Current and Future Packaging Designs for Shipping ATF and HALEU Fuel Materials

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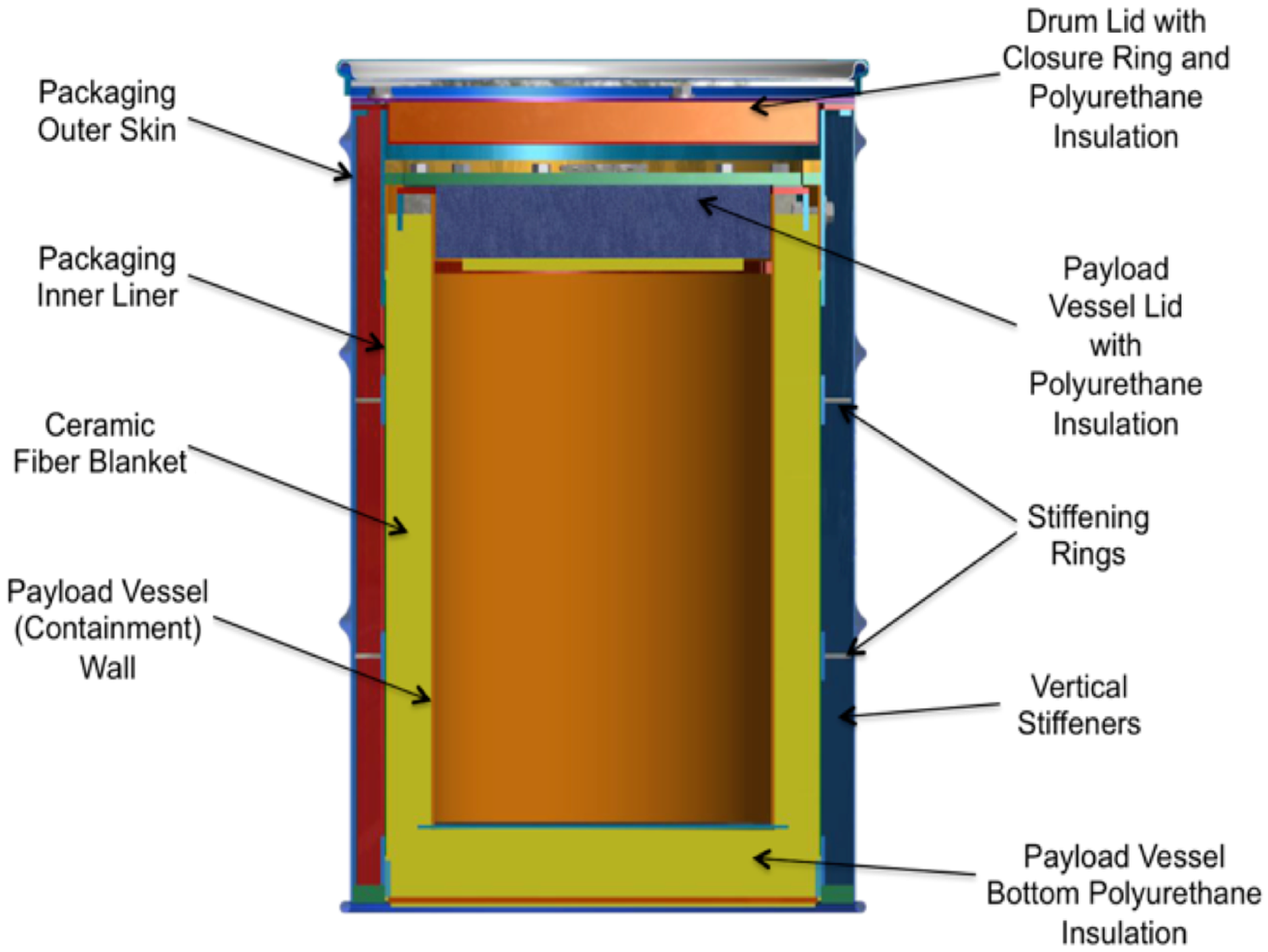
Package Designs for ATF and HALEU

- Versa-Pac Model VP-55
- Versa-Pac Model VP-55XL
- DN30
- DN30-10 and DN30-20

Versa-Pac Model VP-55



Versa-Pac VP-55 Licensing Overview

- General Package Design
- Current Contents
- Recent Addition of Content Types
  - UF_6 1S and 2S cylinders
  - Reduced enrichment loading level (1.25 wt.% U-235)
  - Air transport configuration
- Increased payload weight
  - Drop testing results
- Current NRC application includes the addition of TRISO fuel with enrichments up to 20 wt.% U-235
- Shipment of 1S and 2S cylinder in process from Vienna to DOE site
- Future amendment to include 10 wt.% U-235 hydrogen restricted (1 lb of plastic) to allow up to 685g U-235

Versa-Pac VP-55 Loading Table

U-235 Loading Table for VP-55

Enrichment U-235 (wt.%)	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100	350	350
≤ 20	410	410
≤ 10	470	470
≤ 5	580	580
≤ 1.25	2000	--

U-235 Loading Table for VP-55 with 5” Pipe

Enrichment U-235 (wt.%)	U-235 Mass Limit (g)	
	Ground/Vessel	Air
≤ 100	695	395
≤ 20	1215	495
≤ 10	1605	590
≤ 5	1065	790

Hydrogen Restricted U-235 Loading Limits

Enrichment U-235 (wt.%)	U-235 Mass Limit (g)	
	CSI=0.7	CSI=1.0
≤ 20	605	635

1S/2S Cylinder Limit for the VP-55 (up to 20 wt.% U-235)

Content	Maximum Cylinders per VP-55	Mass UF_6 per VP-55 (lb/g)	Enrichment U-235 (wt.%)	U-235 Mass Limit per VP-55 (g)	Air U-235 Mass Limit (g)
1S Cylinder	7	7.0 / 3,175	≤ 20	429.8	429.8
2S Cylinder	2	9.8 / 4,445	≤ 20	600.8	495

1S/2S Cylinder Limit for the VP-55 with 5” Pipe (up to 100 wt.% U-235)

Content	Maximum Cylinders per VP-55 (in 5-inch Pipe(s))	Mass UF_6 per VP-55 (lb/g)	Enrichment U-235 (wt.%)	U-235 Mass Limit per VP-55 (g)	Air U-235 Mass Limit (g)
1S Cylinder	1 [a]	1.0 / 454	≤ 100	306	306
2S Cylinder	1	4.9 / 2,223	≤ 100	1497	395

Notes: [a] Limited to one cylinder based on fit inside of the VP-55 cavity with the required 2-inch thick foam liner.

VP-55XL Introduction

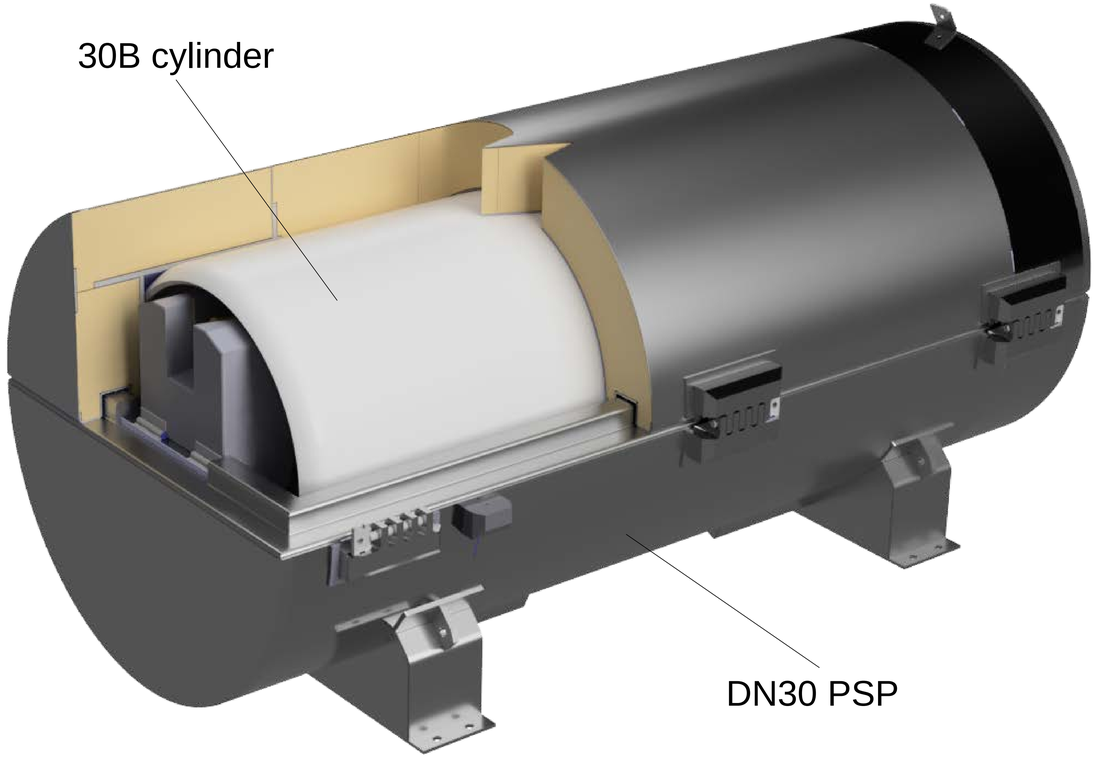
Packaging / Contents

- Double height VP-55
- Utilizes same internal support structure, thermal insulation and closure system as the VP-55
- Internal cavity to be filled with shoring that provides positioning and insulation of a single ANSI N14.1 5A/5B UF_6 cylinder
- Lifting and tiedown devices will be included for handling the package
- Cavity sized to accommodate 8A and 12B cylinders

Planned Safety Analyses

- Credit some VP-55 NCT testing (e.g. vibration, water spray, penetration)
- Physical drop testing with supplemental LS-DYNA analyses (e.g. worst-case drop angles)
- ANSYS Thermal Analysis
- SCALE Criticality Analysis

DN30



❖ New 30B overpack design

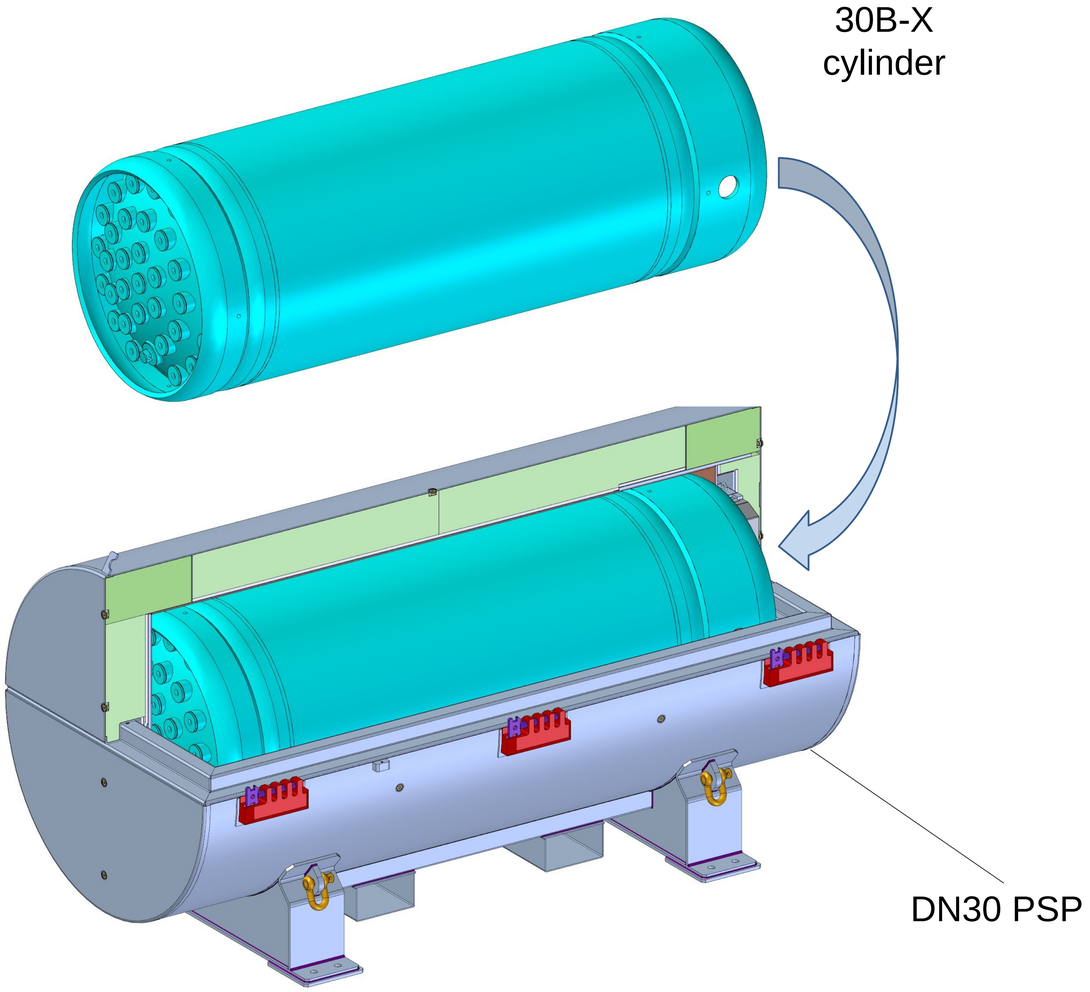
❖ Currently certifications include:

- Type AF for UF_6 containing commercial grade uranium or reprocessed uranium in less or equal to A_2 quantities, and an enrichment of not more than 5 wt.% U-235 in uranium. USA-9362-AF and F/420/AF
- Type IF for UF6 containing commercial grade or reprocessed uranium complying with the requirements for LSA–II, and an enrichment of not more than 5 wt.% U-235 in uranium. F/420/IF
- Type B(U)F for UF6 containing commercial grade uranium or reprocessed uranium with an enrichment of not more than 5 wt.% U-235 in uranium. F/420/B(U)F
- CSI = 0

DN30-X

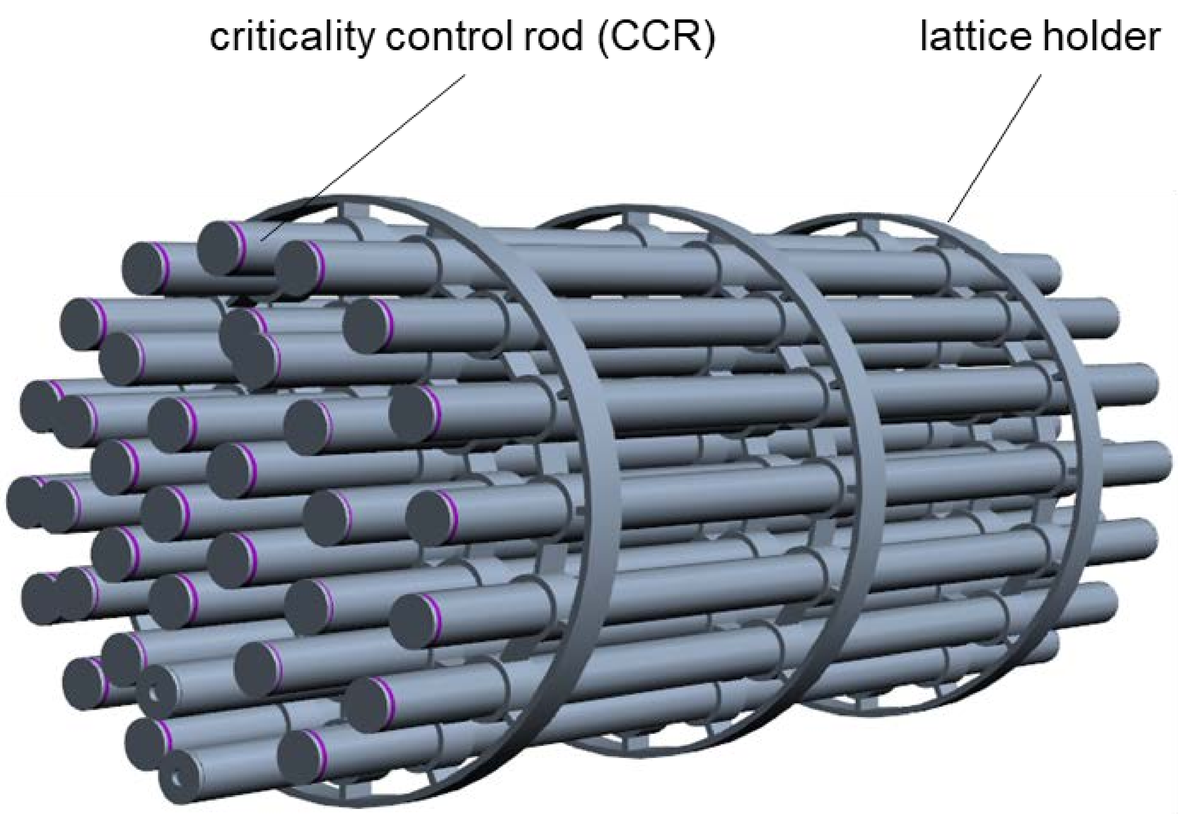
- DAHER Nuclear Technologies is developing a new version of the DN30 to support ATF and HALEU production
- Packaging for the transport of UF_6 with enrichments of up to 20 wt.% U-235
- The DN30-X consists of the unmodified DN30 PSP and the new 30B-X cylinder
- The 30B-X cylinder adds a criticality control system to the standard ISO 7195/ANSI N14.1 30B cylinder.

- The new design accommodates up to 1600 kg of UF_6 at 10 wt.% U-235
- A design dedicated to a higher limit of 20 wt.% U-235 has a payload of up to 1250 kg UF_6



The Criticality Control System (CCS)

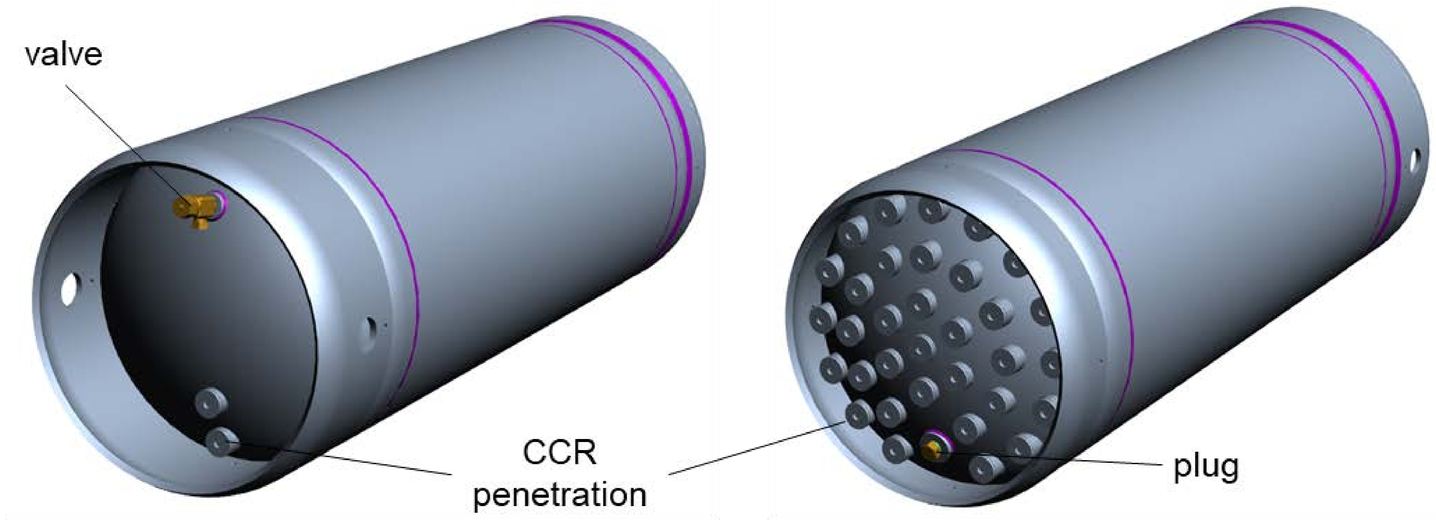
- The CCS consists of steel rods (CCRs) filled with neutron absorbing material
- Positioning of the CCRs is ensured by lattice holders
- Whole CCS made of the same steel as the cylinder, ensuring material compatibility with both the UF_6 and the cylinder walls
- Lower enrichment limits require fewer CCRs

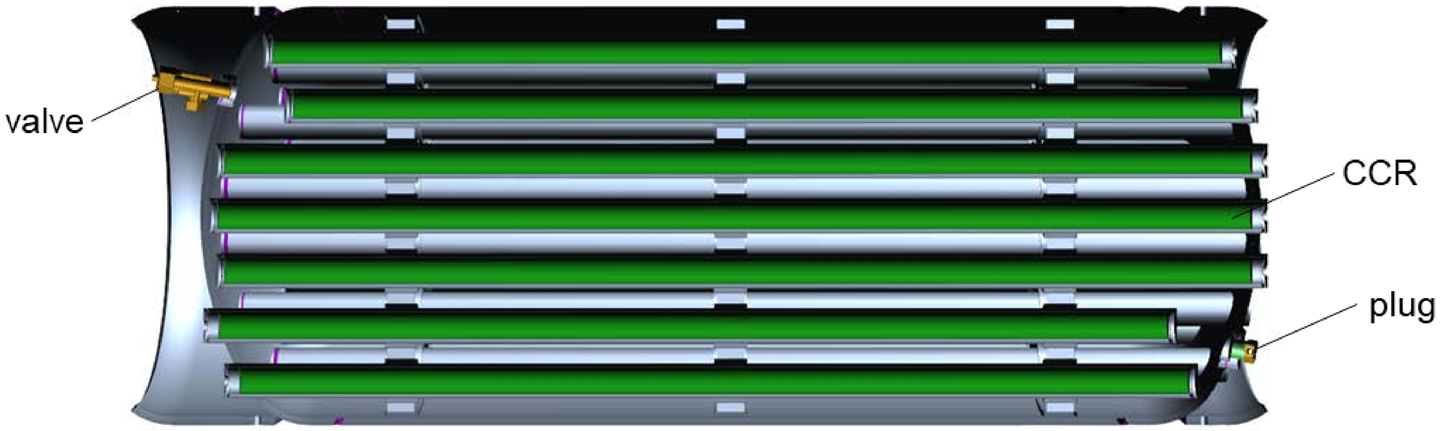


complete criticality control system (CCS)

Complete 30B-X cylinder

- Cylinder has same outer dimensions, material and interfaces (valve/plug) as standard 30B cylinder
- It will fit within current fuel fabrication process with no modifications
- Even without further markings, can be easily distinguished from standard 30B cylinder due to CCR penetrations on both sides





DN30-X Schedule

- Feasibility study completed in April 2020
- Safety analysis report for DN30-X completed by Q4/2020
- Application to be made to the NRC (pre-application meeting scheduled for May 2020)
- Goal to achieve NRC certification Q4/2021
- Initial fabrication of 30B-X starting Q1/2022