April 27, 2007

MEMORANDUM TO: William H. Ruland, Deputy Director
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

FROM: Meraj Rahimi, Senior Project Manager /RA/
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

SUBJECT: SUMMARY OF APRIL 18, 2007, MEETING WITH ENERGY SOLUTIONS ON THE 3-60B PACKAGE (DOCKET NO. 71-9334, TAC NO. L24068)

On April 18, 2007, the Nuclear Regulatory Commission (NRC) staff and the Energy Solutions representatives held a pre-application meeting to discuss the design of a new Type (B) transportation package which is to replace the 3-55 package. The Certificate of Compliance for the 3-55 transportation package will expire on October 1, 2008. The attendance list and the meeting handouts are provided in Enclosures 1 and 2, respectively.

In the area of structural, Energy Solutions stated that it is planning to demonstrate the integrity of the package under Hypothetical Accident Conditions by analyses only. Energy Solutions is proposing to calculate the impact forces using the CASKDROP computer code. The staff expressed reservations about the lack of physical testings of the impact limiters which are normally performed to determine the impact loads. Energy Solutions stated that the CASKDROP will be benchmarked using the actual tests of other cask designs which had been performed in the past.

In the thermal area, the staff stated that non-uniform heat loading should be also considered in assessing the heat transfer capabilities of the 3-60B package. In addition, damages to the impact limiters and the thermal shield from pin punctures need to be included in the thermal model of the package.

The staff also reminded Energy Solutions about the information on the calculations that should be included in the application per Interim Staff Guidance 21.

No regulatory decisions were made at the meeting.

Docket No. 71-9334
TAC No. L23827

Enclosures: 1. Attendance List
2. Meeting Handout

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SFST r/f Attendees w/att.

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OFC:	SFPO	E	SFPO	E	SFPO	
NAME:	MRahimi		MDeBose		RNelson	
DATE:	4/24/07		4/25/07		4/25/07	

C = COVER E = COVER & ENCLOSURE N = NO COPY OFFICIAL RECORD COPY

Meeting Between Energy Solutions and the Nuclear Regulatory Commission Staff
April 18, 2007

ATTENDANCE LIST

Name	Affiliation	E-Mail
Meraj Rahimi	NRC/NMSS/SFST	mxr2@nrc.gov
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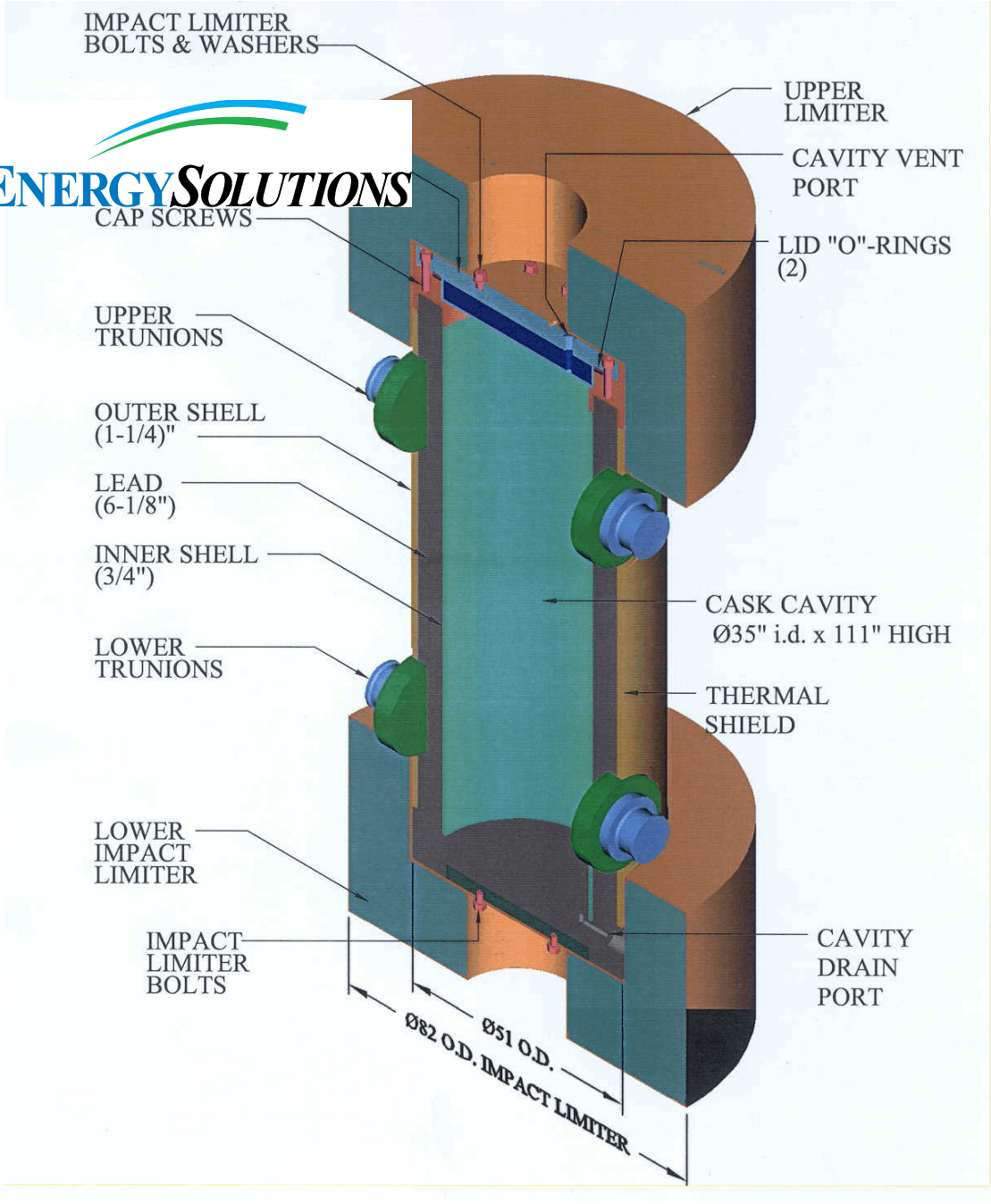
Mark Whittaker	Energy Solutions	mswhittaker@energysolutions.com
Steve Streutker	Transnuclear	steven.streutker@transnuclear.com

Enclosure 1

Enclosure 2

3-60B Cask



Pre-Application
Meeting April 18, 2007

AGENDA

Introduction General

Information

Structural

Evaluation Thermal

Evaluation

Containment

Shielding Evaluation

Criticality

Operations

Acceptance Tests and Maintenance

Schedule

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Introduction

- **Meeting Purpose:**
  Describe contents of SAR (Reg Guide 7.9) Present analysis approach to demonstrate compliance

- **Need - Replacement for 3-55 Cask**

- **Contents - Irradiated hardware; D&D waste**

- **Users - Commercial and Government**

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Chapter One - General Information

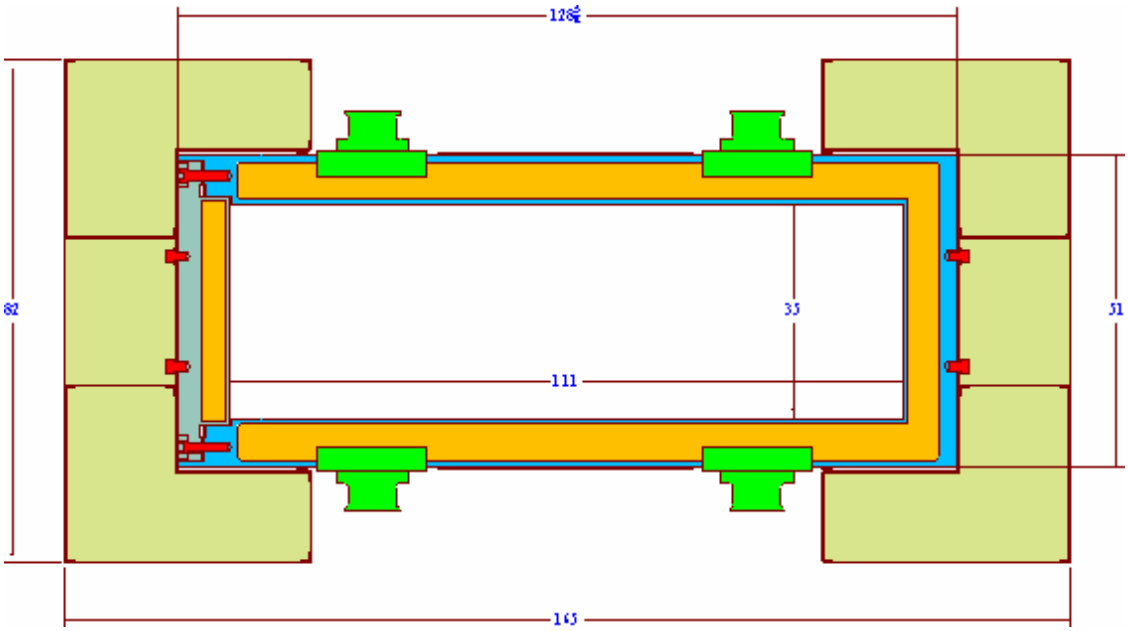
Shielding: Stainless steel and lead
Impact Limiters: Foam filled, toroidally shaped
Overall Length: 128 5/8 inches* Diameter:
51 inches- Not including impact limiters Inside
Cavity Length: 111 inches Inside Cavity
Diameter: 35 inches Gross Weight: 80,000
pounds Maximum Contents Weight: 9,500 pounds

Byproduct, source, or special nuclear material in the form of:

- Irradiated and/or contaminated dewatered solid materials
- Powdered or dispersible solid dewatered material
- Processed solids – solidified or dewatered Dewatered Resin

Maximum Quantity

- Fissile exempt
- 500 watts decay heat
- Category II Limit (Reg Guide 7.11)



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Chapter Two – Structural Evaluation

Lifting & Tie Down Analyses

Lifting components of the cask (trunnions) and the lid (hoist ring) will be designed to meet 10 CFR 71.45 (a)

Tie down arrangement will utilize the trunnions. Therefore, the trunnions will be designed to meet 10W, 5W, and 2W requirement of 10 CFR 71.45(b)

Failure of the lifting and tie down devices will not impair the cask to meet other requirements.

Analyses Features

3-Dimensional ANSYS finite element model will be used in the structural analyses.

Latest FEA technology will be utilized

- **Interface between the steel and lead will utilizes surface-to-surface contact technology.**
- **Transition between fine and course meshes in the model will utilize rigid constraints.**
- **Seamless transfer of temperature between thermal and structural analyses.**

Material properties, used in the analyses will be obtained from credible sources.

- **ASME B&PV Code**
- **NUREG 0481**
- **Cask Designer's Guide**

Temperature dependent material properties will be used in the analyses.

Load Combinations

Load combinations will be performed based on the recommendations of Reg. Guide 7.8

- **Requires that the hot and cold initial conditions be incorporated into various NCT and HAC events.**

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3-60B Cask analyses will incorporate this at the temperaturelevel rather than at the customary stress-level. This will yield more accurate results.

Allowable Stresses

The allowable stresses will be based on the recommendations of Reg. Guide 7.6 which establishes limits on Membrane stresses

- Membrane + Bending stresses

Elaborate finite element analyses also calculate peak stresses. The limits on such stresses will be based on ASME Section III, Division 3, WB-3200 criteria

Free Drop Analyses

Free drop analyses will be performed in two steps.

- Overall system response will be obtained by using Duratek proprietary program CASKDROP, which calculates energy absorbed, maximum deformation and maximum acceleration during a drop event.
- The detailed stress analyses will be performed using ANSYS FEM.

Free drop analyses will be performed for 1-ft and 30-ft drop heights in three orientations – end (top down), side, and, corner-over-C.G.

Shallow angle drops will also been evaluated.

The effect of slap down during the corner drop will be evaluated using a 2-dimensional FEM in which the impact limiter force-deflection data will be explicitly incorporated.

Pin Drop & HAC Fire Analyses

Outer shell & lid thicknesses of the cask satisfy Nelm's equation.

$$treq = (W/Su)0.71$$

3-60B Cask analysis will demonstrate, by a non-linear stress analysis, that the steel-lead wall can absorb the entire kinetic energy without puncture.

The HAC fire stress analysis will be performed using the

temperature obtained from the thermal fire analysis and the cavity pressure obtained from the containment calculations.

Conclusions

The analyses performed for the 3-60B Cask will show that the stresses in the cask under the specified loadings of 10 CFR 71, in all the combinations specified in Reg. Guide 7.8, meet the allowable values per Reg. Guide 7.6 and ASME B&PV Code, Section III, Division 3, as applicable.

Chapter Three – Thermal Evaluation

3-60B Cask Main Features

Stainless Steel – Lead Body
Polyurethane Foam Impact Limiter

- **Provide thermal insulation on the ends**

Fire Shield

- **Provide protection during HAC fire**

500 W (max) Internal Heat Load

Analyses Features

3-Dimensional ANSYS finite element model used in the thermal analyses.
Conduction, convection and radiation between various components of the cask and the environment have been exclusively modeled.
Material properties, used in the analyses have been obtained from credible sources.

- **ASME B&PV Code, CRC Hand Book, Cask Designer's Guide, Text Books**

Load Cases Analyzed

Hot Environment – Steady State
Cold Environment – Steady
State Normal Hot – Steady State
Normal Cold – Steady State
HAC Fire – Transient Analysis

- **Normal Hot Initial State, 30 Minute Pool Fire,Cool Down with Solar Insolation**

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Analyses Results

Include

- **Cask temperature distribution**
- **Temperature time-history during HAC fire**

Thermal analyses results are used for

- **Determining the MNOP**
- **Determining the HAC fire internal pressure**
- **Cask temperature for various load combinations**
- **Cask thermal stresses**

Conclusions

Finite element analyses provide the temperature in 3-60B Cask during all the load cases required to be analyzed per 10 CFR 71.

The maximum temperature of the cask body during normal conditions is less than 185 F to meet 10 CFR 71.43(g) Lead temperature is below its melting point and the seal temperature is within the operating range of the material.

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Chapter Four – Containment

Method for Conducting Periodic Leak Rate Test and Assembly Verification Test

Calculation of Periodic Leak Rate

ANSI N14.5-1997, ªAmerican National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment.º

NUREG/CR-6487, ªContainment Analysis for Type B Packages Used to Transport Various Contents.º

	Max. Volumetric Leak Rate (cm^3/sec)	Max. Hole Diameter (cm)	Reference Leak Rate (ref-cm^3/sec)
Normal Conditions of Trans port, Powdered Solids	$L_{N_PS} = 2.78 \times 10^{-4}$	$D_{max1} = 9.06 \times 10^{-4}$	$L_{R_N_PS} = 1.11 \times 10^{-4}$
Normal Conditions of Trans port, Irradiated Hardware	$L_{N_IH} = 3.19 \times 10^{-6}$	$D_{max2} = 3.06 \times 10^{-4}$	$L_{R_N_IH} = 1.50 \times 10^{-6}$
Hypothetical Accident Conditions, Powdered Solids	$L_{A_PS} = 1.65$	$D_{max3} = 7.55 \times 10^{-3}$	$L_{R_A_PS} = 0.369$

Hypothetical Accident Conditions, Irradiated Hardware	$L_{A_IH} = 2.85 \times 10^{-3}$	$D_{max4} = 1.53 \times 10^{-3}$	$L_{R_A_IH} = 6.74 \times 10^{-4}$

Chapter Five – Shielding

Standardized Computer Analyses for Licensing Evaluation

	Total Dose Rate (mrem/hr)						
	Package Surface		1 m from Surface		2 m from Vehicle*		Occupied Area
Condition	Side	Top/Bottom	Side	Top/Bottom	Side	Top/Bottom	[~6m]
NCT							
Calculated	60.9	36.1/14.1	N.A.	N.A.	8.1	3.4/1.6	0.33
Allowable	200	200	N.A.	N.A.	10	10	2
HAC							
Calculated	N.A.	N.A.	104	19.6/7.7	N.A.	N.A.	N.A.

Allowable	N.A.	N.A.	1000	1000	N.A.	N.A.	N.A.

Chapter 6 - Criticality

No more than exempt quantities of fissile materials will be permitted as contents.

Chapter 7 - Operating Procedures

Loading

- **Preparation for Loading**
  - **Cask Inspection**
  - **Lid Removal and Seal Inspection**
- **Loading of Contents**
  - **Load Secondary**
  - **Container Replace Lid**
  - **Drain Cavity**
- **Preparation for Transport**
  - **Leak Test**
  - **Surveys**

Unloading

- **Package Receipt**
  - **Surveys**
  - **Controls and Precautions**
- **Removal of Contents**
  - **Remove Lid**
  - **Engage Liner and Remove**
  - **Inspect Seals and Replace Lid**

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Chapter 8 - Acceptance Tests/Maintenance Programs

Acceptance Tests

- **Visual examination of entire cask**
- **Containment boundary welds inspected per ASME B&PV Code, Sec. III, Subsection ND-5000 (Category II).**
- **Non-containment boundary welds inspected per ASME B&PV Code, Section III, Subsection NF-5000 (Category II)**
- **Load tests of lifting trunnions and other lifting attachments**
- **Fabrication leak test of lid and other ports to meet LR_N_IH = 1.50 x 10-6 ref cm3/sec**
- **Shielding integrity (gamma scan)**
- **Pressure test of containment boundary at 1.5 x MNOP**

Maintenance

- **Structural and Pressure Tests**
  - **No periodic structural or pressure tests**
  - **Annual Inspection**
- **Leakage Tests**
  - **Periodic**
  - **Assembly**
- **Component and Material Tests**
  - **No periodic material tests**
- **Thermal Tests**
  - **No periodic thermal tests**

Schedule

July 2007 – submit SAR

December 2007 – RAI issued ?

December 2007 – start fabrication of first unit

April 2008 – CoC granted October 2008 – 3-55

CoC expires December 2008 – target date for

first unit

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