



U.S. DEPARTMENT OF  
**ENERGY**

OFFICE OF  
**ENVIRONMENTAL  
MANAGEMENT**

# Integrated Waste Treatment Unit Status

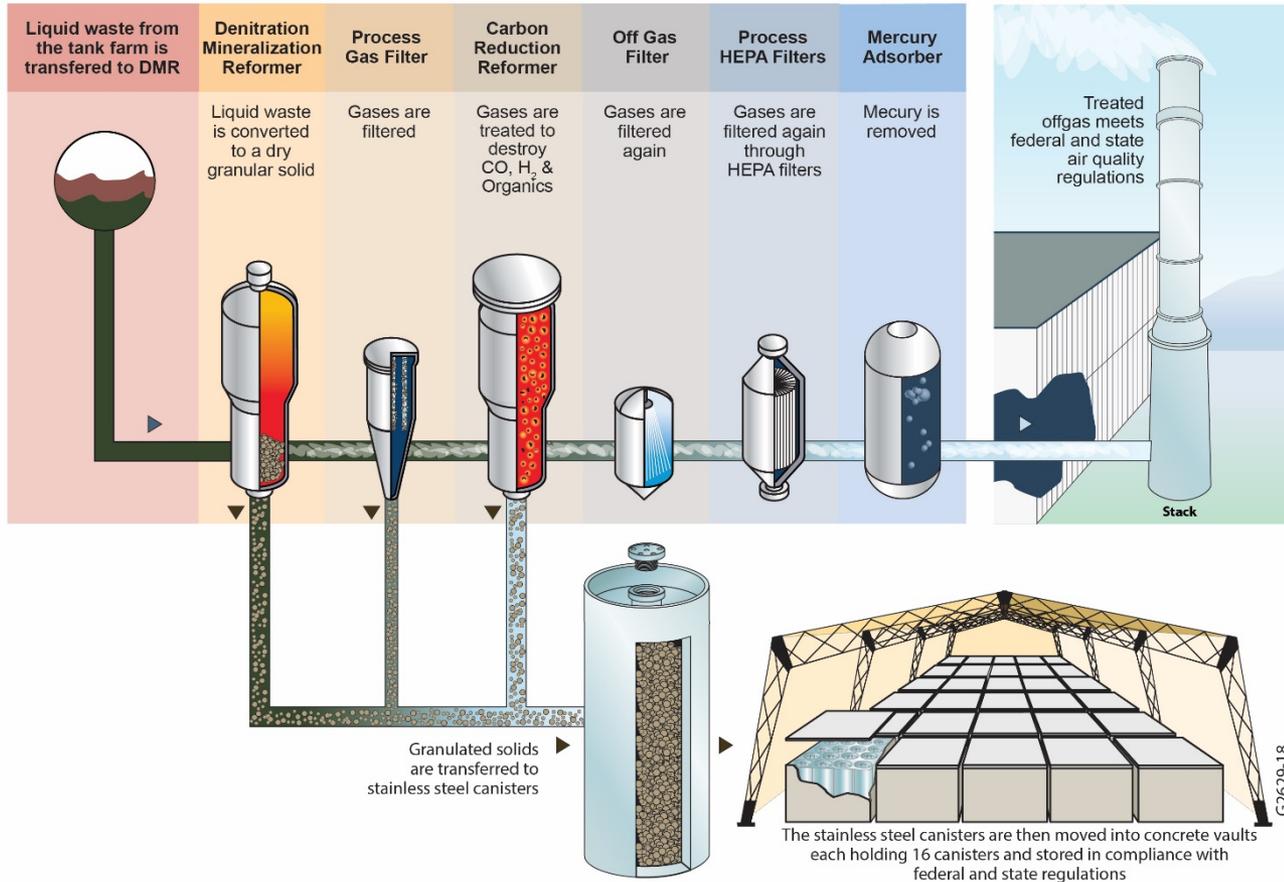
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Feb. 23, 2017

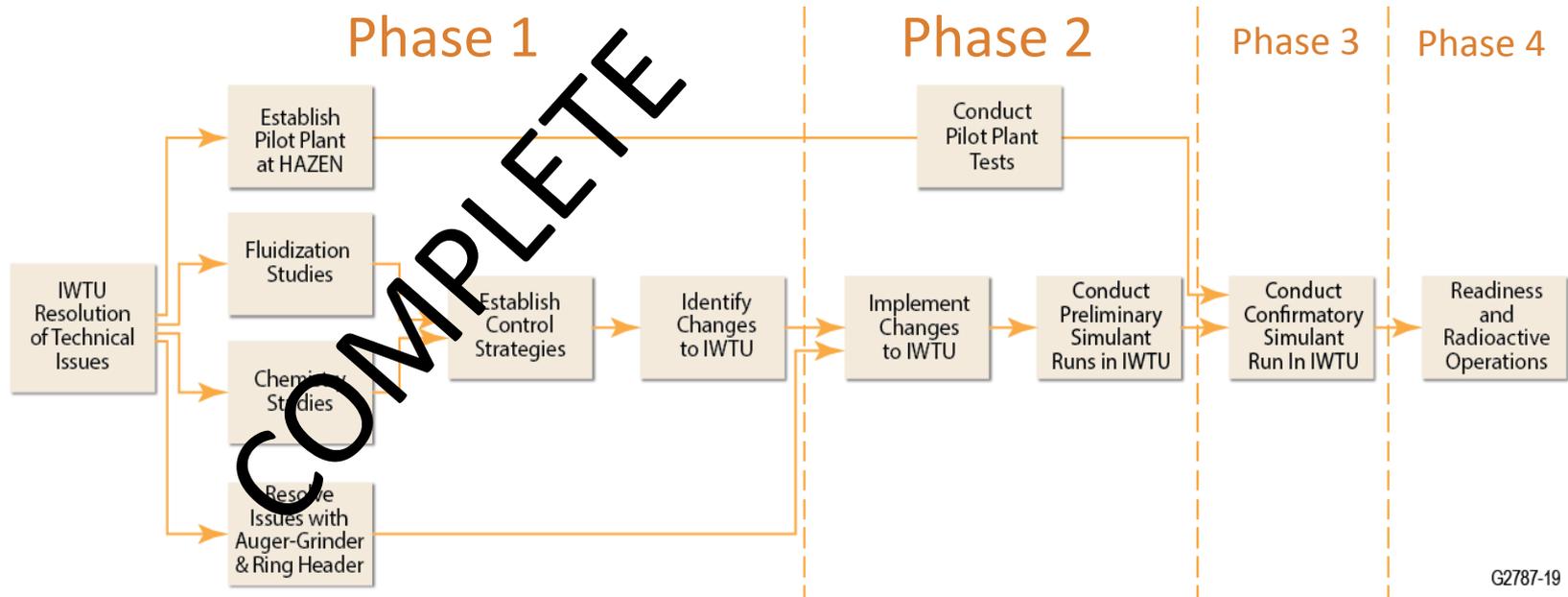


# IWTU Simplified Flow Sheet

IWTU Treatment Process Overview



# Fluor Idaho IWTU Phased Approach

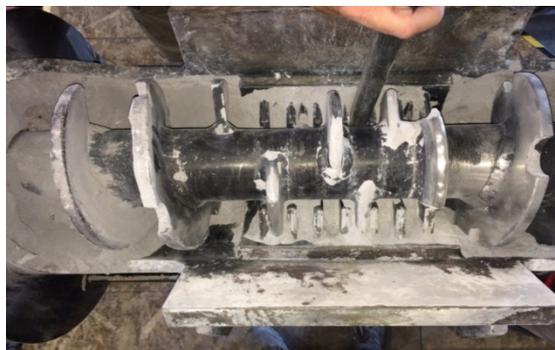


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- Phase 1 completed in October 2016
- Started IWTU plant heat-up on 2/2/17 in preparation for first demonstration test of 20 days.
  - Focused on auger-grinder performance testing.

Based on input from the Phase 1 Technical Review Group and tests completed to date, the challenges encountered at IWTU can be broken down into two distinct areas:

- Chemical/physical – mainly associated with the fluidization process and wall scale in the Denitration Mineralization Reformer.
- Mechanical/equipment – in relation to the auger-grinder and ring header.

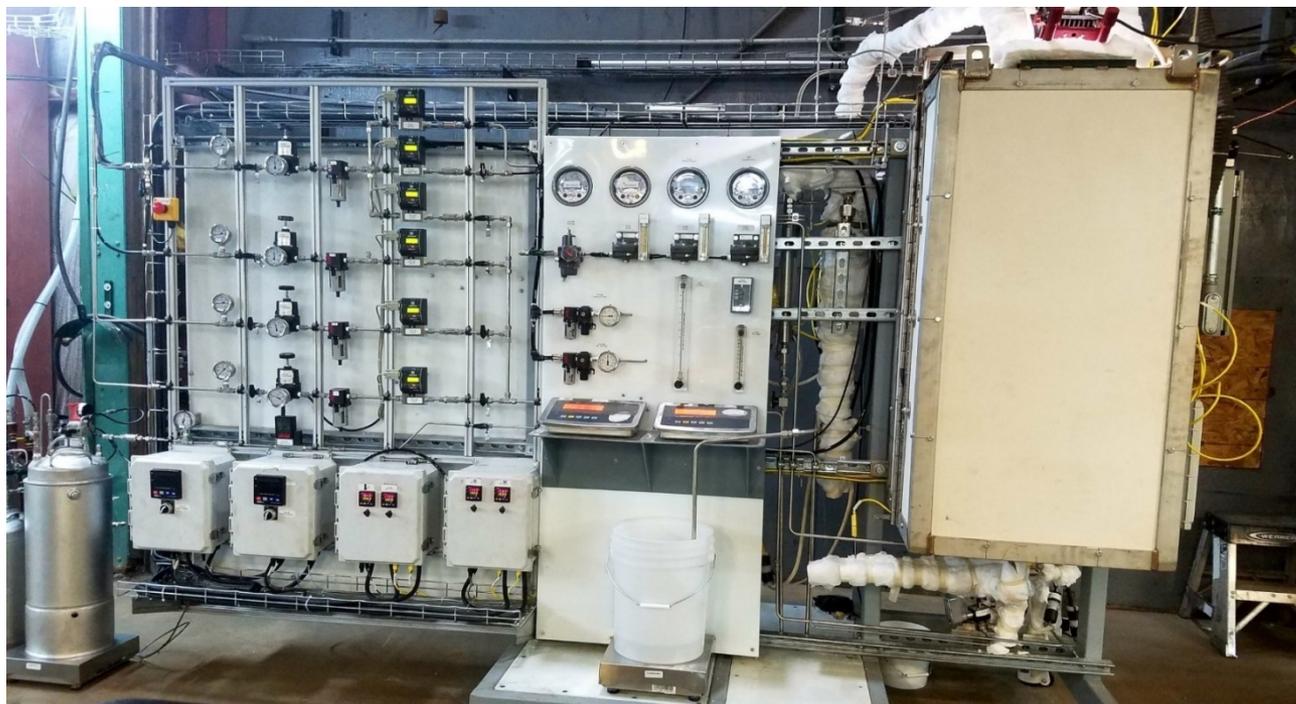


- Fluidization studies in conjunction with chemistry studies (on product and scale) identified modifications and process changes to improve fluidization, stabilize process control and address slow waste feed conversion to product.
- Particle size control is critical for stable operations.
- Waste feed droplet studies complete. Results to be evaluated regarding optimal waste feed rate for adequate product conversion.



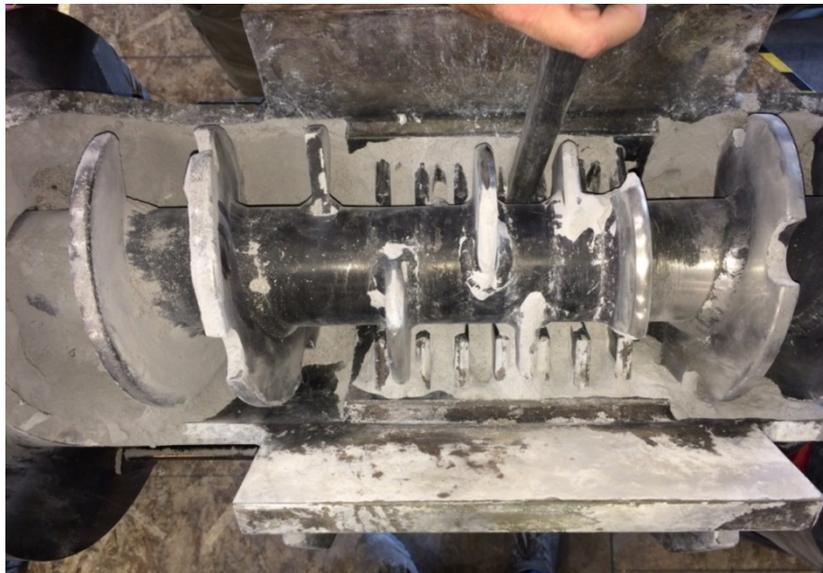
# The Use of Hazen to Resolve Chemical/Physical Challenges

- Hazen 2-inch pilot plant testing and supporting test confirm addition of CO<sub>2</sub> ensures stable bed with no sand castle formation.
- Hazen 18-inch DMR pilot plant was delivered last November and began Phase 2 heat-up in January.



Process Skid (left)  
and Fluidizing Vessel  
(right) at Hazen,  
Colo. test facility.

## Phase 1 Results on Mechanical/Equipment Challenges



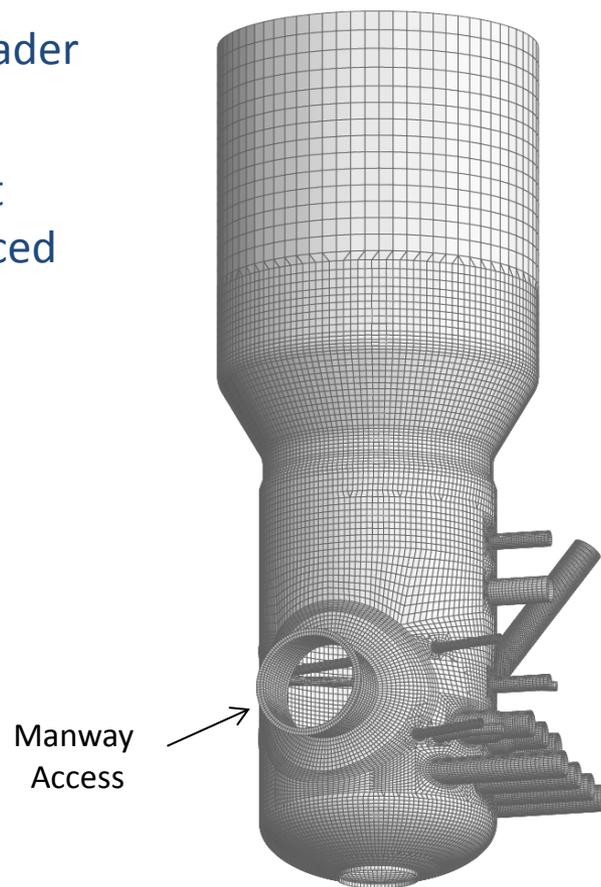
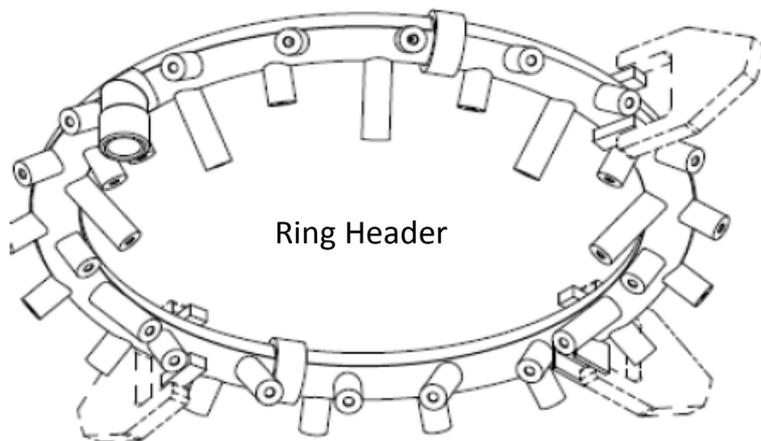
- Auger-grinder failure mechanism (from May 2016 simulant run) evaluation complete.
- Test results indicate steam forms a cementitious material that locks up the auger-grinder.
- Purge strategy very important.
- Developed design, completed fabrication of prototype unit, and installed in DMR.



Prototype SST components to be used for testing.

# Phase 1 Results on Mechanical/Equipment Challenges (Continued)

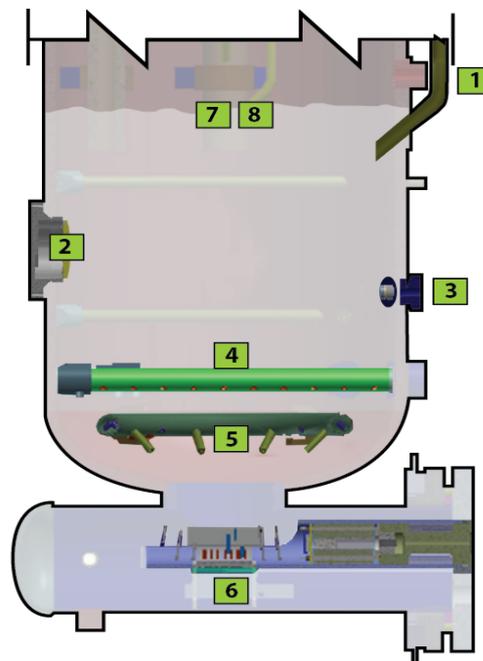
- Ring header/DMR access: stress analysis and vendor evaluation for DMR manway access to allow for ring header replacement complete.
- Ring header damaged due to fluidizing jet impingement during December 2015 simulant run, needs to be replaced before radiological operations.
- Repair requires safe access into DMR – manway to be installed on side of DMR.



# Causes and Solutions from Phase 1 Analysis

Wall Scale	
Observation	Wall Scale
Impact	Build-up of Scale Deposits
Root Cause	Slow Conversion of Feed
Solution	Reduce the Feed Rate Use all Three Waste Feed Injectors Increase DMR Operating Temp Increased DMR Bed Depth
<b>3</b>	<b>7</b> <b>8</b>

Formation of Sandcastles	
Observation	Sandcastles / Agglomerations
Impact	Temperature and Fluidization Instabilities
Root Cause	Slow Conversion of Waste Feed Insufficient Fluidization Insufficient Particle Size Control
Solution	Refine Fluidization Strategy Modify Fluidizing Gas Rails Implement Seeding Control Requires Manway Access Insure sufficient CO <sub>2</sub>
<b>1</b> <b>2</b> <b>3</b> <b>4</b>	<b>5</b>



Auger Grinder Failure	
Observation	Auger-Grinder Locked Up
Impact	Inability to Transfer Product Results in Plant Shutdown
Root Cause	Build-up on Rotating Parts Insufficient Mechanical Design Lack of Adequate Purge
Solution	Auger Grinder Root Cause Analysis Industry Expert Consultant Extensive Prototype Testing Improved Purge Gas Strategy Improve Mechanical Design Recovery Capability
<b>6</b>	

DMR Instabilities	
Observation	Temperature Excursions
Impact	Instabilities, Shutdowns
Root Cause	Defluidization Channeling of Gases Wall Scale
Solution	Refine Fluidization Strategy Modify Fluidizing Gas Rails Implement Particle Size Control
<b>1</b> <b>4</b> <b>5</b> <b>7</b>	<b>8</b>

Ring Header Damage	
Observation	Erosion of Ring Header
Impact	Breach Would Defluidize DMR
Root Cause	Jet from Fluidizing Gas Rails
Solution	Modify Fluidizing Gas Rails Replace Ring Header Requires Manway Access
<b>2</b> <b>4</b> <b>5</b>	

DMR Modifications	
<b>1</b>	Seeding Size Control
<b>2</b>	Manway
<b>3</b>	Waste Feed Injector
<b>4</b>	Fluidizing Rails
<b>5</b>	Ring Header
<b>6</b>	Auger-Grinder
<b>7</b>	Increase DMR Temperature
<b>8</b>	Increase Bed Height

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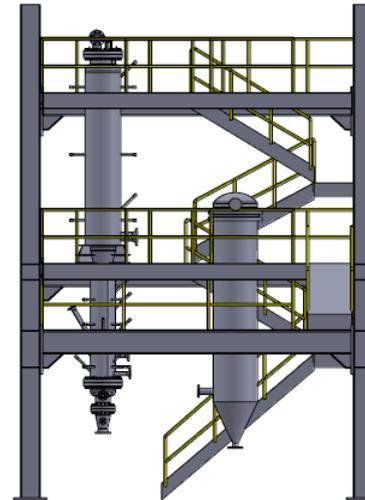
## Path Forward-Phase 2

- Extent of condition plant review conducted by Fluor Idaho complete. Plant review identified required modifications for balance of plant. Modifications have been prioritized and sequenced into Phase 2 project plan.
- Complete IWTU facility mods including manway installation and ring header repair.
- Conducted auger-grinder design development tests.
- Conduct IWTU simulant runs
  - Validate auger-grinder design under plant conditions; fluidization improvements, operating and recovery operations.

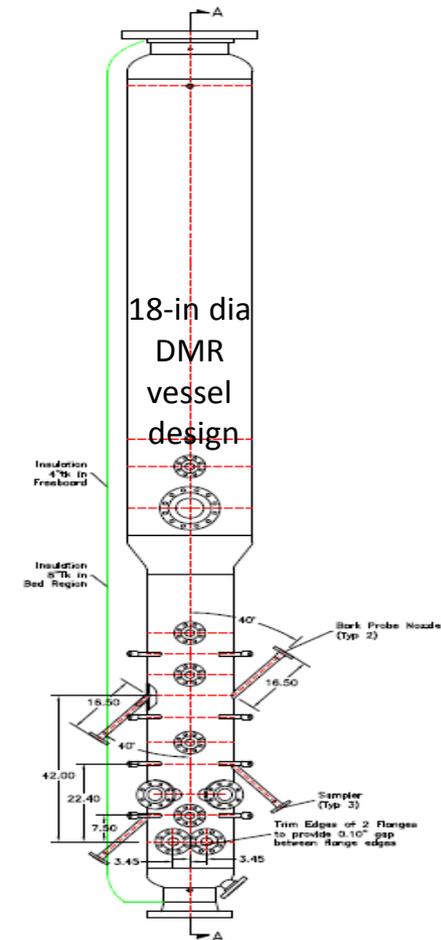


# Path Forward-Phase 2 (Continued)

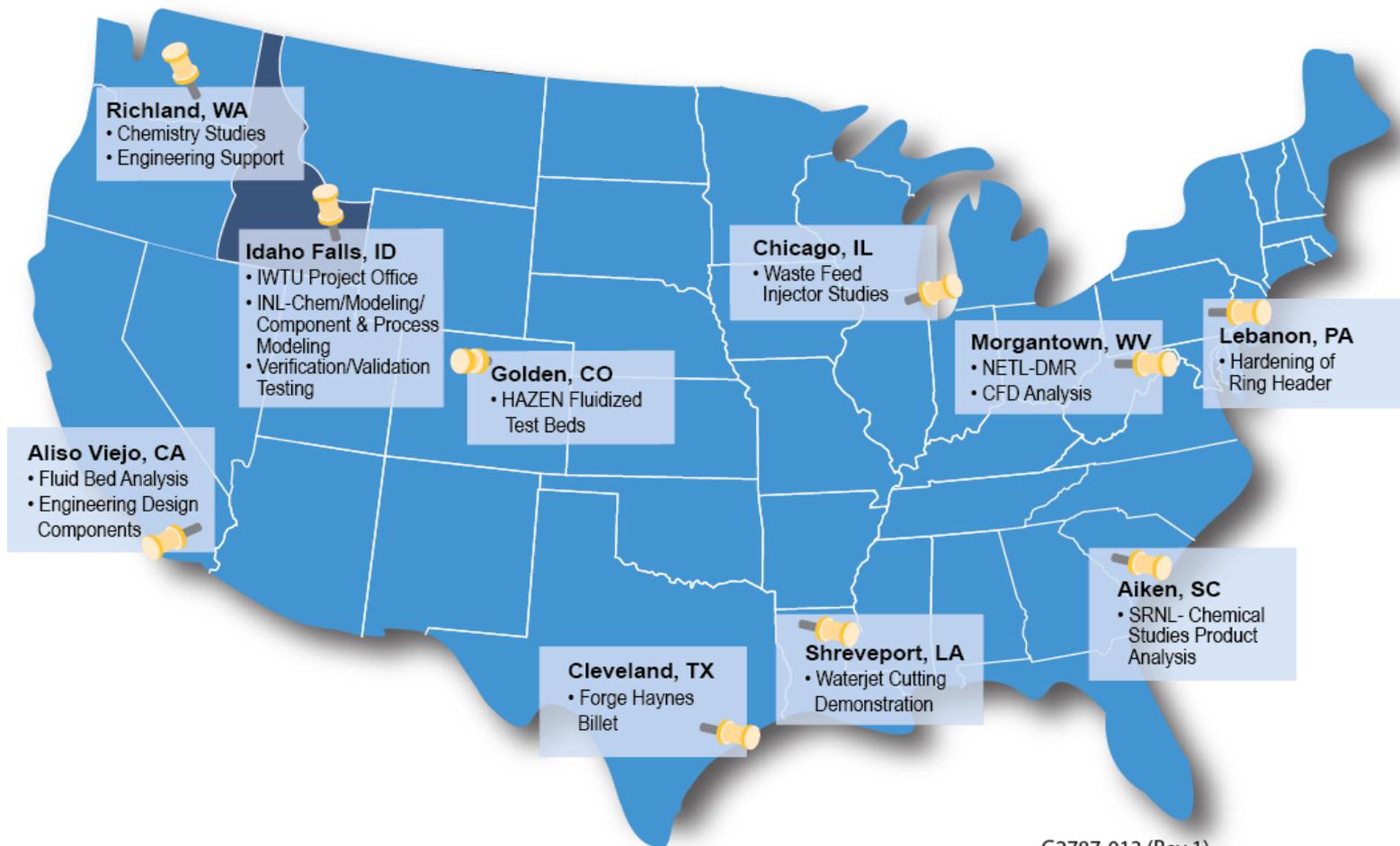
- Conduct 3 test series at Hazen using the 18-inch diameter DMR pilot plant to support IWTU simulant runs.
- Additional bench tests and engineering evaluations to improve understanding and mitigation strategies for slow waste feed conversion and wall scale formation.
- Other engineering assessments (WF injector testing with solids, long-term storage related assessments, simulant adequacy, radiological operations studies).



(Above) 18-in diameter DMR vessel (left) and Process Gas Filter (right)



# Phase 2 Project Work Locations



Wide range of work activities at multiple locations being carried out.

# Summary

- Due to the hard work of IWTU engineers, the Technical Review Group, and extensive studies and testing to date, we believe we have solutions to IWTU's chemical/physical and mechanical/equipment challenges.
- The simulant run to test the redesigned auger-grinder is under way.
- Testing is ongoing at Hazen to learn more about the chemical/physical processes that occur inside the DMR.
- A new ring header will be installed before the second simulant run under Fluor Idaho.