

# An Analysis Of A Spent Fuel Transportation Cask Under Severe Accident Conditions



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**U.S. Nuclear Regulatory Commission**

**Finite Element Modeling Continuous Improvement Workshop**

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**Greenbelt, MD**

# Introduction

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- **Baltimore Tunnel Fire**
- **Spent Fuel Transportation Cask**
- **Preliminary Results**
- **Conclusions and Future Work**

# Baltimore Tunnel fire

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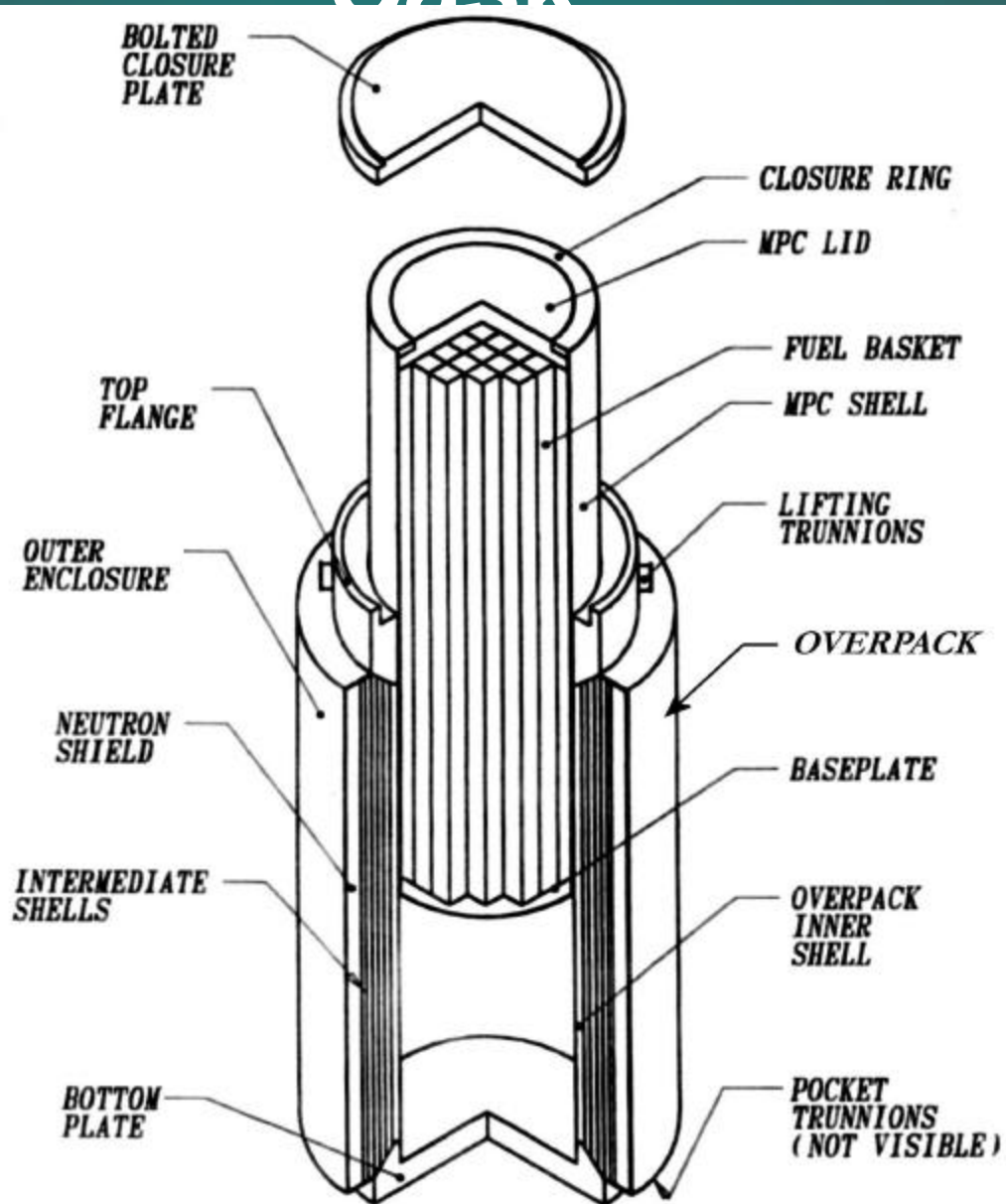
- July 18<sup>th</sup>, 2001
- Howard Street Tunnel
- CSX Freight Train
- Derailment and Fire
  - Tripropylene

# Spent Fuel Transportation Cask

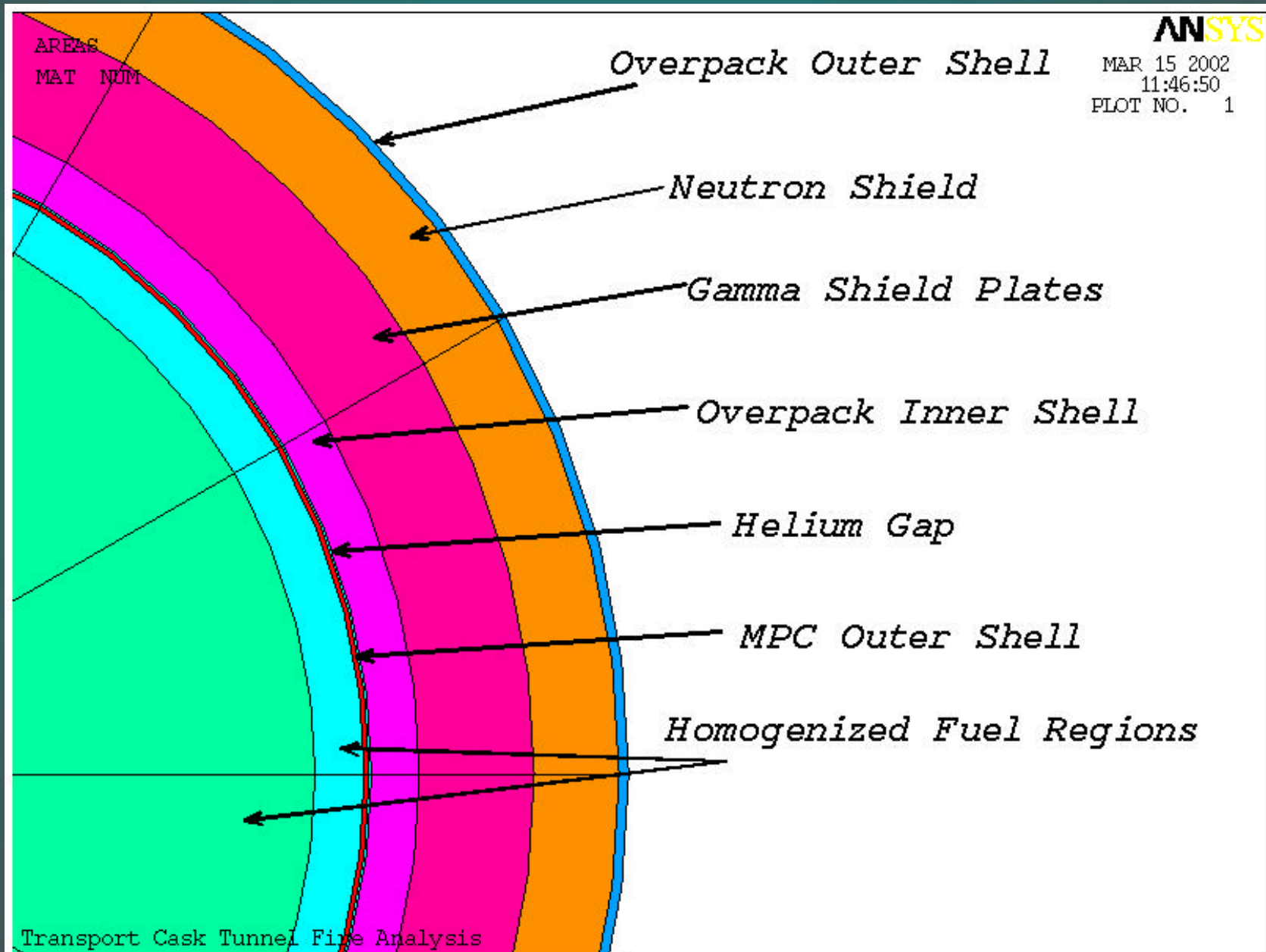
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- 10 CFR 71.73 Fire Accident
- Cask Performance
- Finite Element (ANSYS®) Model

# Spent Fuel Transportation Cask



# ANSYS® Model

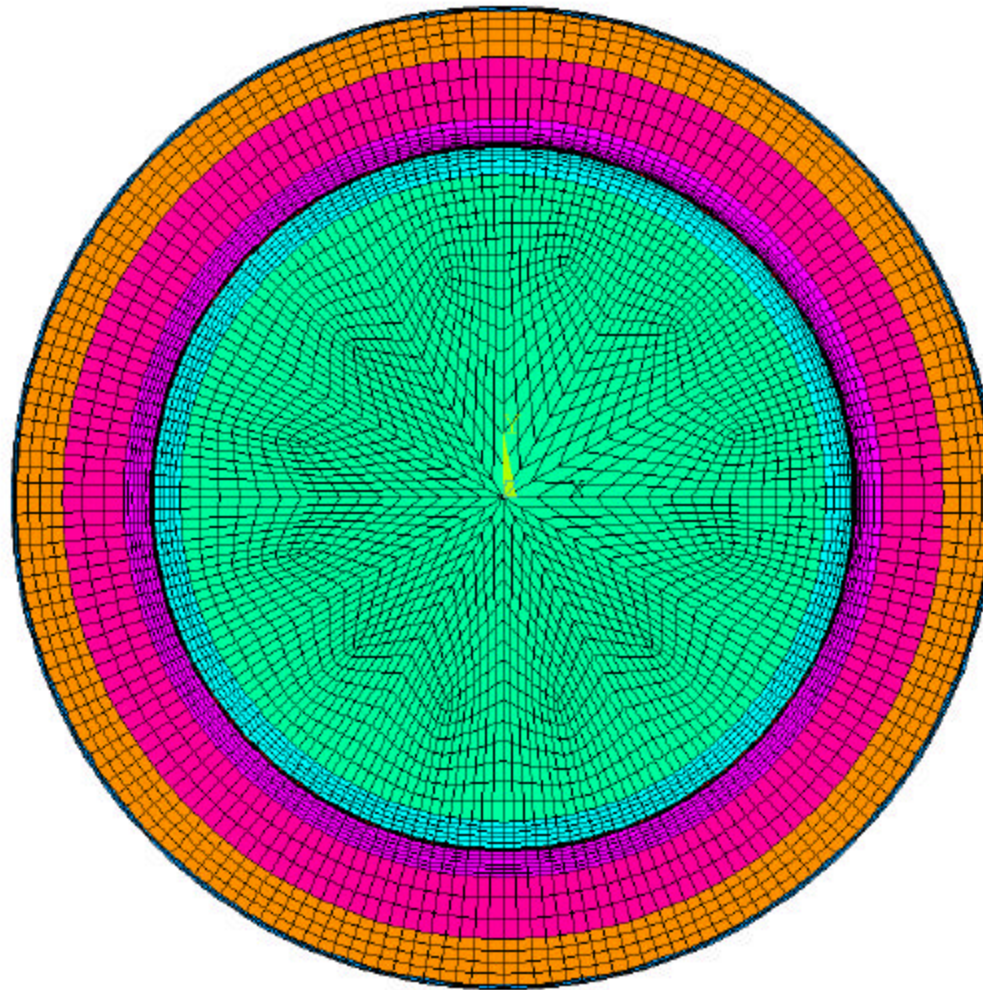




# ANSYS® Model Mesh

1 ELEMENTS  
MAT NUM

**ANSYS**  
MAR 15 2002  
10:52:32  
PLOT NO. 1



Transport Cask Tunnel Fire Analysis

# Boundary Conditions

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- **Heat Transfer Mechanisms**
- **Initial Conditions**
- **Fire conditions**

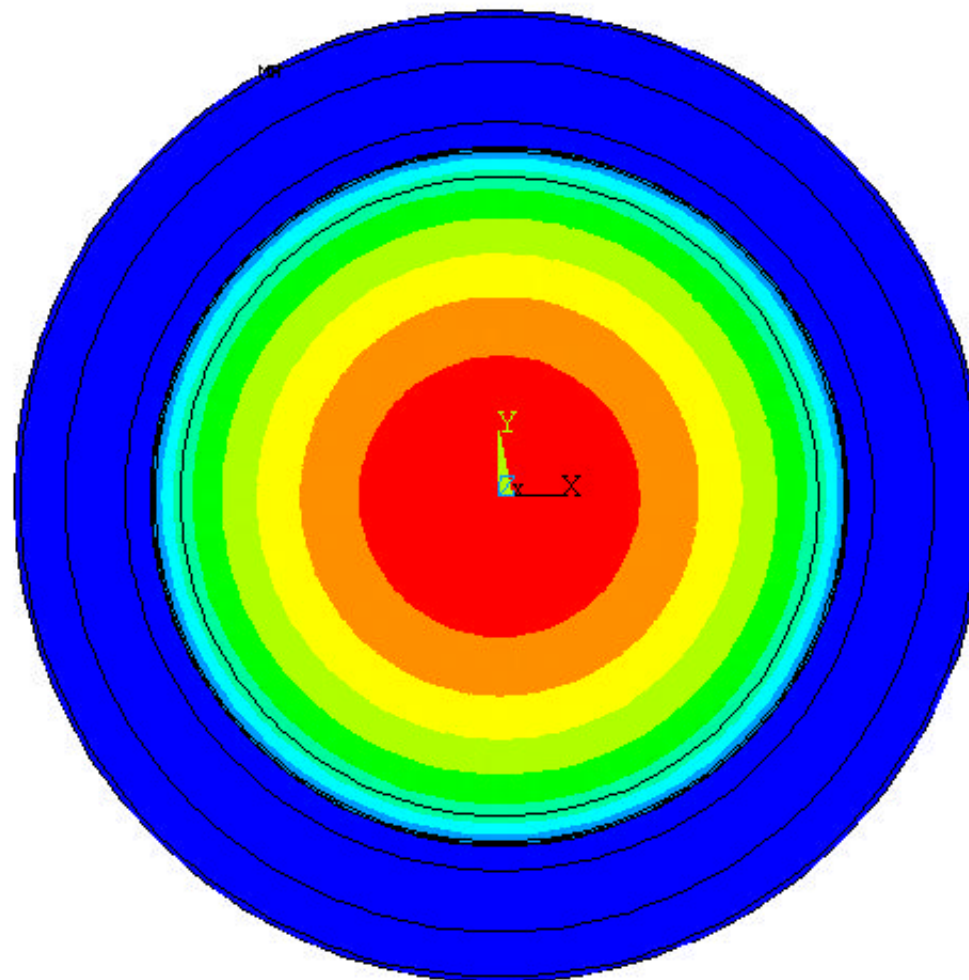


# Normal Condition Temperature Profile

1  
NODAL SOLUTION  
STEP=1  
SUB =1  
TIME=.100E-02  
TEMP (AVG)  
RSYS=0  
SMN =225.902  
SMX =647.543

ANSYS

MAR 15 2002  
09:05:25  
PLOT NO. 1



225.902

272.751

319.6

366.449

413.298

460.147

506.996

553.845

600.694

647.543

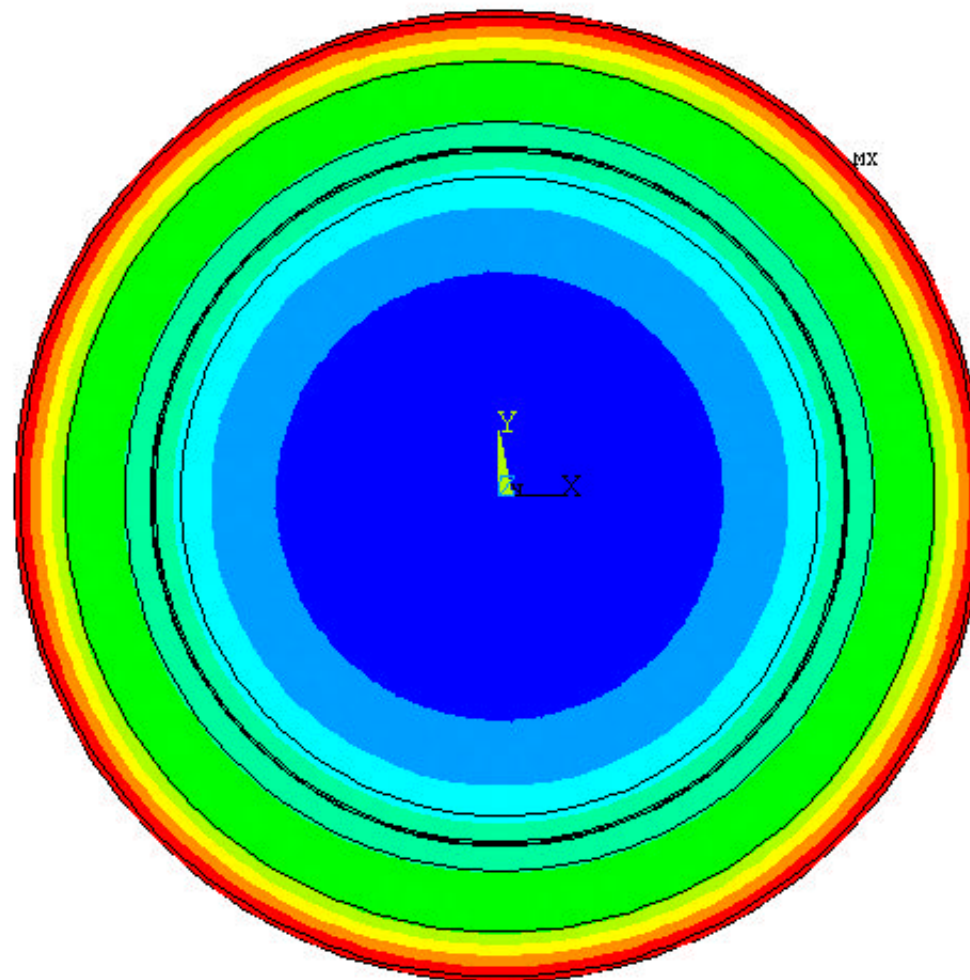
Transport Cask Tunnel Fire Analysis

# 8 Hour Fire Temperature Profile

ANSYS

MAR 15 2002  
11:28:15  
PLOT NO. 1

1  
NODAL SOLUTION  
STEP=2  
SUB =26  
TIME=8.001  
TEMP (AVG)  
RSYS=0  
SMN =724.707  
SMX =1445



724.707

804.688

884.668

964.648

1045

1125

1205

1285

1365

1445

Transport Cask Tunnel Fire Analysis

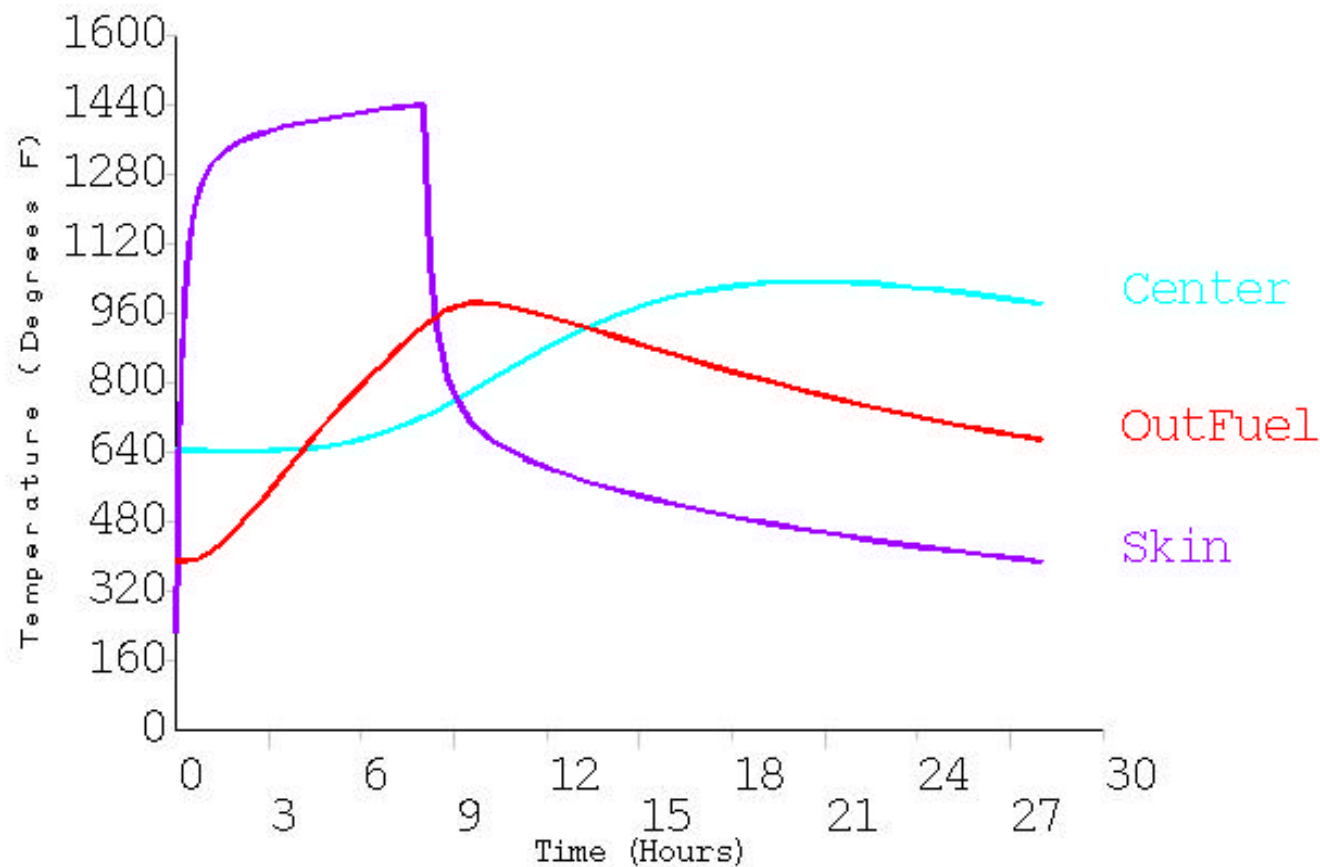
# Cask Component Time vs. Temperature Plot

1

POST26

ANSYS

MAR 15 2002  
09:21:23  
PLOT NO. 1



Transport Cask Tunnel Fire Analysis

# 8 Hour Fire with 20 Hour Cooldown

1

NODAL SOLUTION

STEP=1

SUB =1

TIME=.100E-02

TEMP (AVG)

RSYS=0

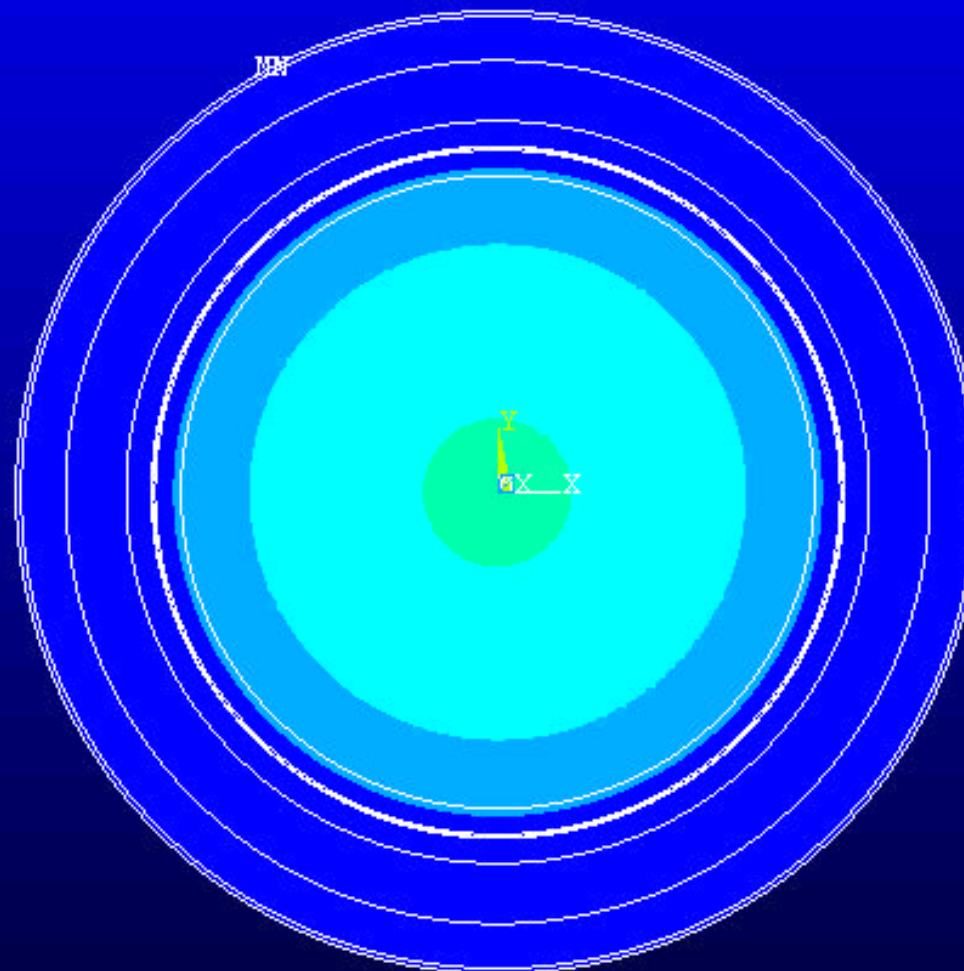
SMN =225.902

SMX =647.543

ANSYS

MAR 15 2002

10:53:50



225.902

361.305

496.708

632.111

767.514

902.917

1038

1174

1309

1445

Transport Cask Tunnel Fire Analysis

# Preliminary Results

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- **Fuel Cladding Temperature Limits**
- **Conservative Assumptions**

# Conclusions and Future Work

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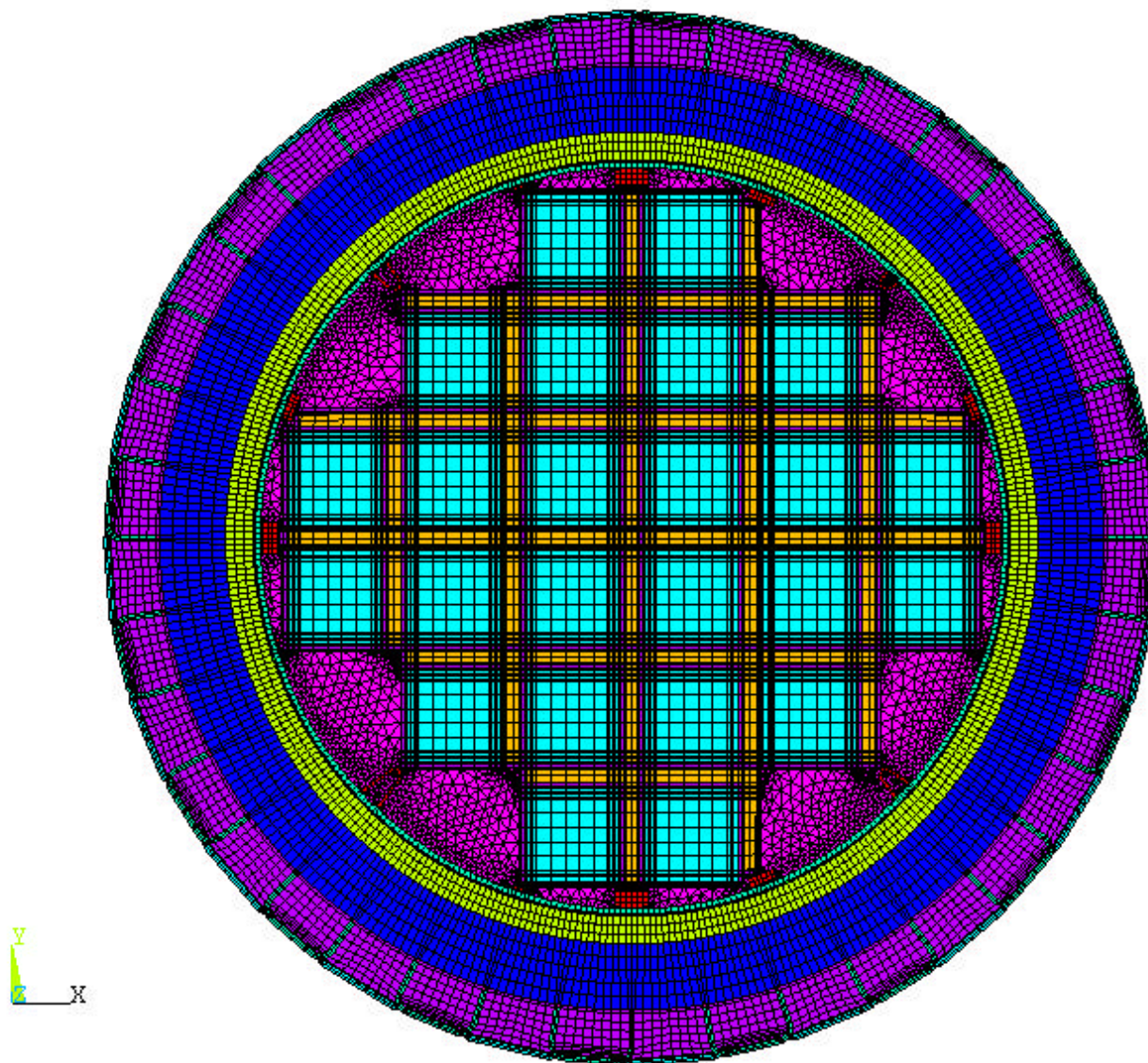
- **Cask Performance**
- **Refined Cask Model**
- **Model Tunnel and Railcar**
- **NIST Tunnel Fire Model**
- **Revise Boundary Conditions**



# Refined Cask Model

1

ANSYS



MPC-24 Thermal Analysis, 4/11/02



# Acknowledgements

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**Pacific Northwest National Labs**