00000	127.81000	22.00000
58	49	854.7421	U	1.00000	1874.04000	24.00000
59	29	827.3278	S	1.00000		
60	28	1387.9285	U	2.00000		
61	12	241.4772	S	3.00000		
62	24	127.6182	S	4.00000		
63	30	1119.8269	U	5.00000		
64	84	978.7100	U	6.00000	391.49000	25.00000
65	32	2788.8000	U	1.00000		
66	1	1857.5200	U	2.00000		
67	1	1857.5200	U	3.00000	2475.00000	26.00000
68	1	1857.5200	U	1.00000	292.46000	27.00000
69	1	1857.5200	U	1.00000	1804.64000	28.00000
70	1	1857.5200	U	1.00000		
71	32	1857.5200	U	2.00000		
72	32	1857.5200	U	3.00000		
73	45	1857.5200	U	4.00000		
74	83	172.4857	S	6.00000		
75	24	378.7061	S	8.00000		
76	26	717.8982	S	6.00000		
77	45	847.7828	S	7.00000		
78	68	808.8884	S	8.00000		
79	110	838.8625	S	9.00000		
80	12	117.6829	S	10.00000		
81	12	123.8278	S	11.00000		
82	12	742.6029	S	12.00000		
83	12	149.6191	S	13.00000	595.32000	29.00000
84	2	16.2642	S	1.00000		
85	2	8.5962	S	2.00000		
86	2	23.8924	S	3.00000	26.50000	30.00000
87	18	258.2861	S	1.00000		
88	18	38.2862	S	2.00000	188.20000	31.00000



? GIS is used to create graphical & numerical data to represent rural, suburban, and urban population densities within census blocks along any truck/rail routes for risk assessments.

# TRANSNET

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- **TRANSNET provides the transportation operations and risk assessment communities with remote access to Sandia's tools and databases used in assessments of transportation health risk.**

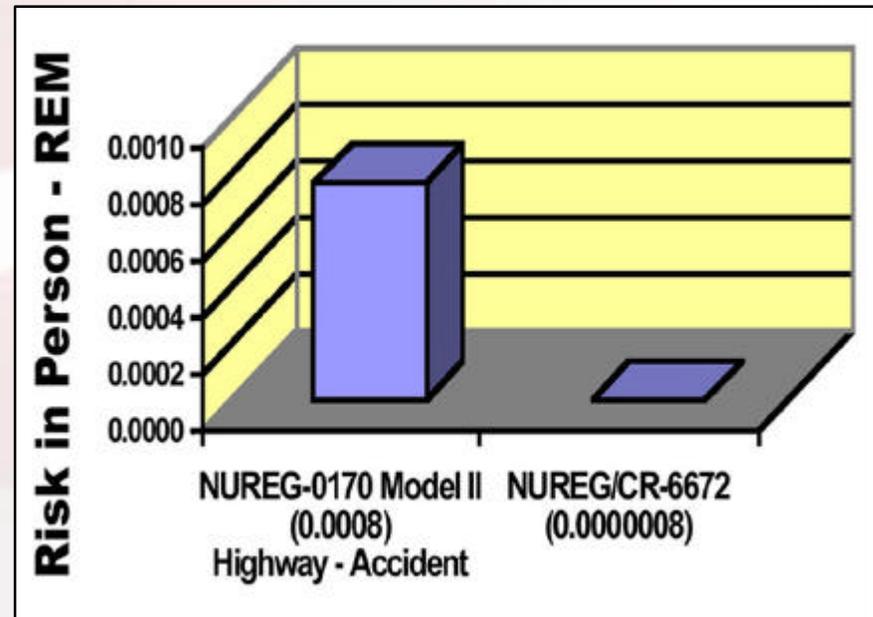
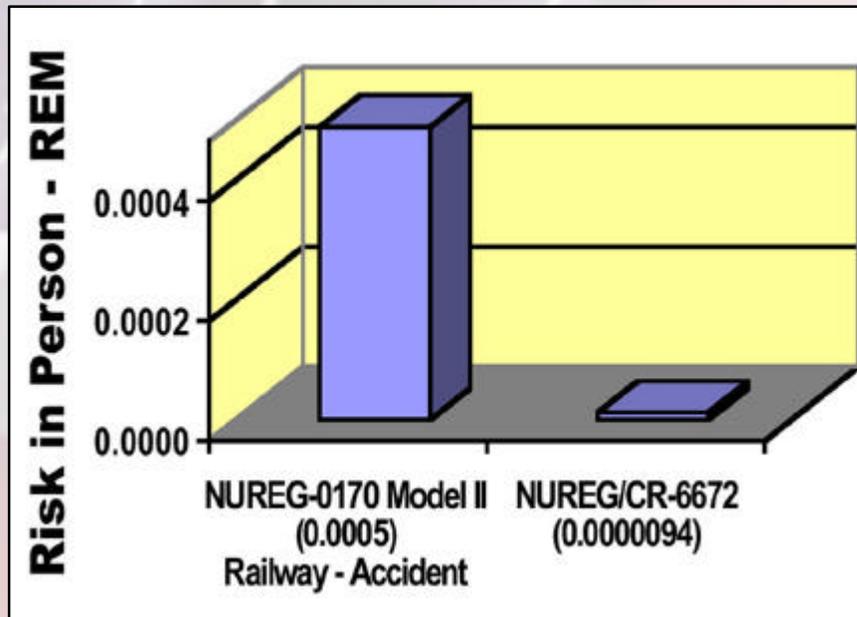
# RADTRAN

- Sandia's RADTRAN5 is the world standard for transportation risk assessment computer code.
- It combines user-determined meteorological, demographic, transportation, packaging, and material data with health physics data to calculate the expected radiological consequences and accident risk of transporting RAM.



# Transportation Risk Assessment

- Support for the **FRR** return shipments
- Support for the **Yucca Mountain EIS**.
- Sandia computed **dose risks** for the NRC from impact and thermal accident conditions.
- Calculated risks are orders of magnitude smaller than those computed in **NUREG-0170**



# Facilities Overview

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- **One of the differentiating capabilities of the Transportation Risk & Packaging Program is its ability to provide in-depth **analytical and experimental analysis** to scenarios that could affect the integrity of transportation packages for nuclear and hazardous materials.**
- **Because nuclear weapons remain at the center of the Sandia National Laboratories mission, extensive and unique test facilities are available for regulatory and engineering testing for all perceived accident conditions.**

# Facilities

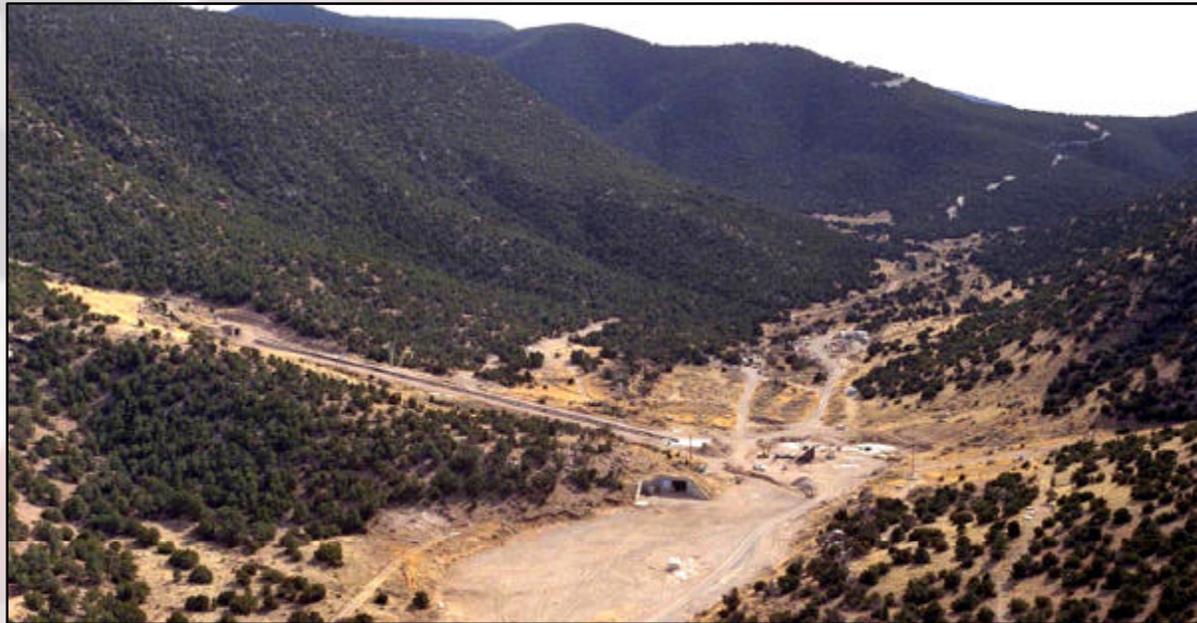
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- **Aerial Cable Facility**
- **1000-ton Armored Unyielding Target**
- **Drop Tower Facility**
- **Burn Test Facility**
- **Radiant Heat Facility**
- **Rocket sled track facility**
- **Mobile Laser Tracker**
- **Photometrics and Ultra-High-Speed Video**
- **Mobile Instrumentation Data Acquisition System (MIDAS)**
- **Seals Laboratory**
- **Visualization Laboratory**

# Aerial Cable Facility

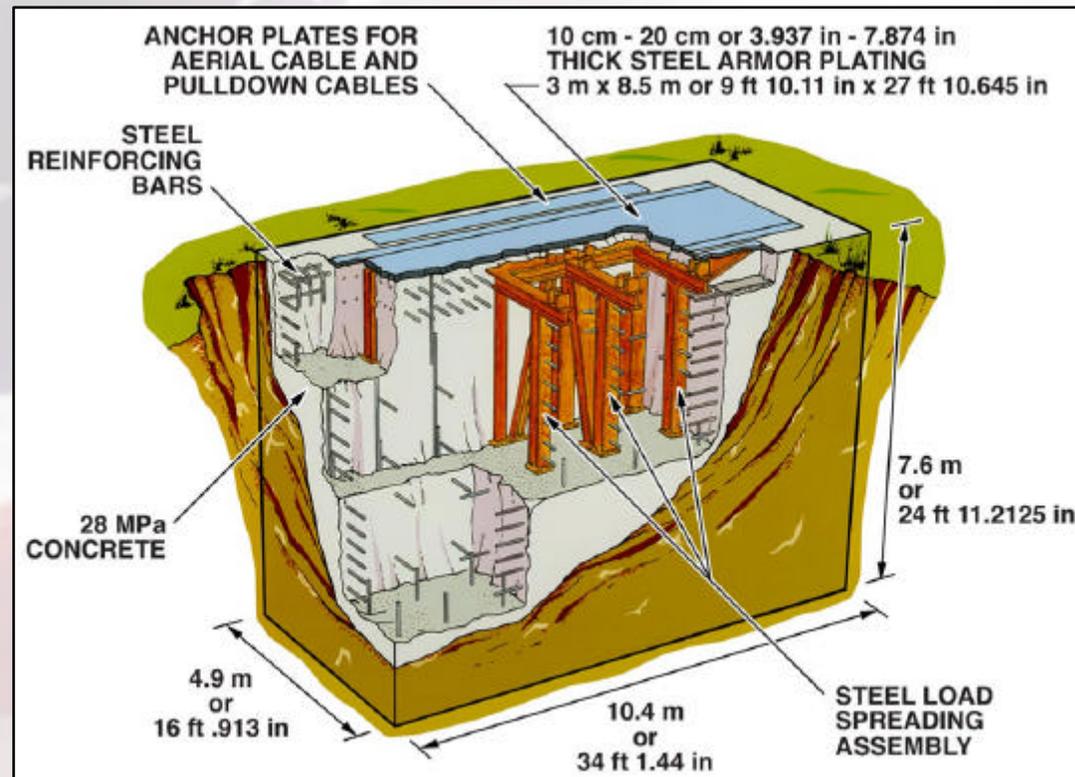
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- **The aerial cable facility has four cable systems that extend 5000-feet between two ridges.**
- **The cable can lift, hold, and drop objects weighing 80,000-pounds from 100-feet in the air and smaller objects from 700-feet.**
- **Various free drop, guided drop, puncture, and pull-down tests are conducted here.**



# 1000-ton Armored Target at the Aerial Cable Facility

- 1000-tons of armored steel and reinforced concrete used to drop, puncture, and pull-down test objects onto.
- The unyielding target will not absorb any energy in an impact which forces all of the deformation to be in the test object, none in the target.



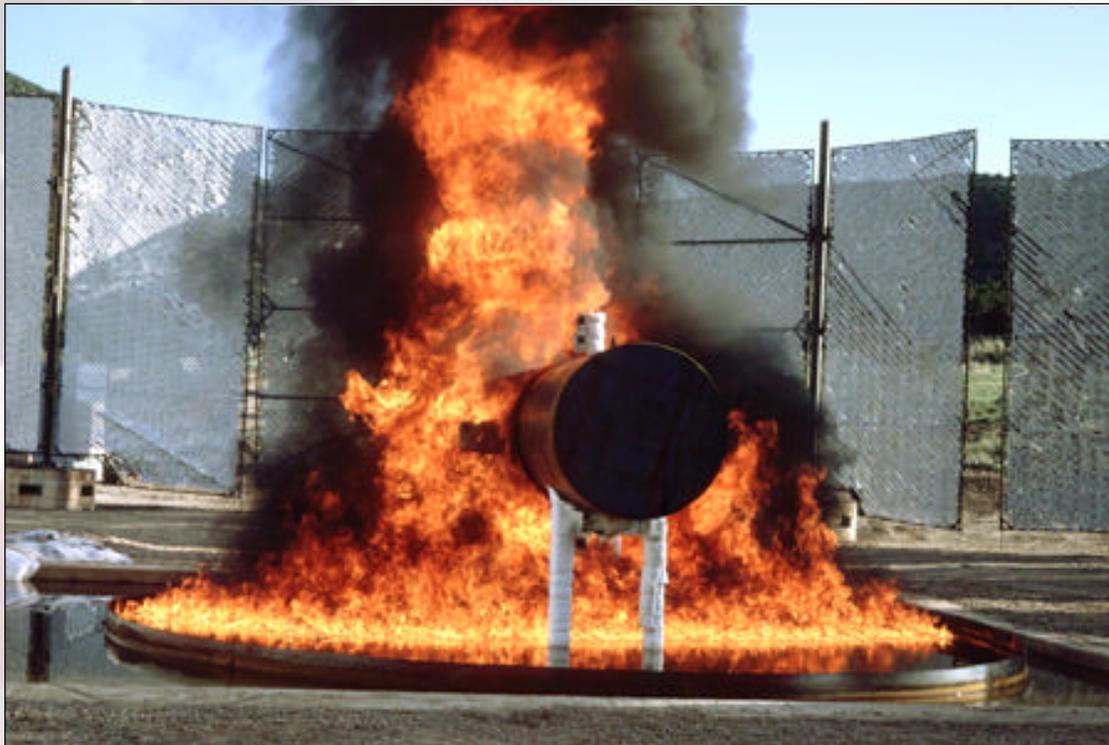
# Drop Tower Facility

- **The drop tower is 185-feet tall with a four inch thick steel plate target on a reinforced concrete block**
- **This photo shows dropping a 1100 pound steel plate from 30-feet onto a 55-gallon drum.**
- **The speed on impact is 44-feet per second or 30 miles per hour.**



# Burn Test Facility

- The burn facility consists of **three sizes of open pools**, an enclosed pool, a small wind-shielded enclosure, and a bunker-like structure.
- This photo shows a package in a 20 by 20 meter pool, 40 inches above burning fuel for 30 minutes at 800 degrees Celsius or 1475 degrees Fahrenheit.



# Radiant Heat Facility

- The radiant heat facility provides a controlled environment to test the performance of components and assemblies under various temperatures.
- These temperatures can be up to **2200 degrees centigrade** and determine failure levels, demonstrate system integrity, and to develop and validate thermal numerical models.



# Rocket Sled Track Facility

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- The rocket sled track provides high-velocity impact, aerodynamic, acceleration testing of small and large test objects.
- This facility has a **10,000-foot track** for very high-speed tests and a **2000-foot railroad track** for very large object tests.



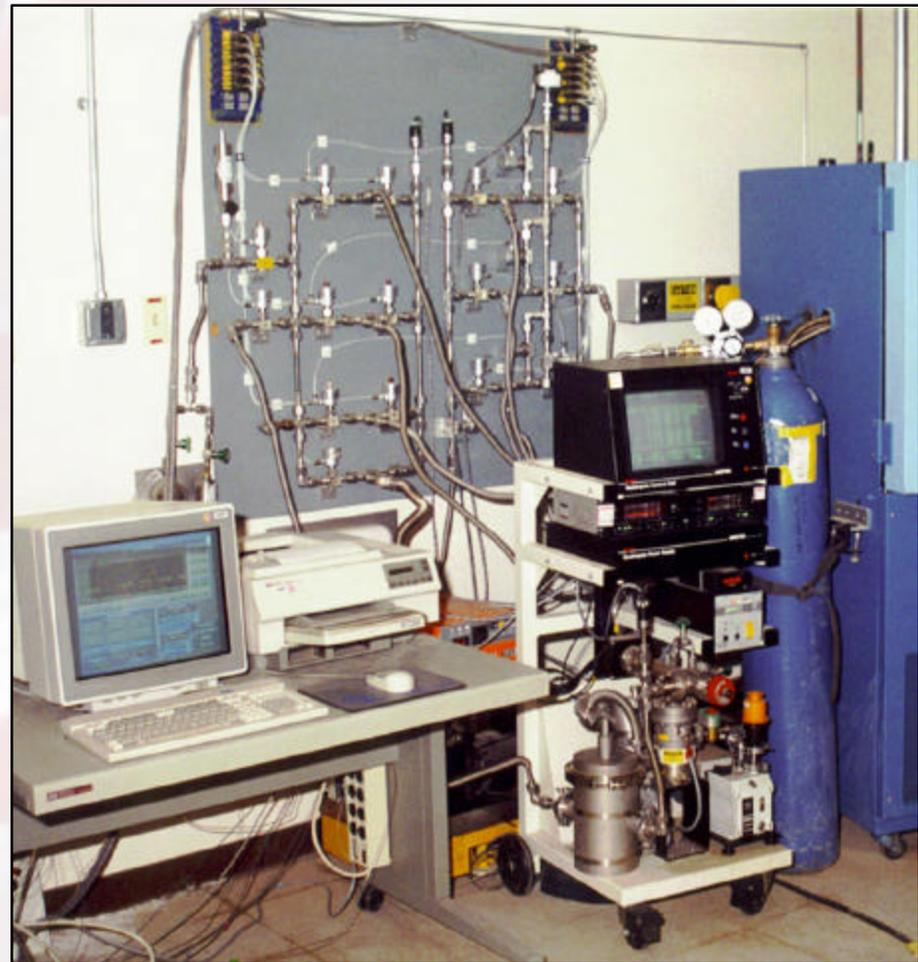
# Mobile Instrumentation Data Acquisition System (MIDAS)

- MIDAS was developed by Sandia for the U.S. Department of Energy.
- This self-contained facility is built within a 44-foot trailer, and is equipped with structural and thermal data acquisition systems to provide **on-site data acquisition** of test objects during drop, crush, puncture, fire, and immersion tests.



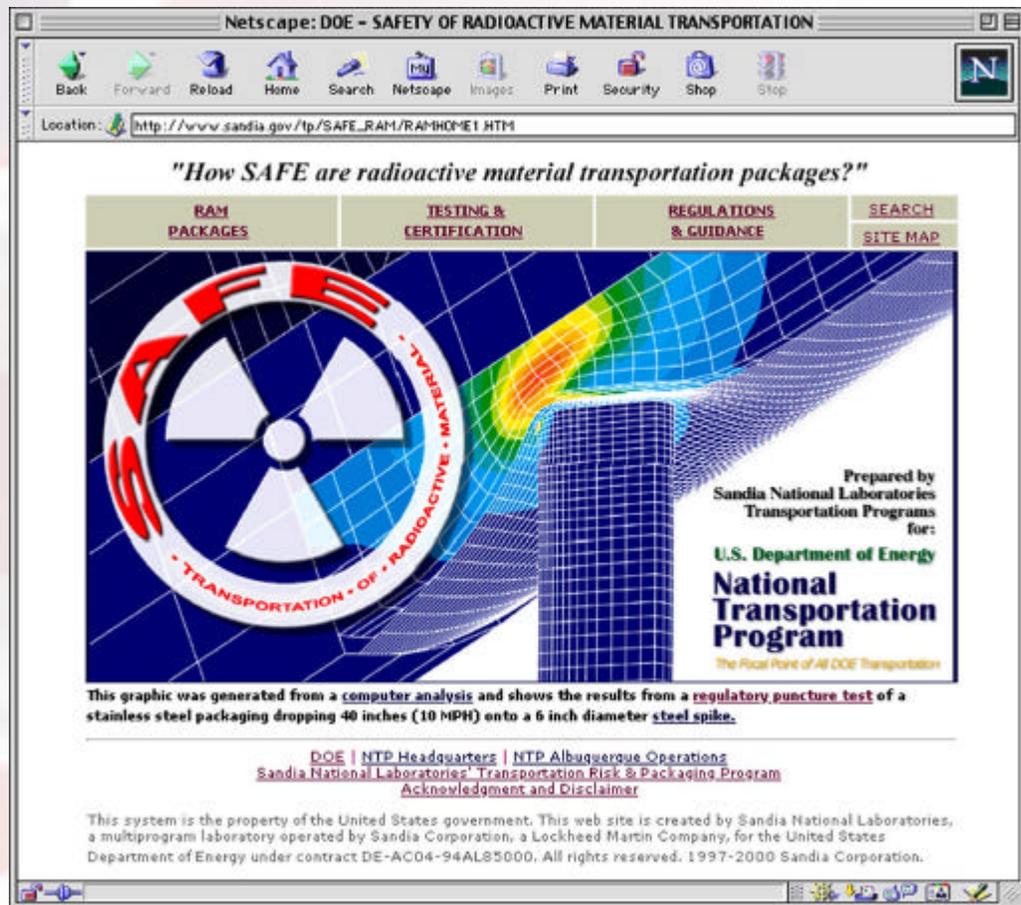
# Seals Laboratory

- This laboratory is used to **test the o-rings** that are used to provide a leak-tight seal between the package lid and the package body of a **RAM transportation package**.
- Testing includes high and low temperatures and relative displacement of the the sealing surfaces.



# Visualization Laboratory

- This lab is equipped with state-of-the-art multi-platform visualization tools that are used to explain and demonstrate how computer analysis, full-scale testing, and scale-model testing assures **SAFE** cask performance in the transportation of RAM for DOE, Sandia, press, public, and stakeholders.



[www.sandia.gov/tp/SAFE\\_RAM/RAHHOME1.HTM](http://www.sandia.gov/tp/SAFE_RAM/RAHHOME1.HTM)