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National Nuclear Security Administration

Development of the 435-B(U) Packaging for Radioactive Source Recoveries in International Locations

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Introduction

- The Off-Site Source Recovery Program (OSRP)
- History and Background of 435-B
  - Design and Development
  - Testing
  - Manufacturing
  - Operations

OFF-SITE SOURCE RECOVERY PROGRAM
NATIONAL SECURITY THROUGH SOURCE REMOVAL

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OSRP Mission and Accomplishments

Mission: Recover excess, unwanted, abandoned, and orphaned radioactive sealed sources in the interest of global security and public health/safety

- OSRP has contributed to national and global security by removing more than 43,000 radioactive sources, totaling over 1.3 million curies *(49,776 TBq)* of material.
- OSRP has removed sources from 27 countries worldwide.

Isotope	Sources Recovered	TBq Recovered
^{60}Co	6,741	12,614
^{90}Sr	303	23,701
^{137}Cs	5,397	12,163
^{238}Pu	2,528	587
^{239}Pu	1,185	49
^{241}Am	24,551	648
All Others	2,988	14
TOTALS	**43,693**	**49,776**

OSRP is sponsored by the NNSA Office of Radiological Security (ORS), NA-212

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Cat 1 and 2 Devices Commonly Recovered by OSRP

Self-shielded irradiators, primarily Cs-137 and Co-60, 4.81 TBq to 148 TBq decayed

High-Activity Beta/Gamma Devices

Gammacell 1000

Isotope: Cs137

Max. Activity: 120 TBq

Weight: 1,361 kg

Gammacell 3000

Isotope: Cs137

Max. Activity: 120 TBq

Weight: 1,588 kg

IBL 437c

Isotope: Cs137

Max. Activity: 208 TBq

Weight: 2,018 kg

Gammacell 40

Isotope: Cs137

Max. Activity: 155 TBq

Weight: 3,175 lbs

Gammacell 200/220

Isotope: Co60

Max. Activity: 977 TBq

Weight: 3,742 kg

J.L. Shepherd 143

Isotope: Cs137

Max. Activity: 122 TBq

Weight: 907 kg

J.L. Shepherd Mark 1

Isotope: Cs137

Max. Activity: 833 TBq

Weight: 1,361 kg

Theratron 780

Isotope: Co60

Max. Activity: 496 TBq

Weight: 2,495 kg

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Type B Container Development

- In 2004, the U.S. NRC revised regulations to harmonize with the IAEA's 1996 edition of "Regulations for the Safe Transport of Radioactive Material" (IAEA Safety Standards Series No. TS-R-1).
- As a result, a number of Type B packaging models used by OSRP and industry for Type B shipments were phased out of use in October 2008.
- This limited the number available Type B containers and increased the costs of Type B shipments while demand was increasing.

The 20-WC was a Type B packaging in common use prior to the regulation change

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Type B Container Development

- NNSA's Office of Radiological Security directed OSRP to design, test, certify and fabricate new Type B container models in anticipation of upcoming shortages of compliant containers.
- NNSA and OSRP began work on two type B containers in 2009.
  - The 435-B, a smaller, non-shielded packaging.
  - The 380-B, a large, shielded packaging.
- OSRP worked with federal entities, industry experts, the IAEA and a other stakeholders over the course of a decade to bring the new models into operation.

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Design and Development of 435-B

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435-B Development History

2009: Project Funding Approved

2011: Prototype Drop Testing

2013: SAR submitted to USNRC

2014: Design approved by USNRC

2016: First two units fabricated

2018: First use of the 435-B

2019: Third unit donated to IAEA

2019: Fourth unit fabricated

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435-B Design

- Based on previously certified containers.
- Design criteria/parameters
  - Leak-tight – Normal Condition of Transport (NCT) and Hypothetical Accident Conditions (HAC)
  - Transportable by truck, rail, ship, air
  - External dimensions 211 cm H x 178 cm outside diameter (OD)
  - Internal Cavity 152 cm H x 110 cm inside diameter (ID)
  - Gross weight 4,490 kg (2,636 kg empty)
  - 480 TBq Co-60, 200 Watts

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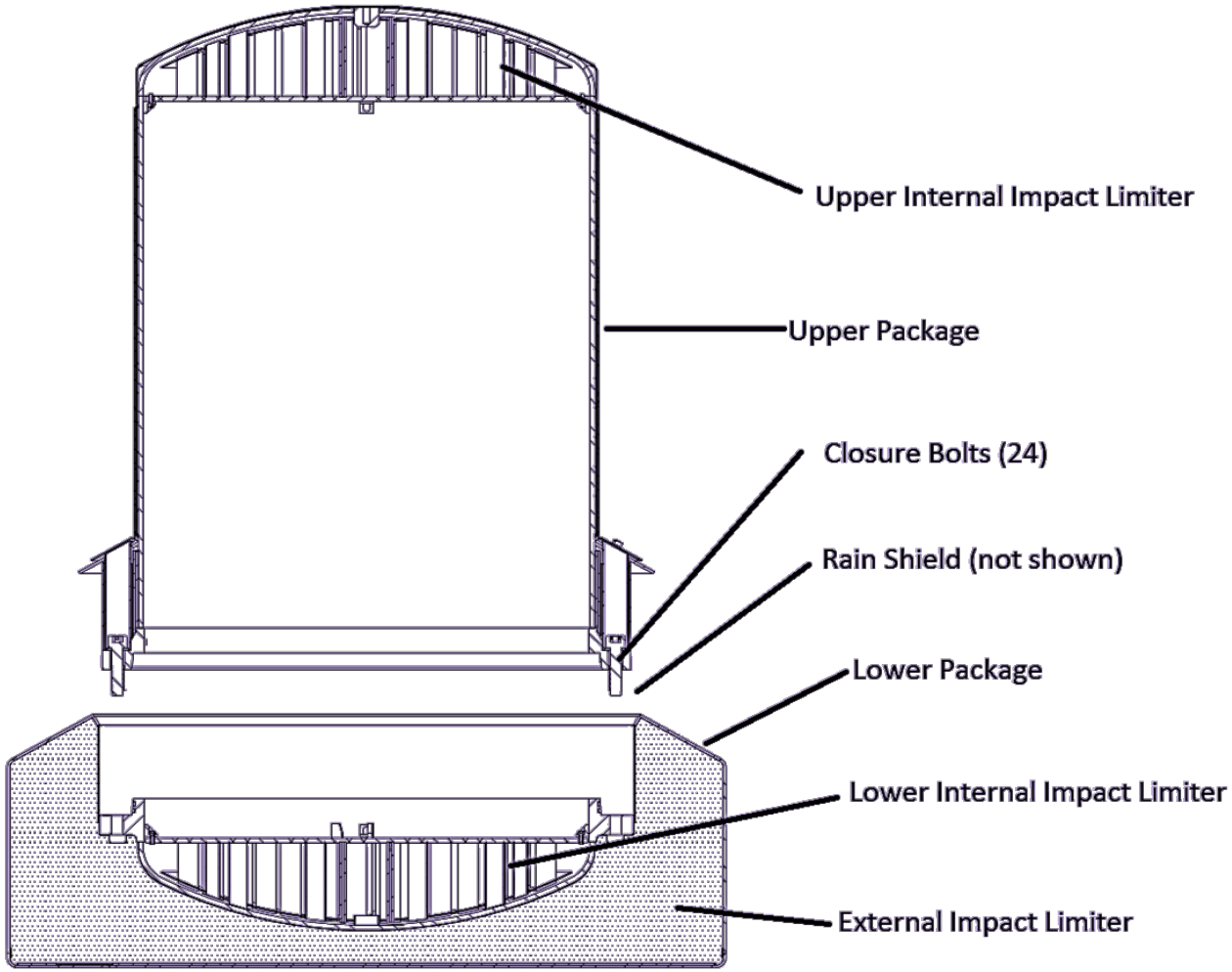
435-B Design



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435-B Payloads

- For transportation of
  - The LTSS with a lodgment
  - The disposal canister with a lodgment
  - A large shielded device with a lodgment
  - A shielded device inside an inner container
- Maximum activities:

Nuclide	Maximum Activity (TBq)
Co-60	480
Cs-137	1000
Sr-90	37
Ra-226	0.7
Ra-226/Be	0.2
Ir-192	7
Se-75	3

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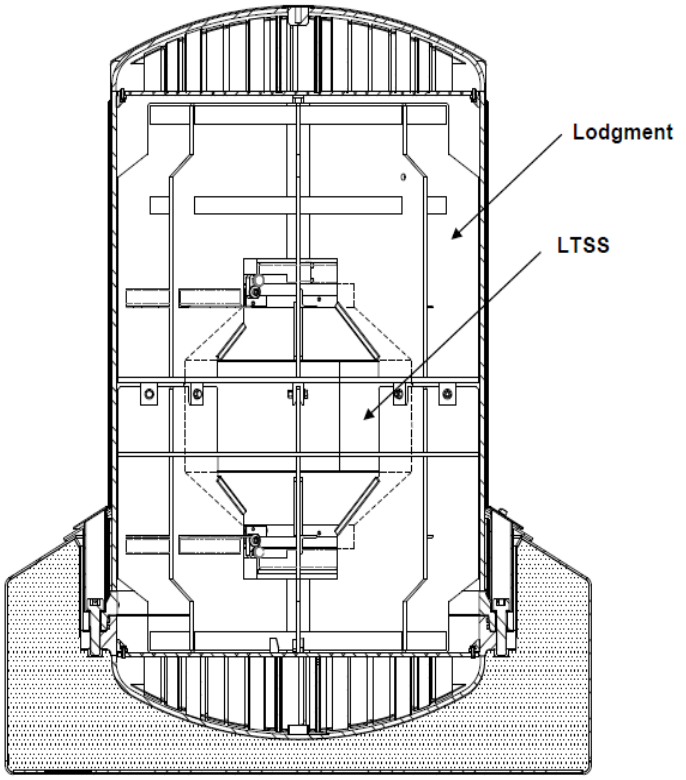
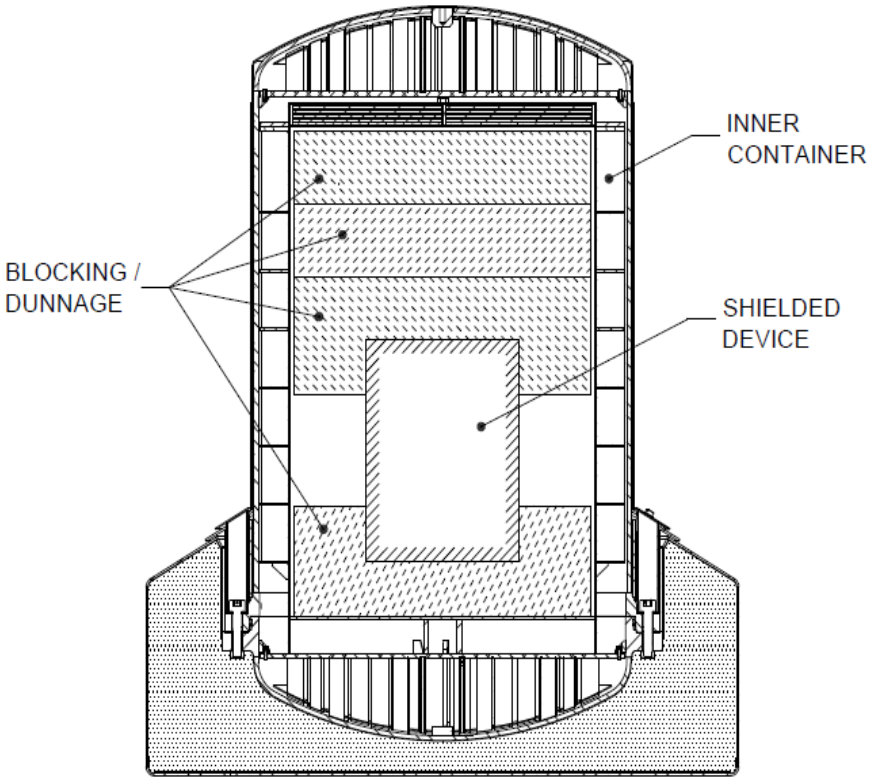
Cross-sectional View with Payloads



435-B with LTSS



435-B with shielded device

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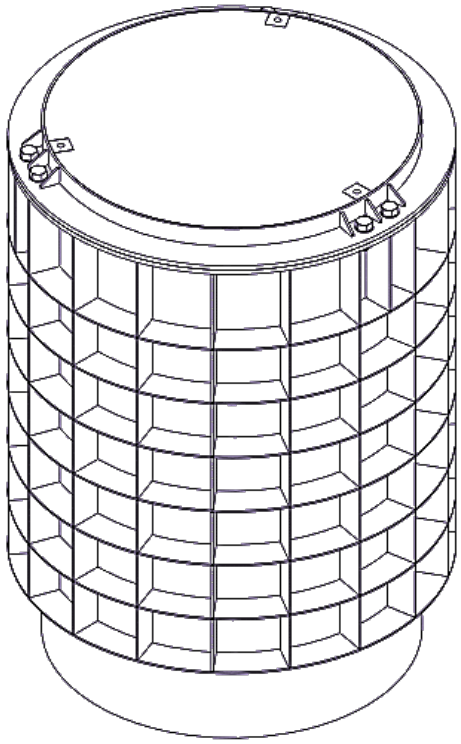
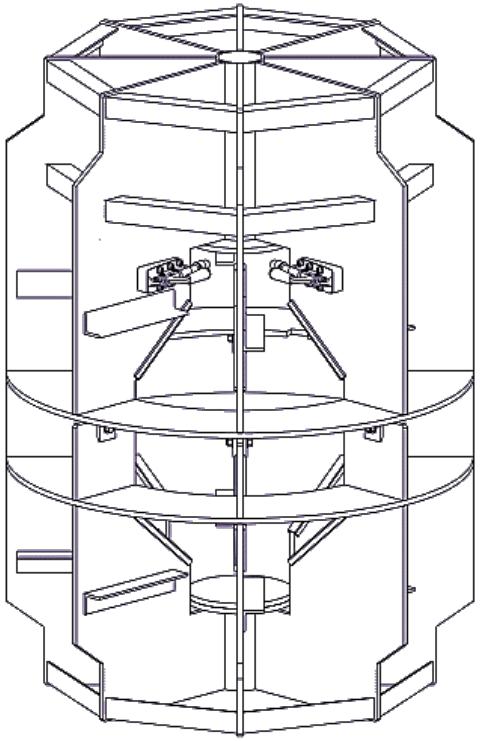
Bracing Components for Payload



Inner Container for Shielded Devices



LTSS Lodgement

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Authorized Content

- Because the 435-B packaging relies on the source retention and shielding properties of the payloads under both NCT and HAC, they must be evaluated prior to being added as authorized content.
- Current authorized content includes:
  - LTSS
  - Disposal canister
  - Gammator Series
  - Gammacell 1000
  - Gammacell 3000
  - Gammacell 40
  - IBL 437C
  - Hopewell Designs shielded devices

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435-B Testing

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Manufacturing the 435-B

- Fabrication started in November 2015
- Four units fabricated to date
  - Two are being operated by Idaho National Laboratory
  - One has been donated to the IAEA
  - One will be operated by Los Alamos National Laboratory

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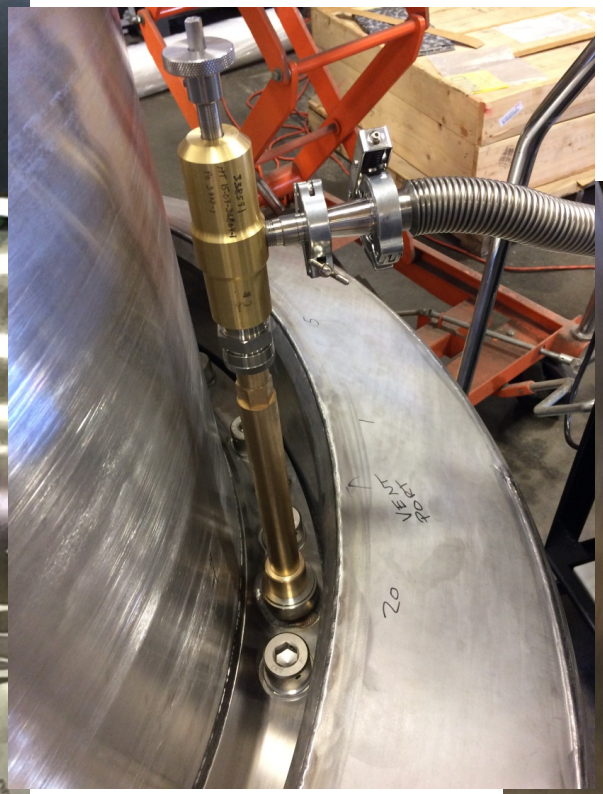
Manufacturing the 435-B (continued)



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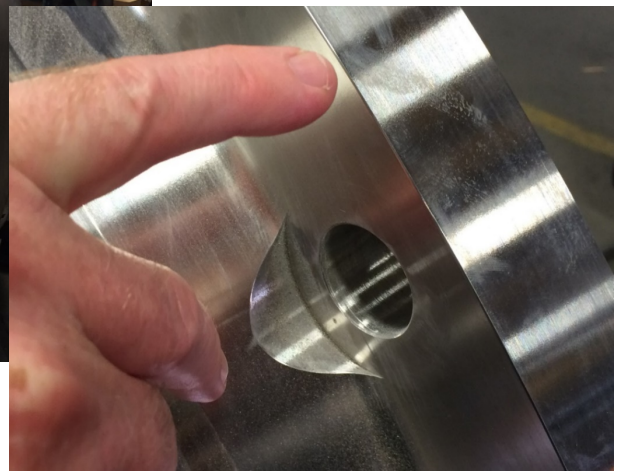
Manufacturing the 435-B (continued)



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435-B Operations

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First Recovery: March 2018

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IAEA Collaboration

- In the early phases of container development, OSRP worked with the IAEA on design requirements
- International recoveries were anticipated using the IAEA mobile hot cell to disassemble and consolidate sources from high-activity devices
- The LTSS is designed to mate with the mobile hot cell to safely pull sources into the LTSS for transportation or storage

IAEA's mobile hot cell

LTSS mated to mobile hot cell

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Questions?

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