Developing Waste Acceptance Criteria for Advanced Reactor Waste Forms in the Universal Canister System

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Agenda

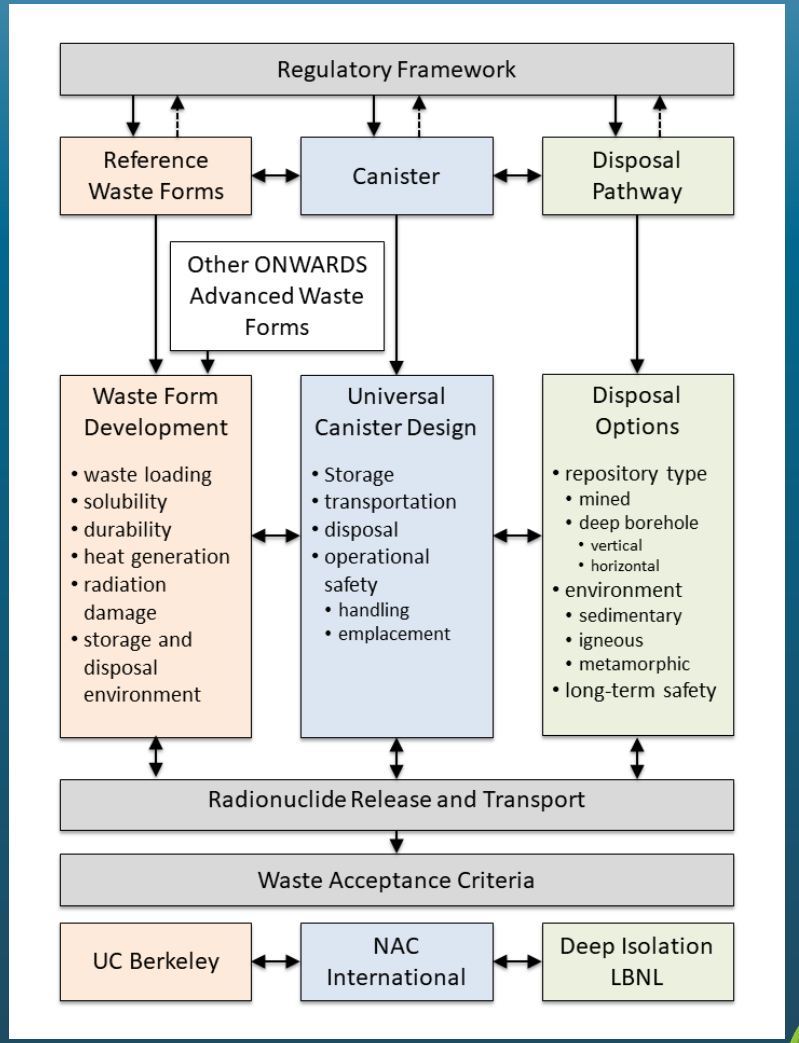
- Project Overview
- Progress and Future Work per Workstream
- Development of Waste Acceptance Criteria
- Conclusion
- Questions

Project Overview

- Project **UPWARDS**

  ***U**niversal **P**erformance Criteria and Canister for Advanced Reactor **W**aste Form **A**cceptance in Borehole and Mined **R**epositories Considering **D**esign **S**afety*

- ~2 years into 3-year project
- Four workstreams:
  1. Waste Form Development – UCB
  2. Canister Design and Prototype – NAC
  3. Models and Generic Performance Assessment – DI/LBNL
  4. Regulatory Review and Waste Acceptance Criteria – DI



Workstream 1: Waste Form Development

- Waste form research
  - Lanthanide Borosilicate (LaBS) glass
  - TRISO
  - Frozen halide salt
- Developed standards & specifications gap analysis
- Setting up experiments
- Culminates in recommended standards and specifications for waste forms

→ performance assessment inputs

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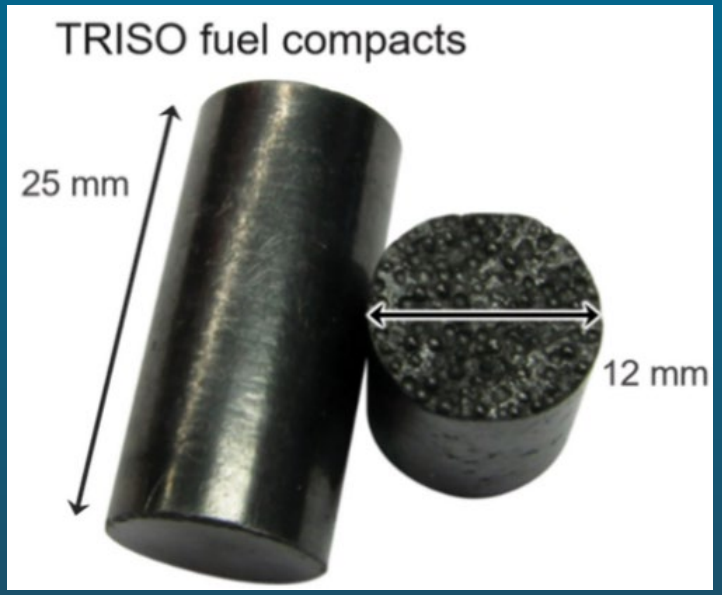

Demkowicz, Paul, and Hunn, John D. *Two decades of DOE investment lays the foundation for TRISO-fueled reactors*. United States: N. p., 2020. Web.

Workstream 2: Preliminary Universal Canister Design

- Developed
  - Functional Requirements Specification
  - Design Specification
  - Preliminary Design & Analysis
    - Limiting configurations (normal & off-normal)
      - Storage
      - Transport
      - Disposal
- In Progress
  - Prototype Fabrication

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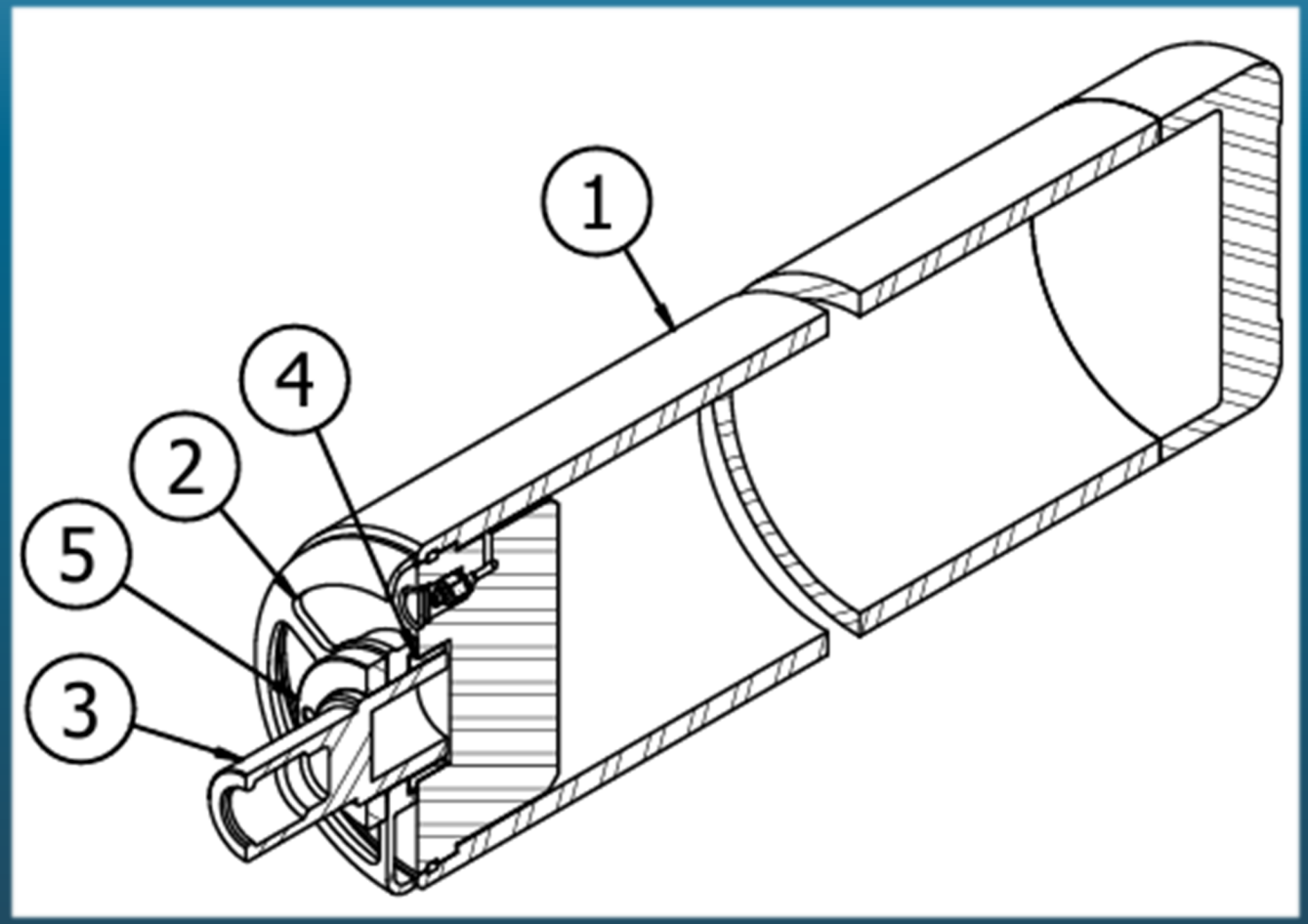
Discipline	Evaluation Description
Structural	UCS External Pressure and Stacking Analysis
	UCS Handling Stress Analysis
	UCS Transfer 20-foot End Drop Evaluation
	Drag Force for UCS Borehole Drop
Nuclear	UCS Source Term and Shielding Evaluation for TRISO Fuel
	UCS Criticality Evaluation for TRISO Fuel
Thermal	UCS Thermal Analysis

UCS Preliminary Design



Item No.	Description
1	UCS Assembly
2	Cap Plate
3	Lift Adapter
4	Key Plate
5	Jam Plate

Workstream 3: Integrated Safety & Performance Assessments

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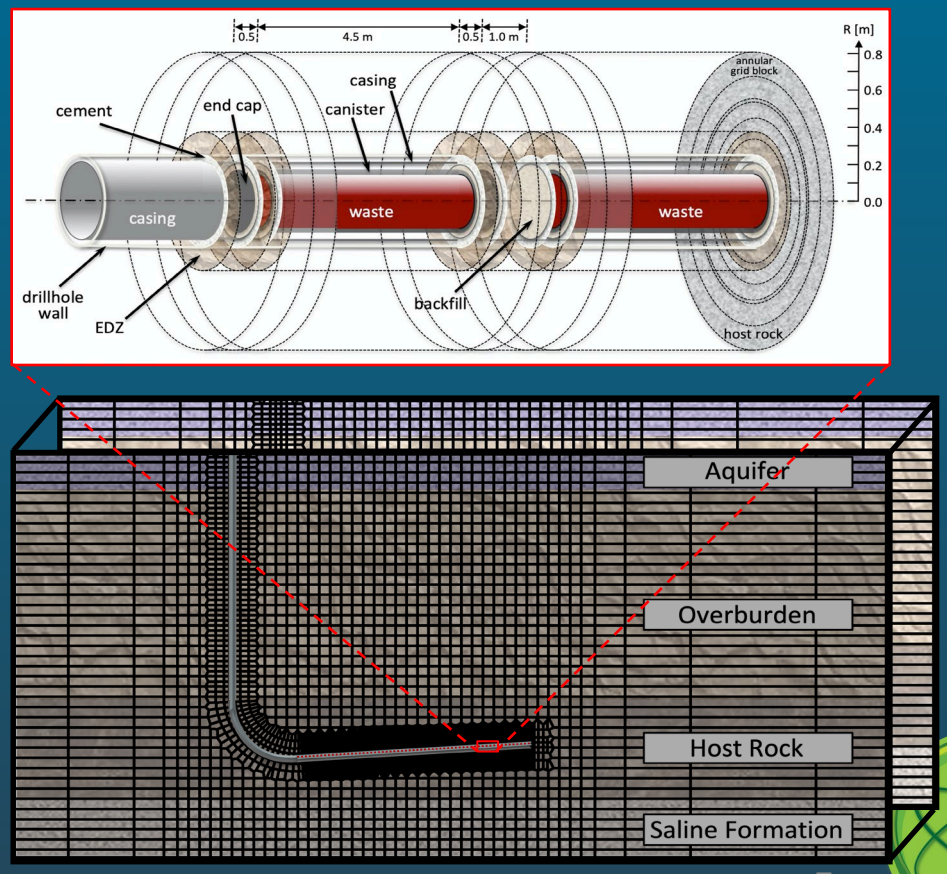
- Developed
  - Representative safety & performance assessment models for mined and borehole repositories
  - Source-term models
- In Progress
  - Calculating safety & performance to determine performance envelope
    - ➢ Input to Workstream 4 (WAC development)
  - Documentation of results



Workstream 4: Development of Waste Acceptance Criteria

- Developed
  - Review of existing regulatory requirements and waste acceptance criteria
- In Progress
  - Formulation of generic WAC
  - WAC coupling against disposal configurations

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Regulatory Topic	Consideration
Borehole Conditions	Extent of design flexibility
	Credit for overly robust boreholes
UCS Design Credit	Extent to which canister factors into "canister plus waste acceptability"
	Credit for radiological, chemical, and mechanical stability
Retrievability Period	Assumed timing for retrievability, backfilling, and sealing
	Minimum conditions thereafter
Managing AR Waste versus Legacy Waste	Extent to which lessons learned from LWR mgt informs AR guidance

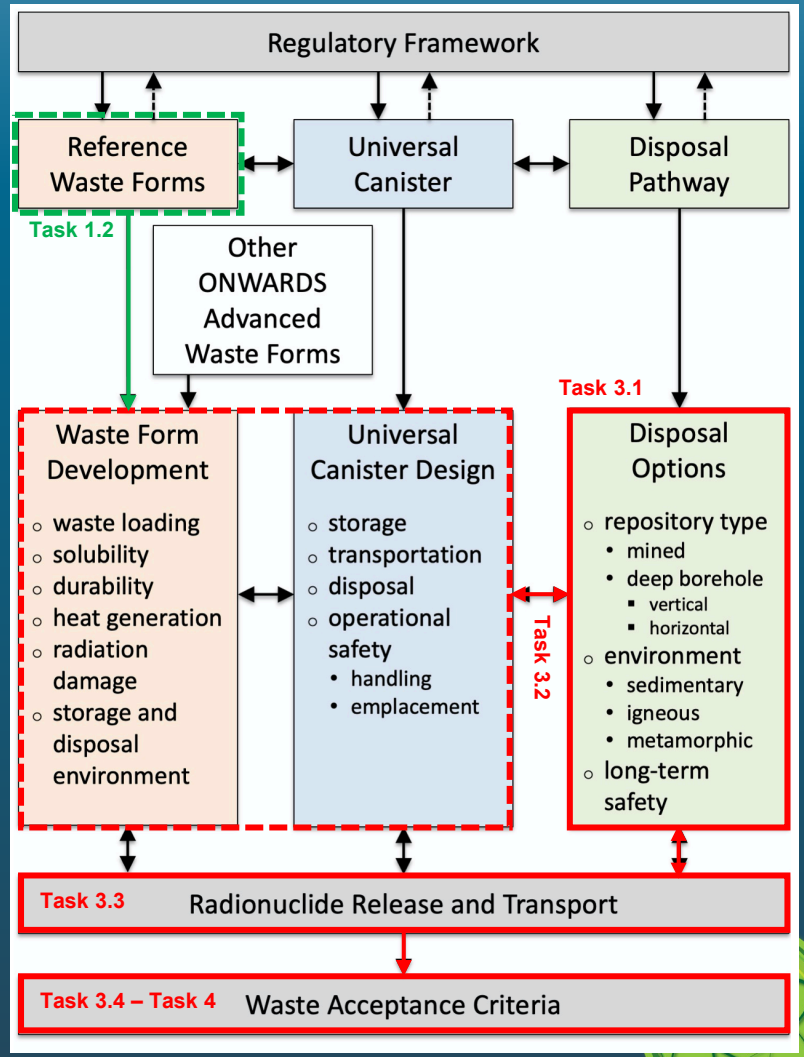
Integration of Workstreams

Task 3.1 Develop representative safety and performance assessment models for different disposal concepts

Task 3.2 Develop source-term models for different waste forms and disposal concepts

Task 3.3 Calculate safety and performance measures and determine performance envelope

Task 3.4 Identify acceptable range of safety-relevant design factors and site characteristics



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Categories of Waste Acceptance Criteria

Based upon review of WAC/WASRD for:

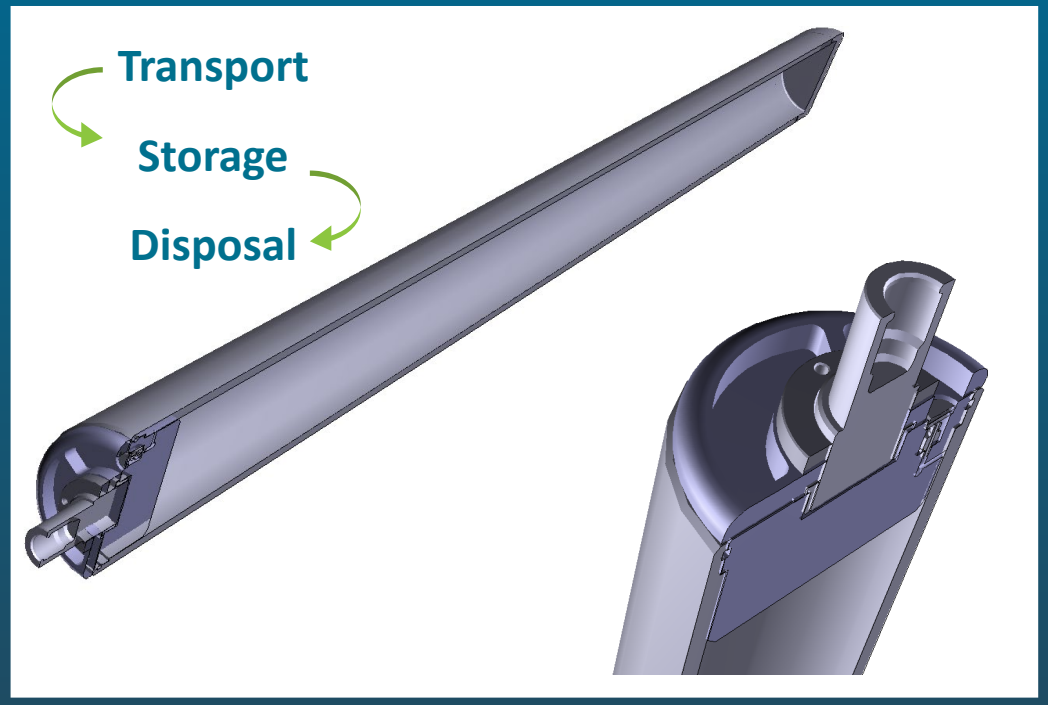
- RH-TRU at WIPP
- Vitrified waste at DWPF

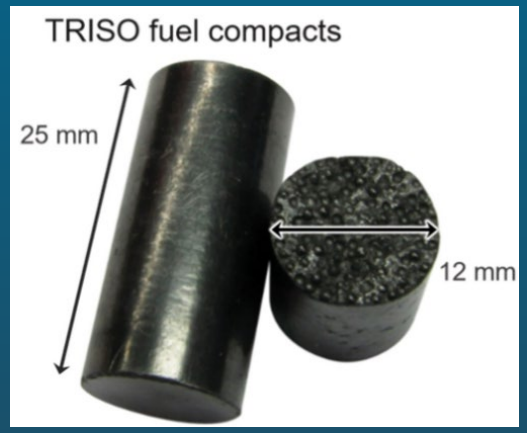
- Many of these considerations are addressed by UCS design and analysis
- Identifying compliance methods as WAC are further generated

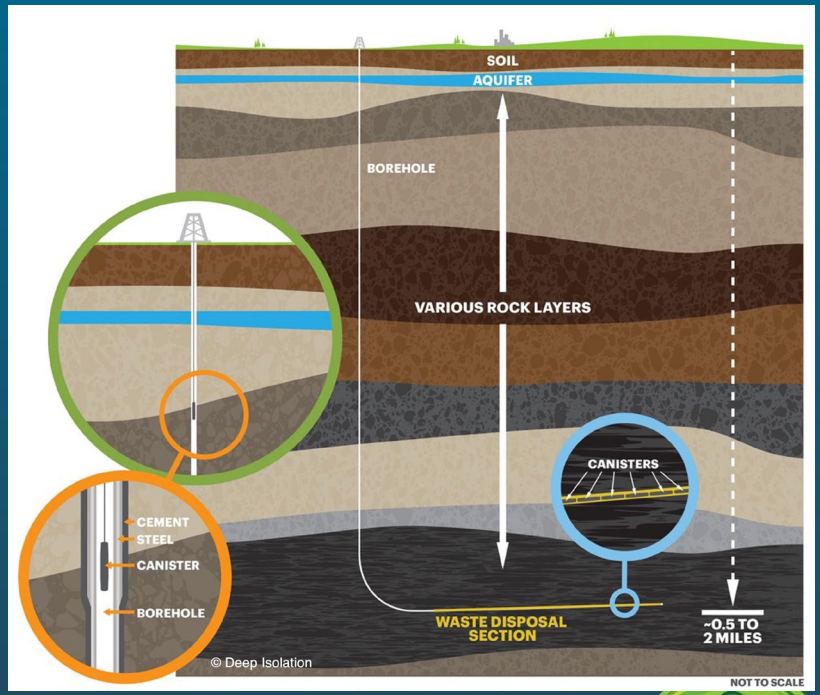
Topic	Consideration
Container Properties	Physical dimensions & weights
	Mechanical performance
Radiological Properties	Radiation effects (dose rate)
	Contamination control
	Decay heat
	Nuclear criticality
Physical Properties	Free liquids
	Compressed gases
Chemical Properties	Chemical durability
	Combustibility
	Gas generation
	Fire and explosion hazards
	Toxic/corrosive materials
Data Package Contents	Unique identification

Configuration Applicability & Pairing Matrix

Canister Class ⟷ Waste Form ⟷ Repository Configuration







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International Applications

Joint Project on Waste Integration for Small and Advanced Reactor Designs (WISARD)

- Treatment, recycling or reprocessing
- Spent fuel and waste storage
- Transportation
- Disposal

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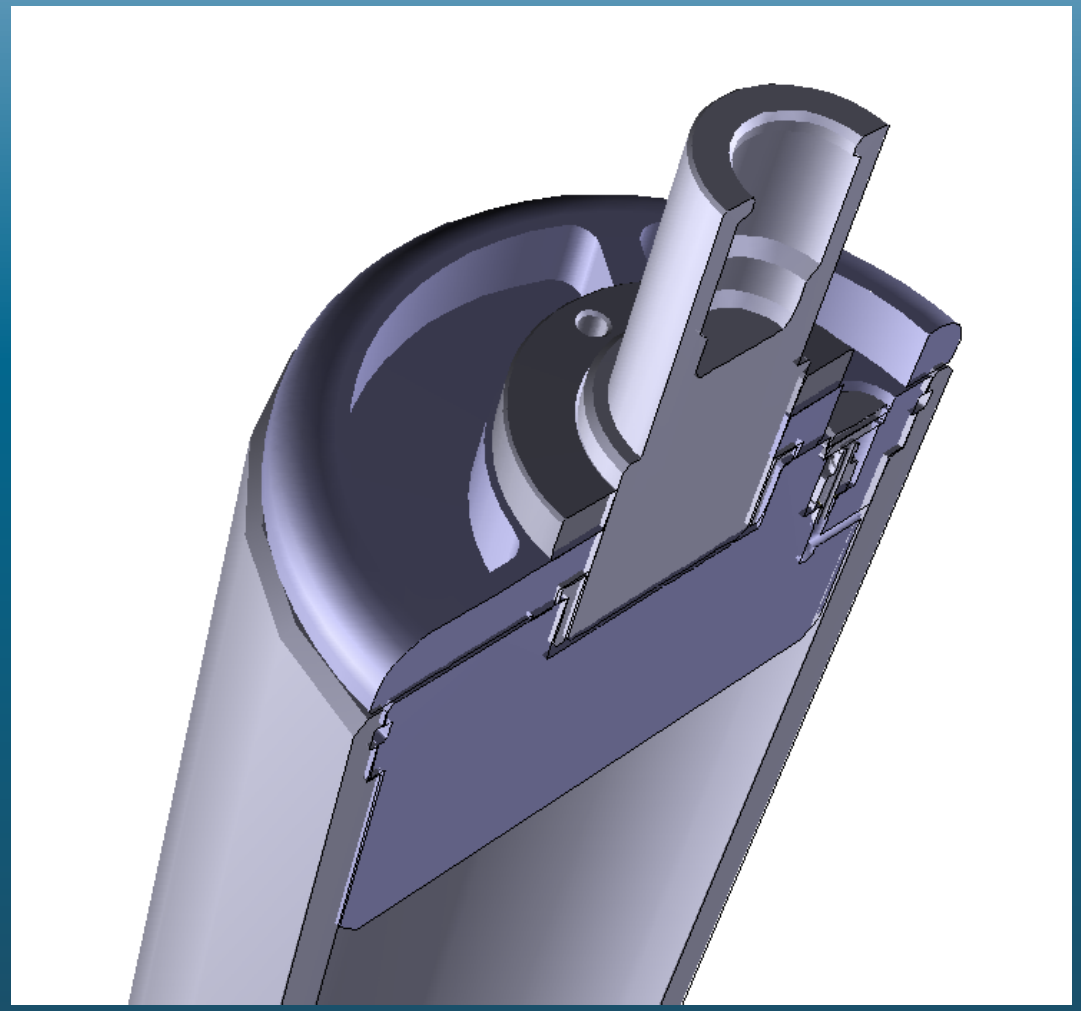
Conclusion

- Project concludes in July 2025
- Will deliver first-of-a-kind fully integrated waste management system
  - Accommodate 3 waste forms
  - Compliant to the design and analysis
  - Demonstrated suitability in generic performance envelope
  - Capable of pairing with waste forms and disposal methods using WAC



Thank you!

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