Contract No:

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Development of a Cost-Effective Type B Tritium Package

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Project Statement

Project Statement:

- The United States Department of Energy (DOE) has continuing programmatic needs for a radioactive material (Type B) shipping package that is inexpensive enough to justify one-time use and disposal.
- Savannah River National Laboratory (SRNL) is developing a Type B(U) shipping package, designated the X3, for the transport of tritium waste to meet these programmatic needs.

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Objective

- The objective of this new tritium package design is to develop a large tritium containment system that can be utilized principally as a tritium waste/disposal container, but also a reusable shipping package.
- The new tritium package design focuses on maximizing the containment vessel size for tritium components while maintaining a package foot-print of a 55-gallon (208 L) drum. Further, automated packaging fabrication techniques based on existing certified designs are considered to reduce package manufacturing costs. The new package design will be authorized for the transport of Type A and Type B quantities of tritium.

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X3 Shipping Package Project Outline

- Definition of Requirements for the X3
- Comply with Applicable Regulations, Orders and Guides
  - US DOE Orders, U.S. Nuclear Regulatory Commission (NRC) Regulations
- Perform Design, Analysis and Testing
  - Conduct Design Reviews and User Meetings
  - Design Based on Finite Element Modeling and validated by,
  - Normal Conditions of Transport (NCT); Hypothetical Accident Condition (HAC) and Component Testing
- Prepare Safety Documents for Package Certification
  - Safety Analysis Report for Packaging (SARP)
  - Engineering Evaluations and Test Reports
- Utilize cost-effective manufacturing processes

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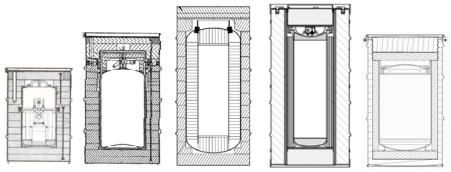
Tritium Packaging Designs – Type B



LP-12-1	LP-50	UC-609	BTSP-1	X3
~30gal (113 L)	>55gal (208 L)	85gal (321 L)	85gal (321 L)	55gal (208 L)
		GW: 500 lbs (227 kg) Payload: 120 lbs (54 kg)	GW: 650 lbs (295 kg) Payload: 120 lbs (54 kg)	

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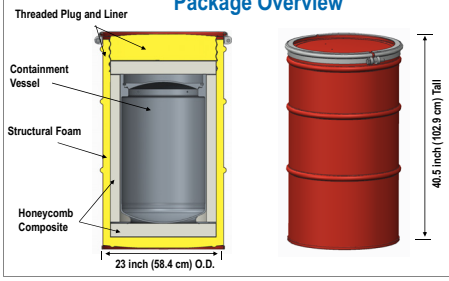
Package Overview



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Containment Vessel Overview

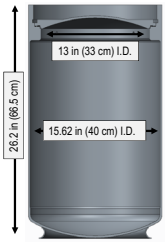
Fabrication Materials

CV Flange & Closure Device
- Commercial Sch. 160 piping

CV Lid
- Stainless Steel Plate

CV Body
- Commercial Sch. 10s piping for vessel wall
- Commercial ASME F&D Tank Head

Leak Test Port
- Fittings are modified commercial parts



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Containment Vessel Design

- Design has been optimized to reduce material costs and maximize internal volume.
- Containment vessel is fabricated from commercially sized pipe and tank components.
- Leak test port fittings are modified commercial components.
- Containment vessel closure is a bolt-less design with a simple go/no-go style locking device.
- Eliminating bolts reduces expenses from calibrated instruments (e.g. torque wrenches) and assembly time.

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Package Structural Insulation

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Materials Testing

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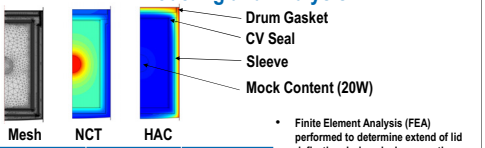
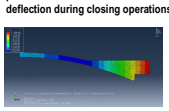
Modeling and Analysis



Component	Maximum Temperature NCT	Maximum Temperature HAC
Drum Surface	153.3 °F (67.3°C)	1473 °F (800.6°C)
Drum Gasket	143.3 °F (61.8°C)	1457 °F (791.7°C)
Drum Liner	150.3 °F (65.7°C)	1456 °F (791.1°C)
Foam, Cover	153.3 °F (67.3°C)	1462 °F (794.4°C)
Crush Insulating Sleeve	181.1 °F (82.8°C)	1213 °F (656.1°C)
CV Seal	180.8 °F (82.7°C)	188 °F (86.7°C)
Contents	240.3 °F (115.7°C)	240 °F (115.6°C)

- Finite Element Analysis (FEA) performed to determine extend of lid deflection during closing operations.



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Evaluation of Manufacturing Processes

- Several manufacturing processes were evaluated for fabricating the helical closure
  - Rolling
  - Stamping
  - Additive Manufacturing
  - Hydroforming
  - Explosive Forming
  - Machining

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Evaluation of Manufacturing Processes

Fabrication Method	Setup Expenses	Production Expenses	Component Precision
Rolling	Low	Low	Low
Stamping	Med	Low	High
Additive Mfg	Low	Med	Med
Hydroforming	High	High	High
Explosive Forming	High	Med	High
Machining	Low	High	High

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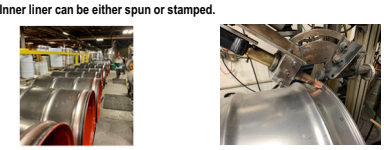
Prototype Fabrication - Automation

- Outer drum is a commercially available 55-gallon (208 L) drum.
- Resistance welding, rolling, and lock seaming are entirely automated processes.
- Non-automated processes such as stud welding and GTAW are optimized for efficiency using specialized tool & jigs.
- Inner liner can be either spun or stamped.



Fabrication photos courtesy of Skolnik Industries and Paragon D&E.

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Prototype Fabrication - Automation

Fabrication photos courtesy of Skolnik Industries and Paragon D&E.

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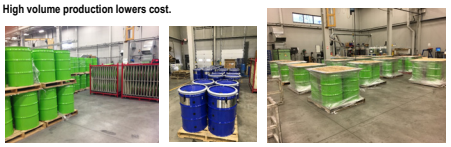
Conclusion

- Producing a cost-effective Type B(U) tritium shipping package is feasible.
- The utilization of standard and commercially available construction materials reduces cost of the containment vessel.
- Outer packaging fabrication is largely automated and optimized for high volume production.
- Similar packagings (e.g. 9979 Type AF) are routinely fabricated in quantities exceeding 1000/yr.
- High volume production lowers cost.



Fabrication photos courtesy of Skolnik Industries and Paragon D&E.

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