LANS 380-B Type B Shielded Package for Sources:

Test Plan Review

AREVA Federal Services LLC

under contract to

Los Alamos National Security, LLC

AREVA

Agenda

- Introductions
- Review of 380-B packaging
- Presentation and discussion of Test Plan
- NRC feedback
- Project schedule update

LANS 380-B Packaging - General

- The LANS 380-B is a leak-tight, lead shielded transport cask
- Will be used to safely transport disused radioactive sealed sources to facilitate recovery and management efforts for global threat reduction
- Sources are located within medical, industrial, or research devices
- No reliance will be placed on source device integrity
- Sources are gamma- or beta-producing, non-fissile

AREVA

Package Design Summary

- Type B(U)-96
- Heavy lead shielding
- Leaktight containment (<1.0 × 10^{-7} std-cc/sec, air) for both NCT and HAC
- For transport by truck, rail, ship, and air
- Weight:
  - 120,000 lb total conveyance maximum (highway truck case)
  - 67,000 lb licensed package maximum weight
  - 12,000 lb payload + internal dunnage

AREVA

Payloads

- Payloads will consist of radioactive sources contained in shielded medical, industrial, or research devices.
- Devices consist of a source exposure mechanism and a thick shield.
- Activity is gamma or beta only, governing activity is 7,500 Ci of Co-60
- Maximum decay heat is 205W.
- Maximum device weight is 10,000 lb.
- Devices will be blocked within the cask with dunnage.

AREVA

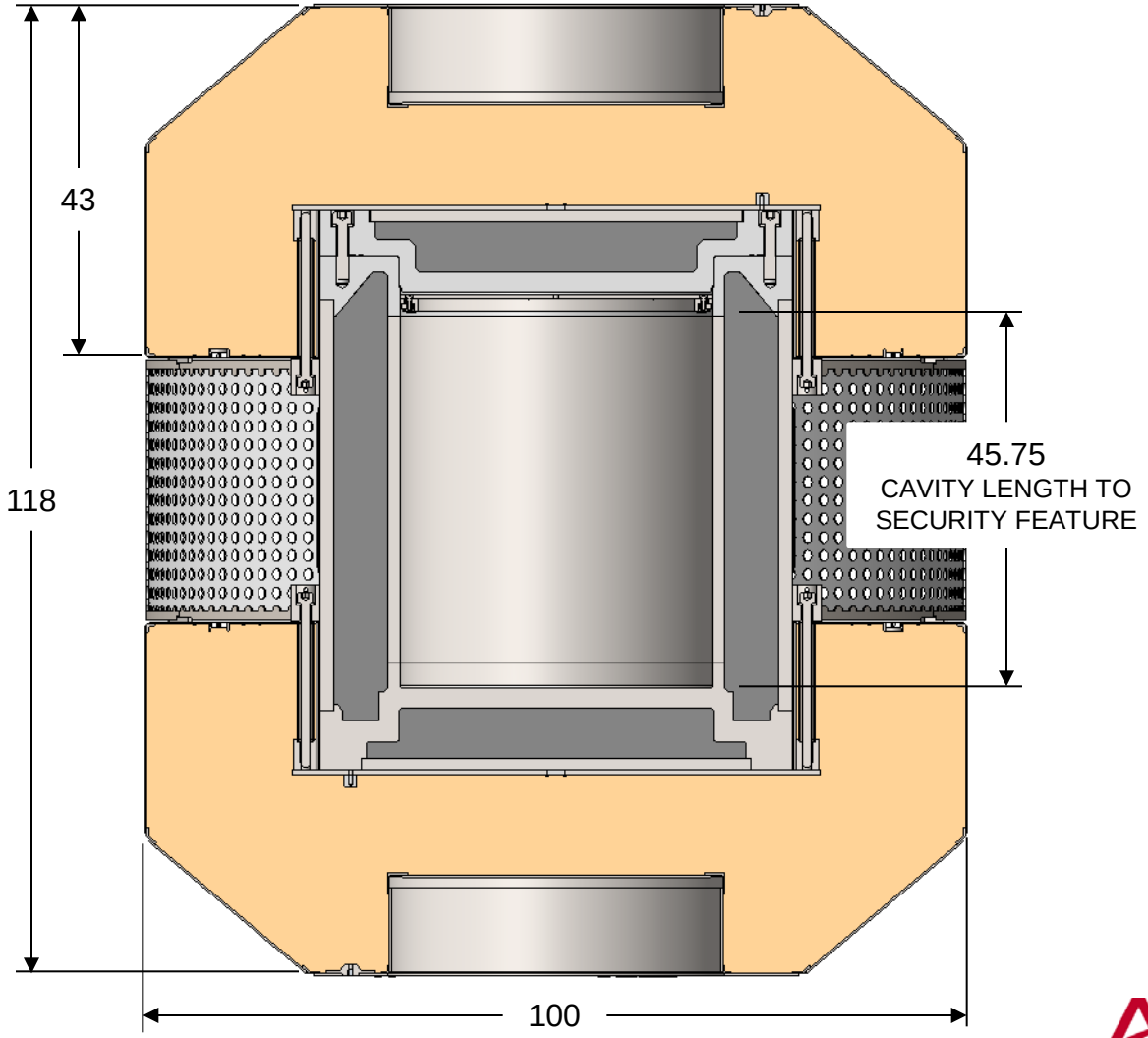
Payloads

- The 380-B cask does not rely on the payload device for shielding or containment
  - The shielding analysis assumes a point source in any location within the package
- Consequently, the 380-B package can be used for devices where the integrity of the device shielding or exposure mechanism is not known or is suspect
- There is no need to consider the integrity of the device shielding or of the mechanism when considering the effects of free drop or puncture
- The 380-B can transport any device that meets the isotopic, activity, wattage, size, and weight limits

AREVA

LANS 380-B Packaging Description

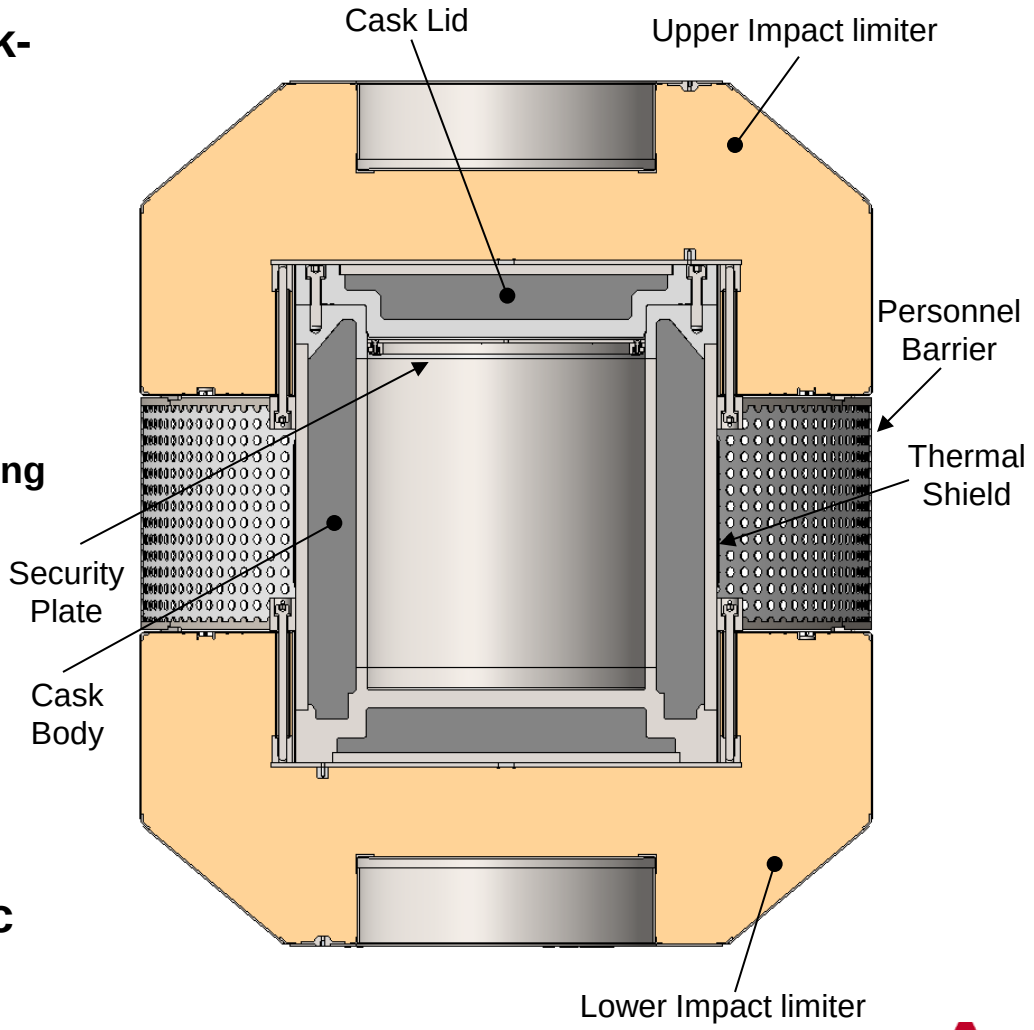
- Overall height, 118 inches
- Overall diameter, 100 inches at impact limiters
- Cask outer diameter, 57½ inches
- Thin gauge thermal shield covers area between impact limiters and lugs



AREVA

LANS 380-B Packaging Description

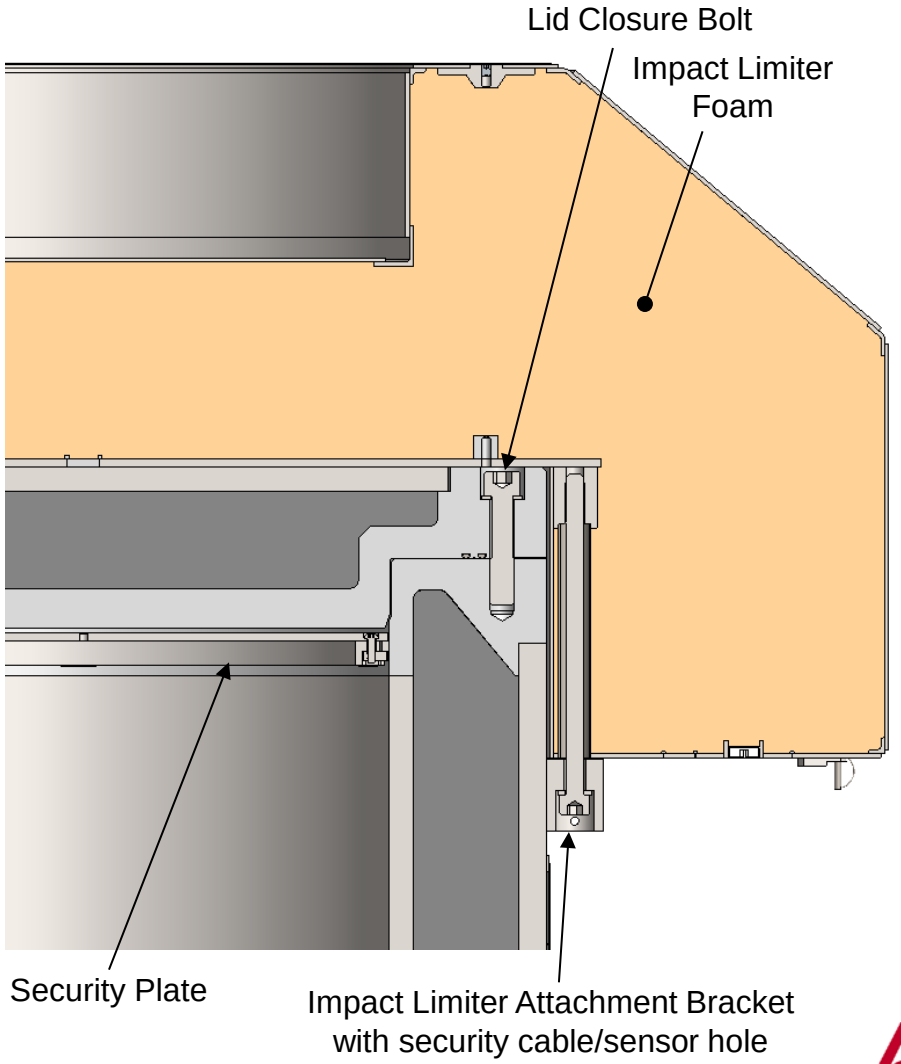
- **Lead shielded cask with leak-tight containment boundary**
- **Bolted closure lid**
- **Cavity dimensions**
  - **Inner diameter 38.0 inches**
  - **Minimum opening 37.0 inches**
  - **Height to lid 48.13 inches**
  - **Height to security plate mounting hardware 45.75 inches**
- **Component thicknesses**
  - **1 ¾ inch outer shell**
  - **1 ½ inch inner shell**
  - **2 ½ inch cavity end plates**
  - **1 ½ inch outer cover plates**
  - **6 inch lead shielding**
- **Material: Type 304 austenitic stainless steel and lead**



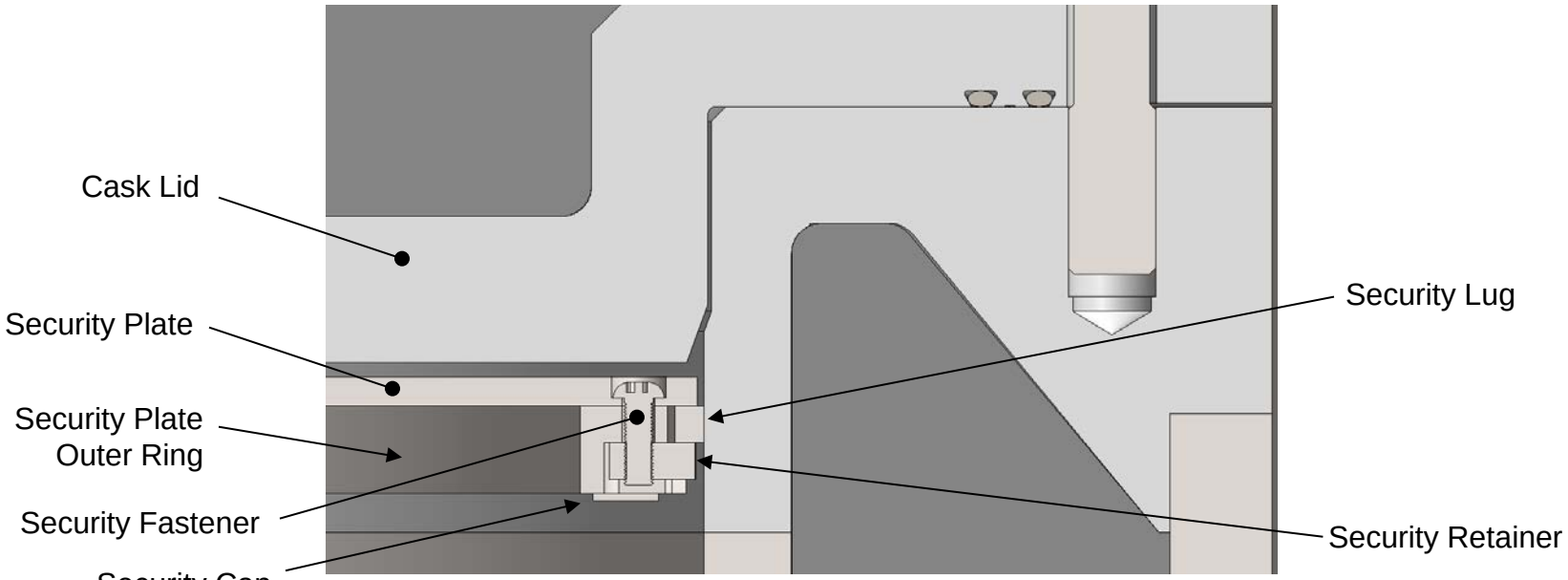
AREVA

LANS 380-B Packaging Description

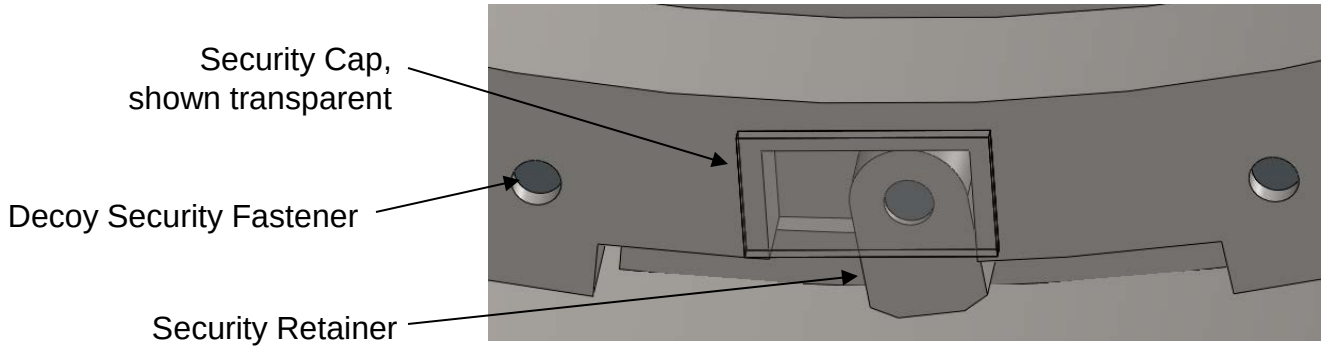
- **Thick section lid flange with lead shielding material and outer cover plate.**
- **36, 1-1/2 inch diameter closure bolts made from ASTM A564 Type 630, Condition H1100**
- **Internal security plate**
  - **½ inch thick type 304**
  - **1 ½ inch thick outer ring for mounting and shielding exclusion zone**
- **Impact limiter lugs have ½ inch holes for security cables/sensors**



LANS 380-B Packaging Description



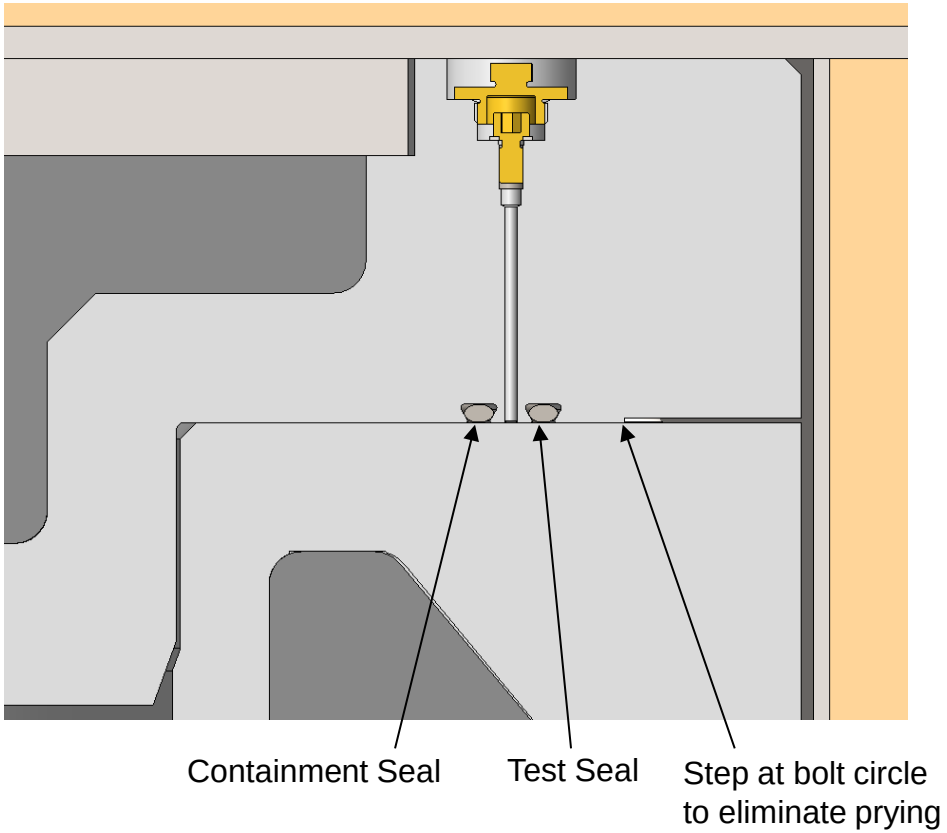
Security Plate



Security Plate Attachment Hardware

LANS 380-B Packaging Description

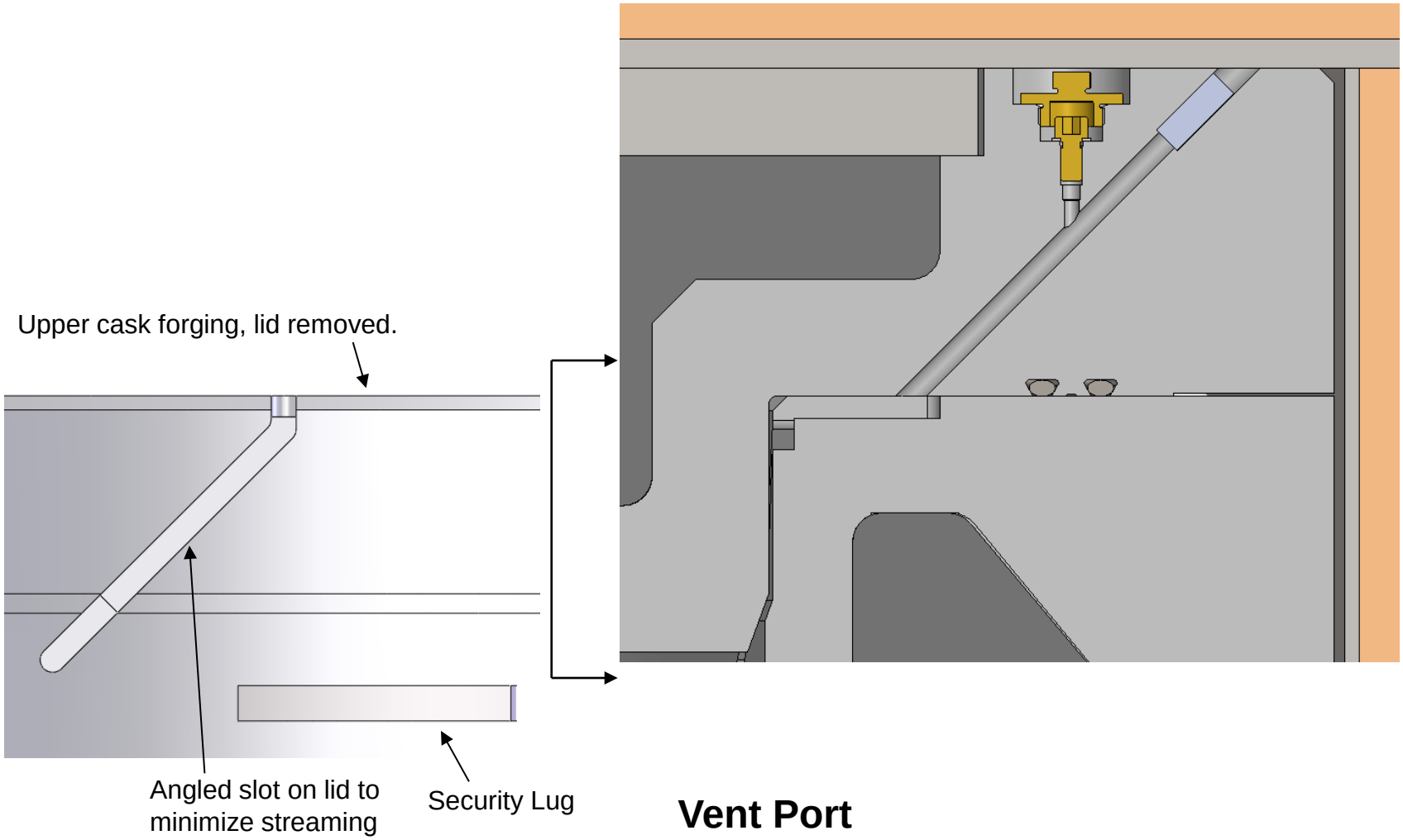
- Containment seal and test seal ⅜-inch diameter butyl rubber on flange face
- Seal material made from Rainier Rubber R-0405-70
- Bolt circle step to relieve bolt prying
- Vent port and seal test port located inboard of bolt circle, with brass covers, brass port plugs, and sealing washers using same butyl elastomer



Seal Test Port

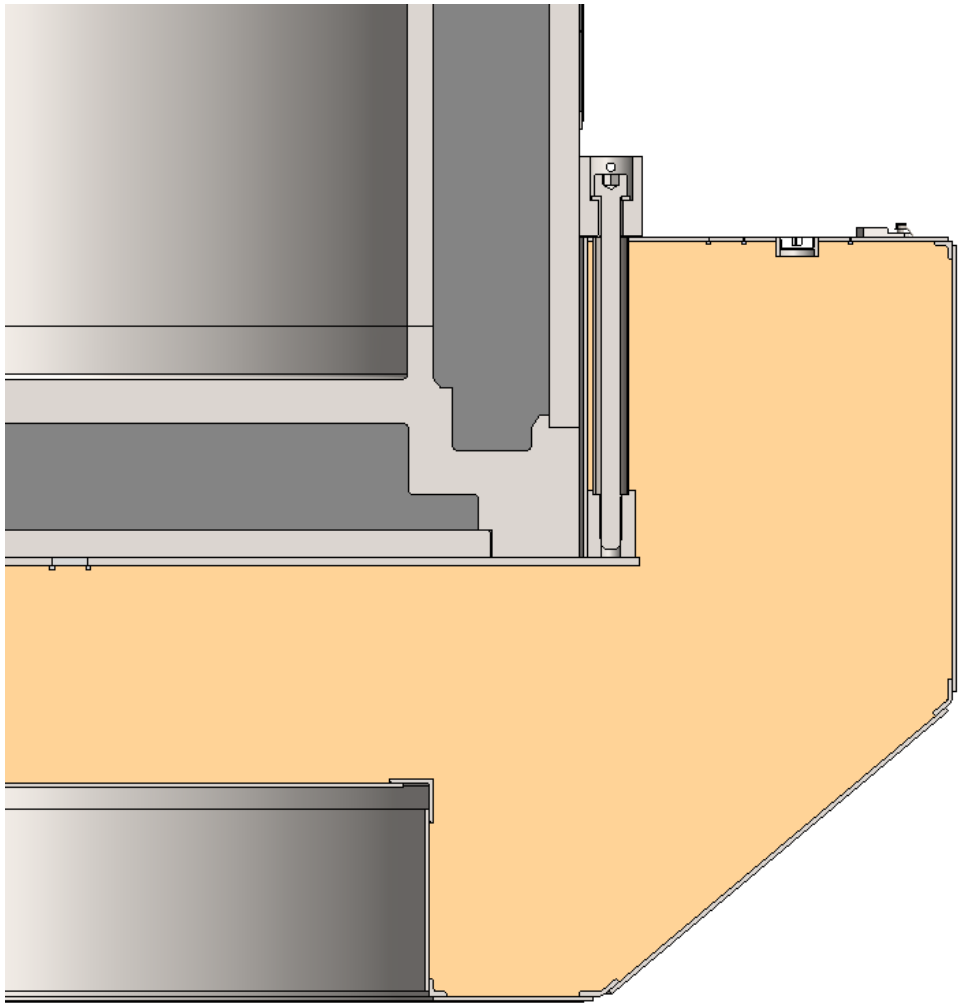
AREVA

LANS 380-B Packaging Description



LANS 380-B Packaging Description

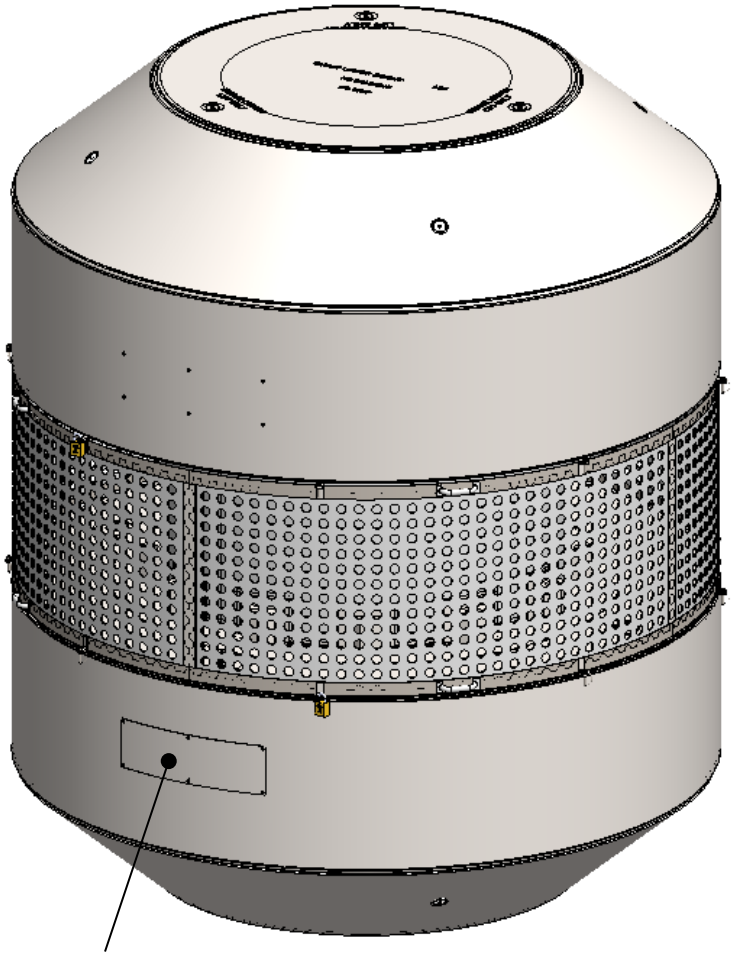
- **Base forging, plate, or casting with lead shielding material and outer cover plate**
- **Complete joint penetration welds to inner and outer shells**



AREVA

LANS 380-B Packaging Description

- Impact limiters protect from direct impact and provide fire protection
- Polyurethane foam, approx. 16 lb/ft^3
- IL shell is ¼ inch thick
- 12, 1 ¼ inch diameter impact limiter attachment bolts, made from ASTM A564 Type 630, Condition H1100
- Personnel barrier between limiters at limiter OD
- Nameplate attached by screws to impact limiter OD
  - Permits changeover to foreign nameplate for use outside US under foreign certificate



AREVA

Licensing Strategy

- Safety demonstration primarily by analysis, including thermal
- Impact limiter performance will be demonstrated by half-scale test of production design, including production attachments
- Test cask will be an equivalent weight dummy
- Active accelerometers will be used for free drops
- Free drops at both cold and warm extremes will be included
- NCT free drops will not be tested
  - NCT drop energy is only 3.3% of HAC energy for 1-ft free drop
  - NCT impact magnitude determined by analysis
- LS-DYNA® calculations used to determine worst-case orientations and behavior at other foam temperatures

AREVA

Certification Test

- **Certification testing will be used to:**
  - **Demonstrate the performance of the impact limiters and attachments**
  - **Confirm LS-DYNA® predictions of impact acceleration and crush deformation are bounding**
- **Test unit will consist of a half scale dummy cask with half scale impact limiters and attachments with complete fidelity to production design**
- **Tests will consist of free drops and punctures**
  - **Free drop height = 30 ft onto unyielding surface**
  - **Puncture drop height = 40 inches onto a half scale puncture bar**
- **Test results will be scaled to full-scale equivalent for subsequent analysis**
  - **Full scale acceleration = half scale acceleration divided by 2**
  - **Full scale deformation = half scale deformation multiplied by 2**

AREVA

Certification Test

- **Tests will satisfy the drop-puncture order requirements of both 10 CFR 71 as well as TS-R-1**
  - **Sufficient tests using free drop followed by puncture will be performed to demonstrate effectiveness for 10 CFR 71**
  - **Some test sequences will satisfy both 10 CFR 71 and TS-R-1 utilizing a free drop followed by puncture**
  - **An added test using puncture followed by free drop will be performed to address TS-R-1**
  - **SAR will explain in detail the logic used in each case**
  - **It is understood that the NRC CoC will not mention TS-R-1**

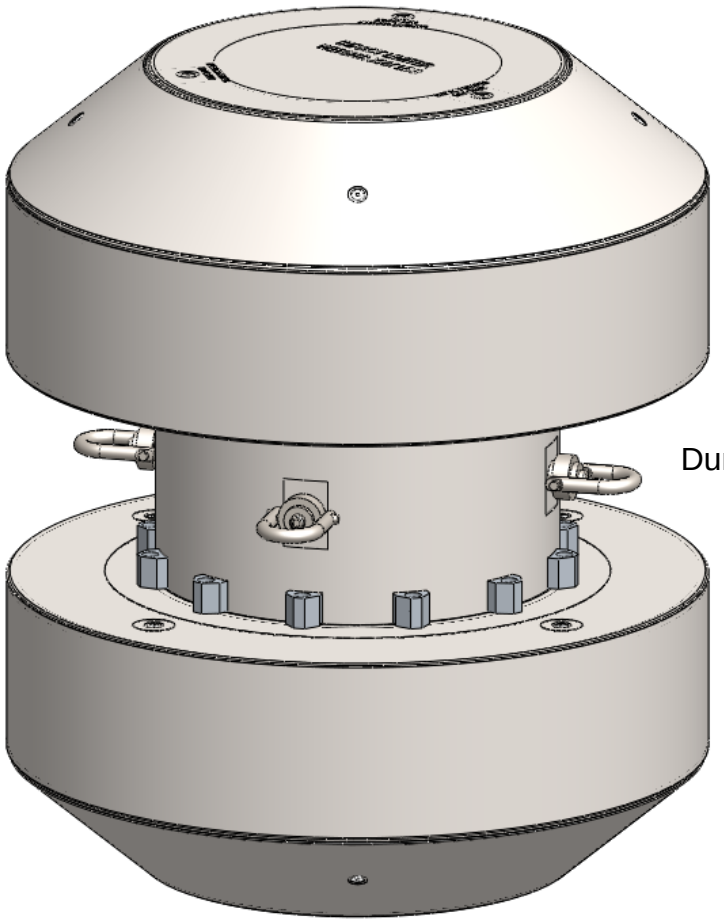
AREVA

Certification Test

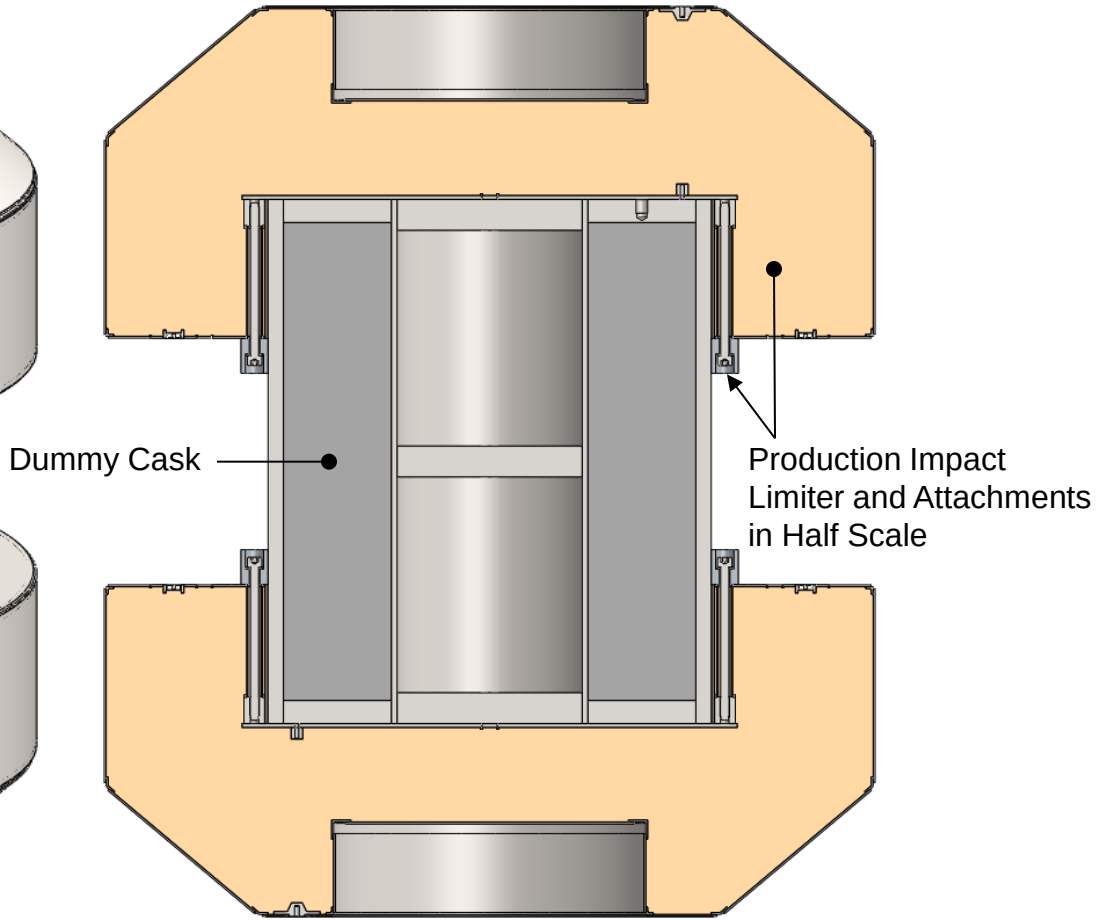
- **Test cask configuration:**
  - Test cask will be an equivalent weight dummy
  - Envelope dimensions will be one-half of the full scale cask
  - Weight will be 1/8 that of the full scale cask
  - Impact limiter attachments will model the size and strength of the full scale attachments
  - Will mount active accelerometers and provide lifting attachments
- **Test impact limiter configuration:**
  - All construction details will be essentially identical to production limiters, except for half scale
  - Any differences to production components will be listed and justified in SAR
  - Polyurethane foam density will be adjusted to facilitate temperature extremes (see next slides)

AREVA

Certification Test



Half Scale Test Unit



Half Scale Test Unit Cross Section

AREVA

Certification Test

- Cold free drop tests will consider TS-R-1 requirement of -40 ºF
- Obtaining foam temperature of -40 ºF at test site is difficult and dangerous
  - Tests expected to occur in summer
  - Extreme cold presents hazards to personnel
- To facilitate the cold test, the polyurethane foam density is adjusted upward by 1 lb/ft^3 and foam is cooled to 0 ºF
- Behavior of 17 lb/ft^3 foam at 0 ºF is essentially identical to behavior of production (16 lb/ft^3) foam at -40 ºF
- Comparison plot to follow…

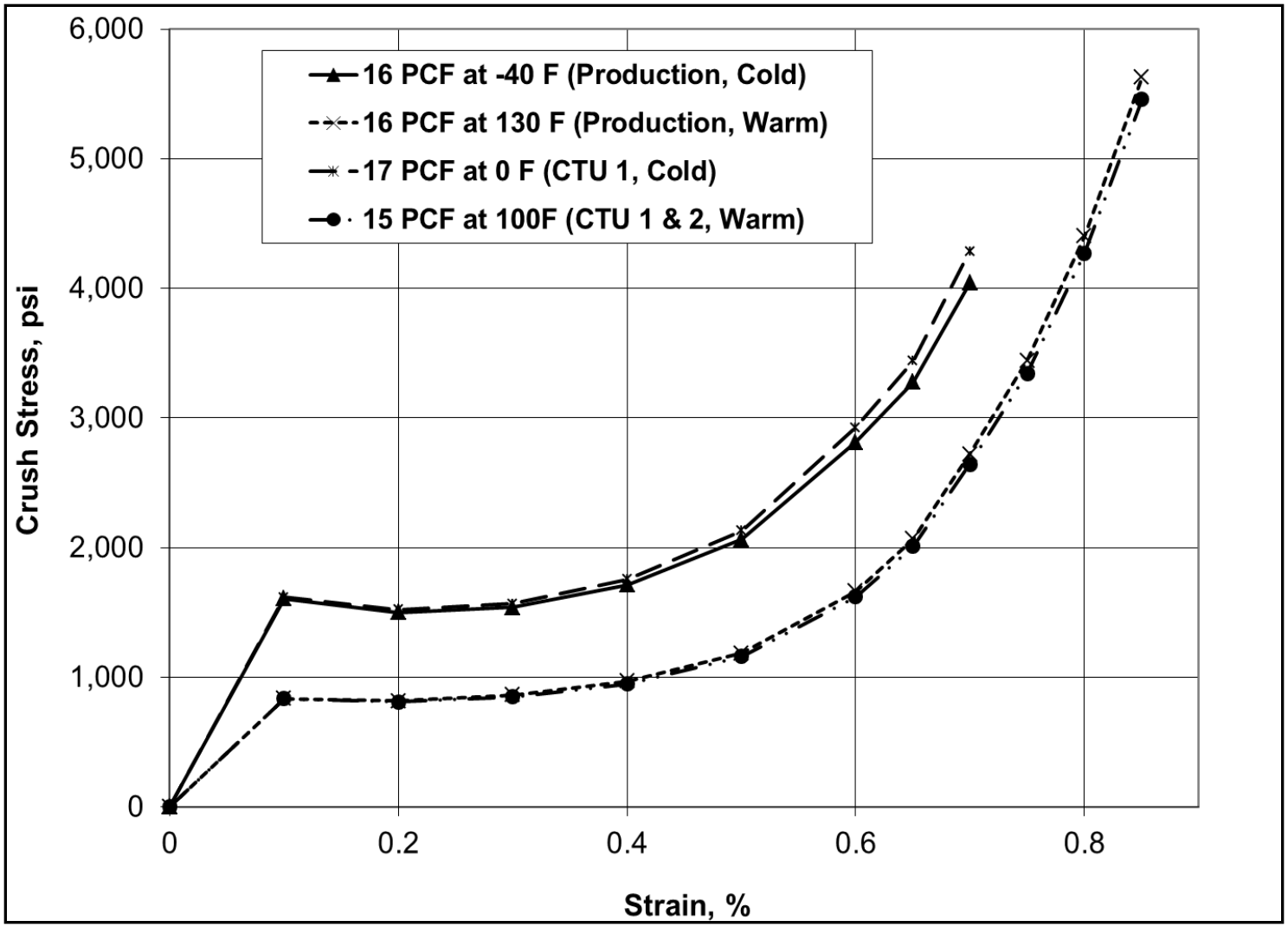
AREVA

Certification Test

- Warm free drop tests must consider the NCT warm case foam temperature of 130 ºF
- Obtaining foam temperature of 130 ºF at test site is difficult and presents burn hazards to personnel
- To facilitate the warm test, the polyurethane foam density is adjusted downward by 1 lb/ft^3 and foam is heated to 100 ºF
- Behavior of 15 lb/ft^3 foam at 100 ºF is essentially identical to behavior of production (16 lb/ft^3) foam at 130 ºF
- See plot

AREVA

Certification Test



AREVA

Certification Test – Free Drop

- **Free drop orientations will include maximum impact and maximum crush deformation**
- **Due to compact proportions (overall length 118 inches long and 100 inches in diameter), slapdown phenomenon will not be important and slapdown orientations will not be performed**
- **Free drop tests will be performed in three orientations:**
  - **Vertical end. Performed with cold foam, provides maximum impact for critical stress analyses**
  - **Center of gravity over cask corner. Performed with warm foam, provides maximum crush deformation to demonstrate no "hard contact"**
  - **Horizontal side. Performed with warm foam, provides maximum crush deformation to demonstrate no "hard contact"**

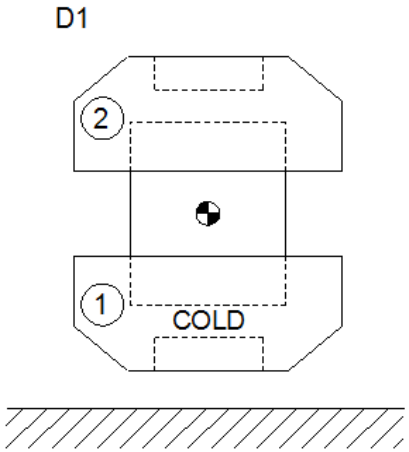
AREVA

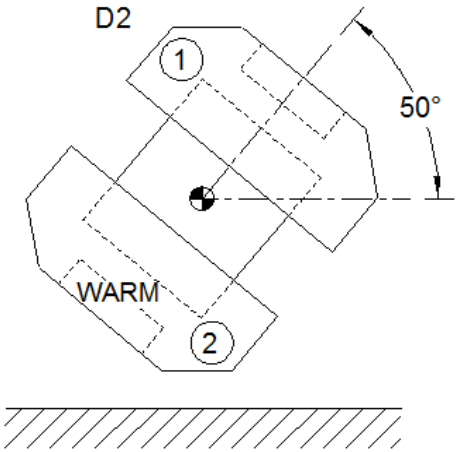
Certification Test – Free Drop

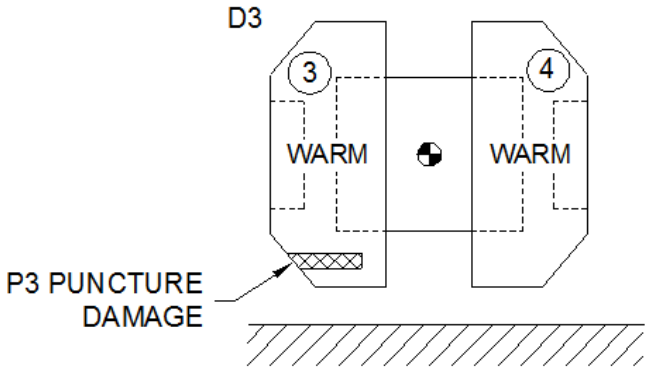
- Horizontal side drop combines both Part 71 puncture order test (on impact limiter at one end) with TS-R-1 puncture order test (on opposite end)
- Prior to free drop, test unit will be subject to a quasi-axial orientation puncture impact on one end (discussed later)
- Side drop will be performed with puncture damage down
- Free drop impact results on puncture tested limiter will address TS-R-1 order requirements
- Free drop impact results on non-puncture tested limiter will be followed by puncture (discussed later) and will address Part 71 requirements

AREVA

Certification Test – Free Drop







Free drop orientation summary

AREVA

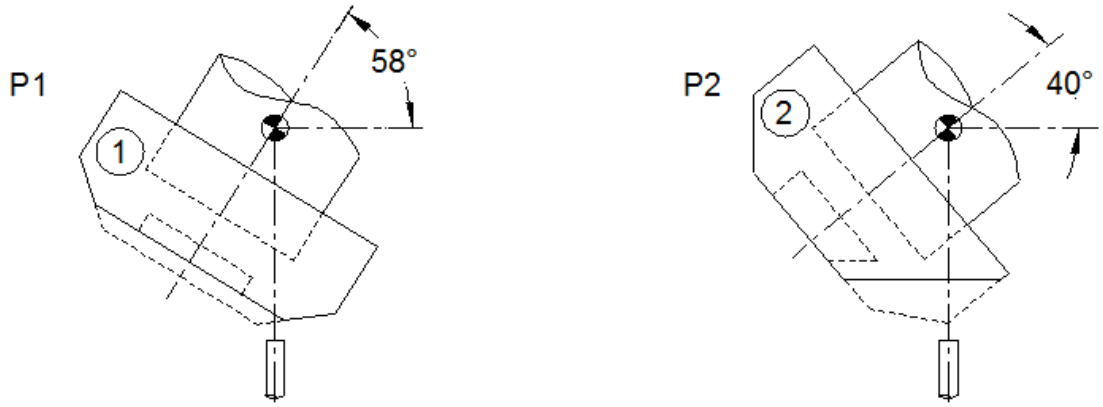
Certification Test – Puncture Drop

- Puncture drop tests will utilize a half scale bar: 3-inch OD, end radius of 1/8-inch maximum
- Except for the TS-R-1 puncture test, all punctures will occur on prior free drop damage
- Predicted free drop damage has been evaluated to determine the worst-case puncture drop that could be applied
- Puncture tests will occur at the prevailing temperature of the shell and foam
- Due to the weight of the cask and thickness of the limiter shell, perforation of the shell is expected in most cases
- Due to the weight of the cask, bending of the bar may occur

AREVA

Certification Test – Puncture Drop

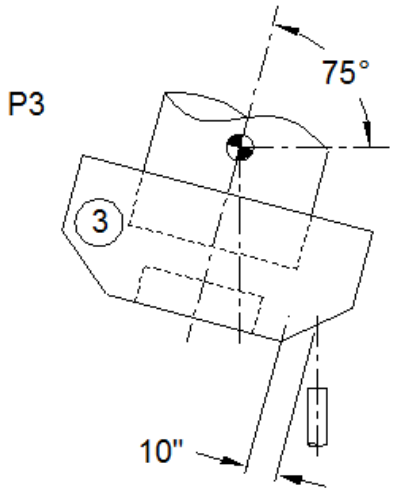
- **Puncture drops will be performed in four orientations:**
  - **Oblique on end through package c.g., on vertical free drop damage. Aligns approximately with vent port location on cask lid. Creates worst case damage around vent port for thermal analysis. (P1)**
  - **Oblique on c.g.-over-corner free drop damage. Creates worst case damage around main lid seal for thermal analysis. (P2)**

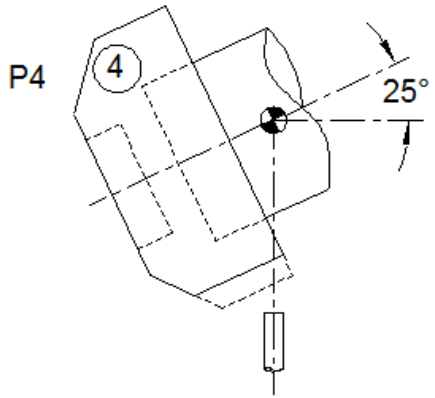


AREVA

Certification Test – Puncture Drop

- **Quasi-axial on impact limiter tapered surface prior to horizontal side free drop. Could cause excessive crush deformation in subsequent free drop. Applicable to future TS-R-1 licensing only. (P3)**
- **Oblique on side free drop damage (on limiter not punctured prior to free drop). Could damage impact limiter shell joint and expose excessive amount of foam to HAC fire. (P4)**





AREVA

Acceptance Criteria

- Damage relevant to thermal performance in the HAC fire shall be bounded by thermal analysis assumptions
- Hard contact shall not occur due to impact limiter “lockup”
- Maximum measured impact shall be bounded by the structural analysis assumptions
- Impact limiter attachments shall retain sufficient integrity to ensure limiters are retained on the cask

AREVA

Planned Project Schedule
(Calendar Year Basis)

- **Half scale certification tests – 3rd Quarter 2014**
  - **NRC Staff is invited to attend tests (most likely Richland, WA)**
- **NNSA application review – approx. 1st Quarter 2015**
- **Licensing application submittal to NRC – approx. 3rd Quarter 2015**
- **RAIs – by approx. 1st Quarter 2016**
- **CoC – by approx. mid 2016**

AREVA

Conclusion

- **NRC Staff Comments and Suggestions**

AREVA