



U.S. DEPARTMENT OF
ENERGY

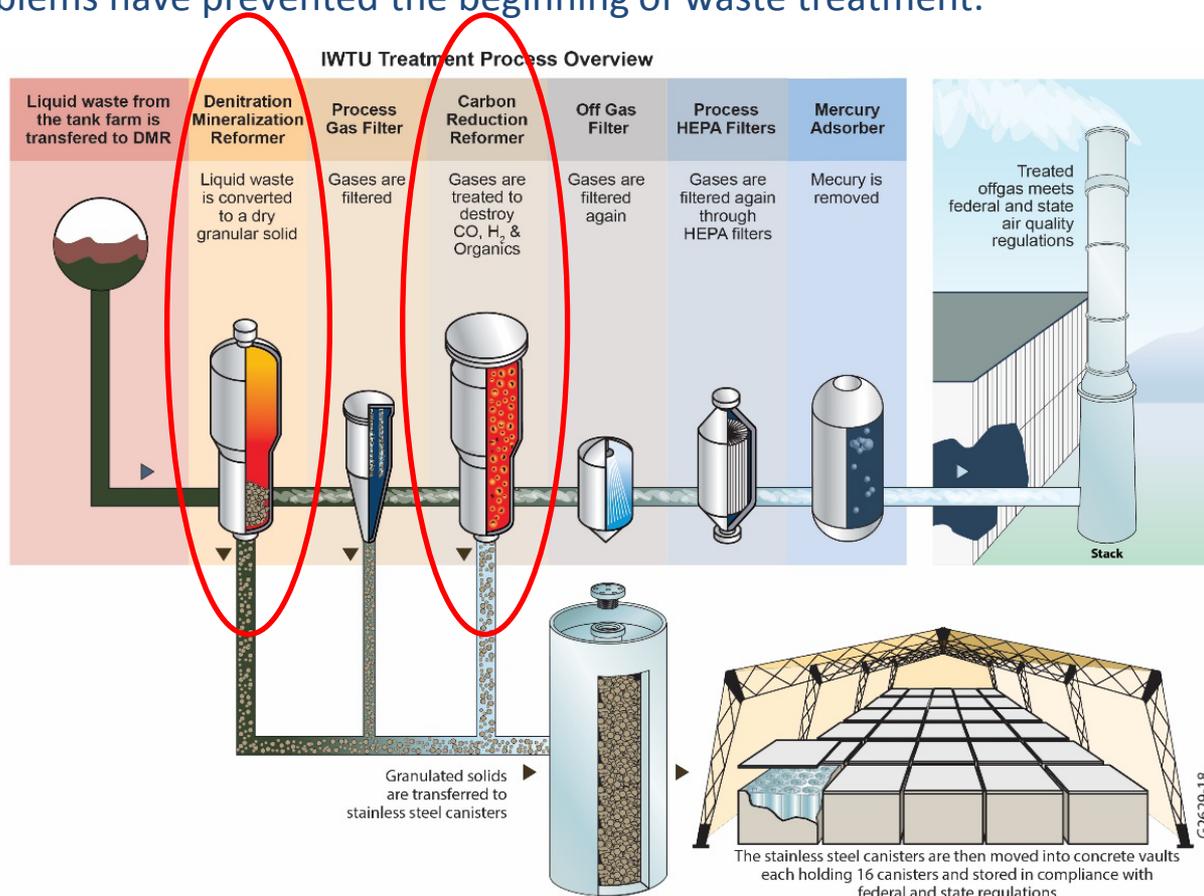
OFFICE OF
**ENVIRONMENTAL
MANAGEMENT**

Status Of Integrated Waste Treatment Unit

Kevin O'Neill
Idaho Cleanup Project
February 21, 2018

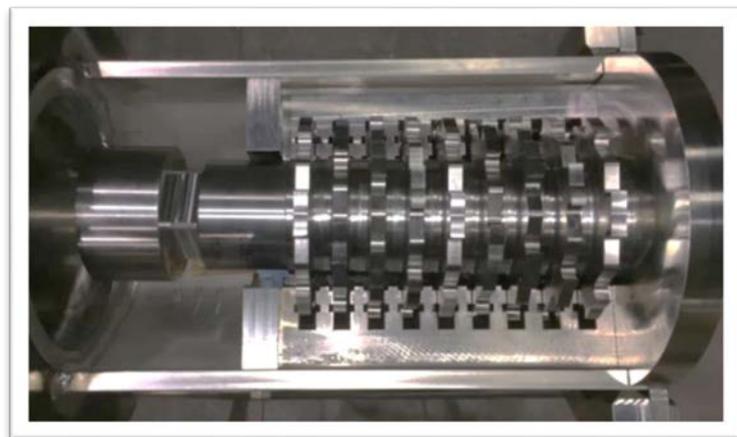
IWTU Background

- There are about 900,000 gallons of liquid radioactive waste stored in three stainless steel underground tanks at the Idaho Nuclear Technology and Engineering Center.
- The Integrated Waste Treatment Unit (IWTU) was constructed to treat the waste, but design and mechanical problems have prevented the beginning of waste treatment.



IWTU Overview / Objectives

- IWTU is a 53,000 sq. ft. facility designed to treat 900,000 gallons of Sodium Bearing Waste (SBW) using the Fluidized Bed Steam Reforming process.
- The process will convert SBW into a solid, granular, carbonate product for on-site storage pending final disposition.
- IWTU construction completed in 2011 and initial operational testing commenced in June of 2012.
- Process instabilities and equipment problems identified during non-radiological testing have delayed the transition to radiological operations.
- Instabilities are associated with the primary reaction vessel, the Denitration Mineralization Reformer (DMR), and include particle size control, difficulties maintaining fluidizing conditions and scale formation within the DMR.



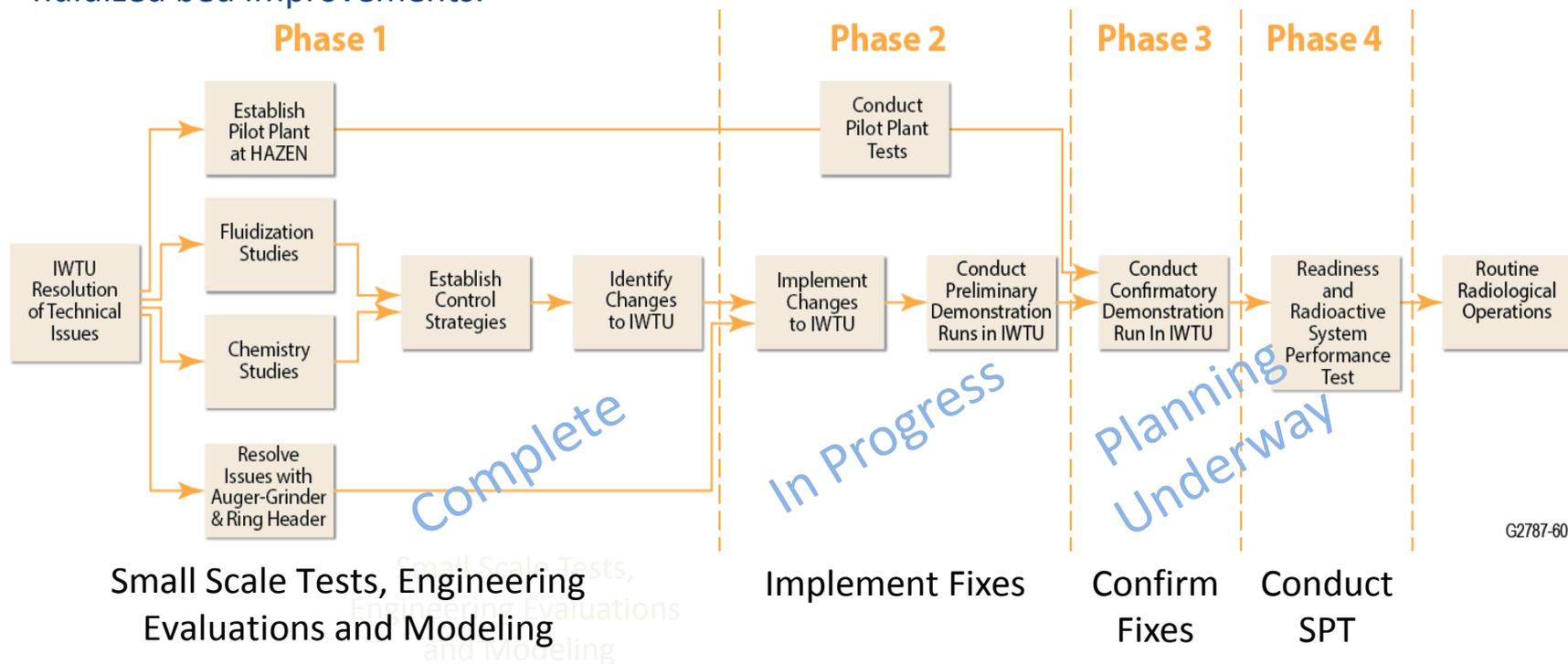
Modified Auger-Grinder



Pilot Plant Product

Approach to Address Remaining Issues

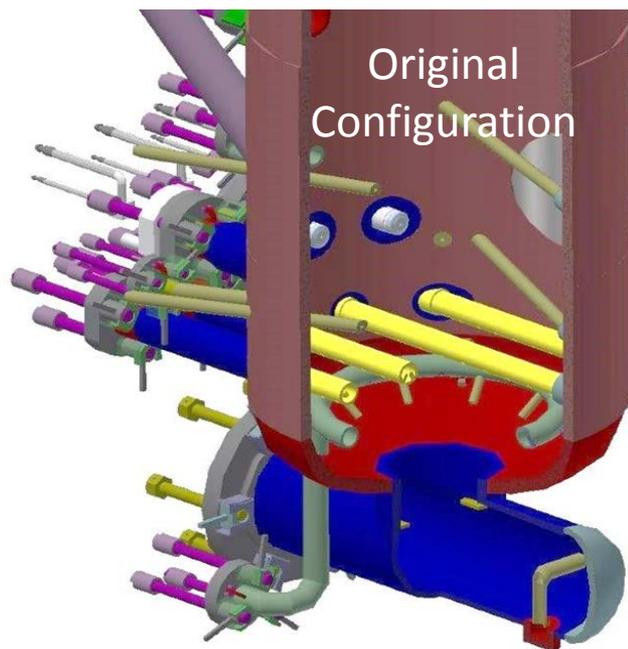
- Fluor Idaho has established a systematic, mechanistic based approach involving 4 phases to address issues with the IWTU
- A team of specialists was assembled to work with IWTU staff, including experts in fluidized bed technology that have solved similar problems in industry
- Fluor established a Technical Review Group consisting of subject matter experts from National Labs, industry and academia to provide input and advice
- Fluor has enlisted the Particulate Solid Research Inc. (PSRI) to assist in the testing and evaluation of fluidized bed improvements.



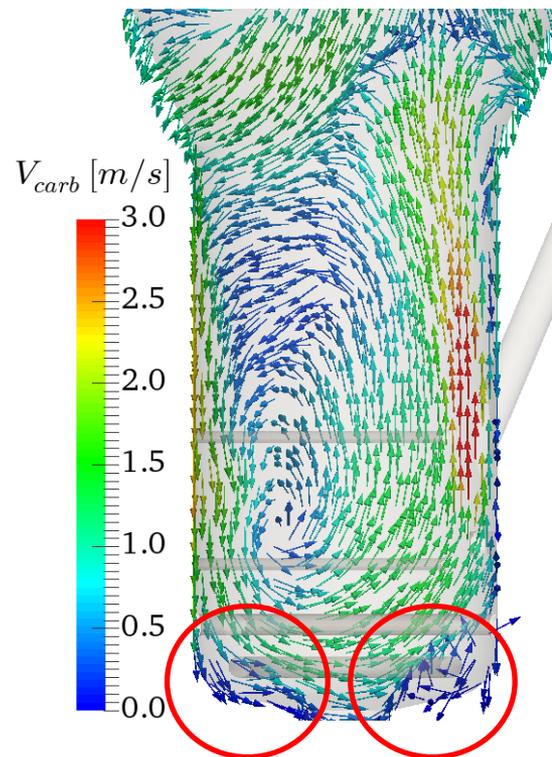
G2787-60

Denitration Mineralization Reformer

In areas of insufficient fluidization in the DMR, particles can settle or agglomerate and disrupt gas flow and mixing, resulting in temperature variations in the DMR, formation of sandcastles, further de-fluidization and other operational impacts.



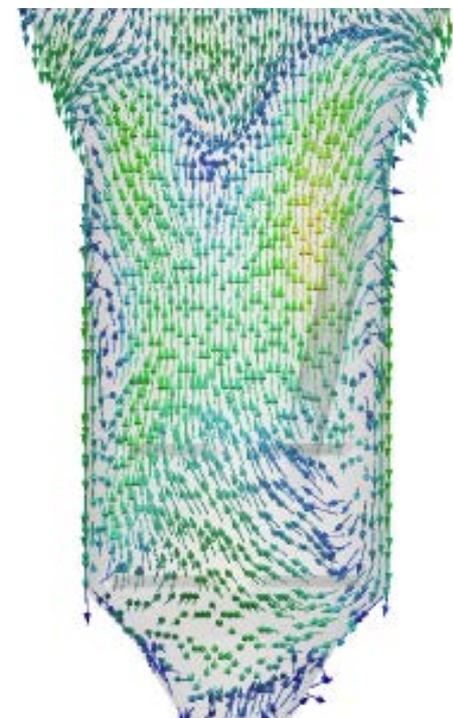
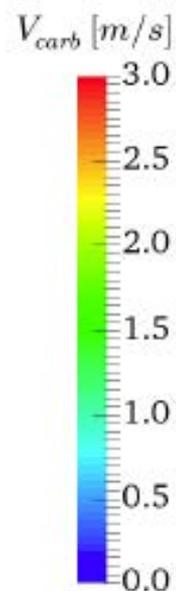
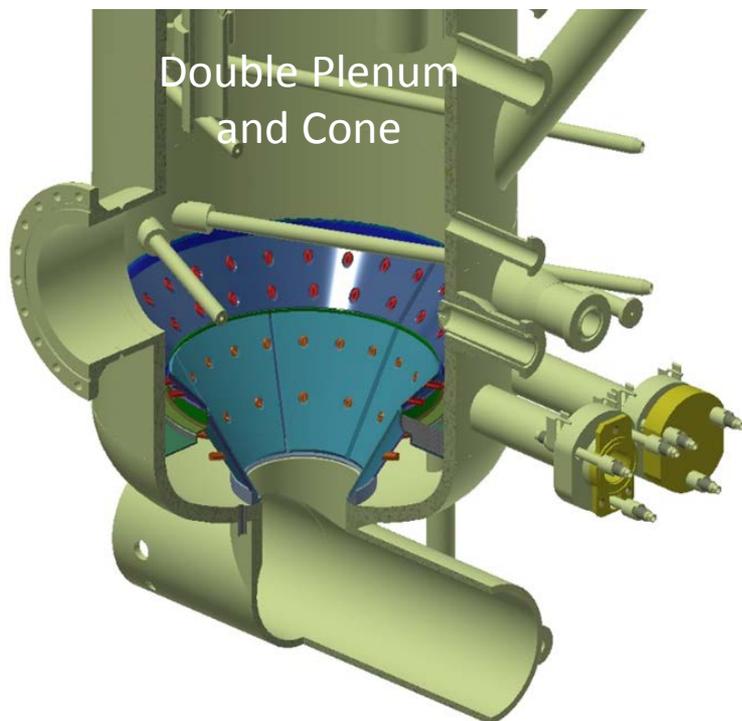
- Hemispherical bottom relatively flat with dead spots in corners.
- Several obstructions.
- Ring doesn't fluidize the media in the bottom and corners.



Model and Cold Flow Testing show areas of weak fluidization (red circles) where sandcastles can form.

Improved Fluidization

DMR has been modified to improve fluidization.

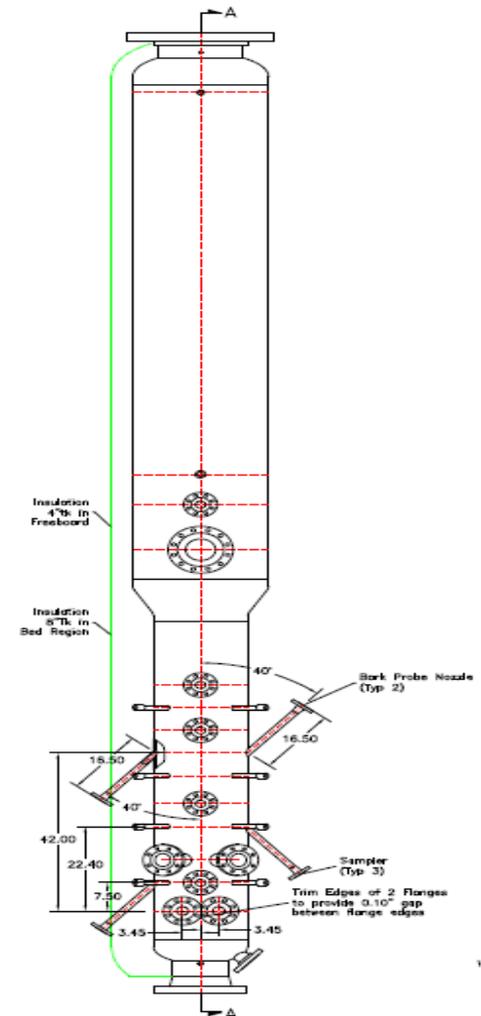


- Few obstructions.
- Cone limits potential for hold up and dead spots.
- Fluidization gases injected directly through wall of cone.

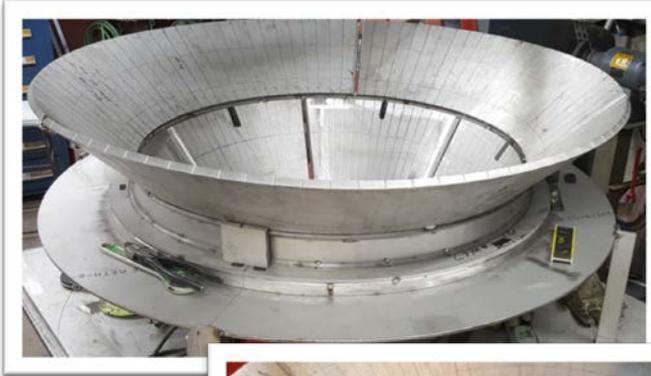
Model and Cold Flow Testing show improved fluidization; no areas of stagnation.

Hazen Pilot Plant Testing

- Hazen long term test - Series 5 - completed November 19, 2017.
- Operated for 39 days with a brief shutdown to change out a feed nozzle.
- 879 hours of operation - processed 11,211 gallons of simulated waste.
- Validated Cone and Double Plenum Design.
- Demonstrated effective particle size control – very important operational control parameter.
- Demonstrated process effectiveness over a wide range of operating conditions.



Cone and Double Plenum Fabrication and Installation



Pre-assembled
cone and plenum
divider

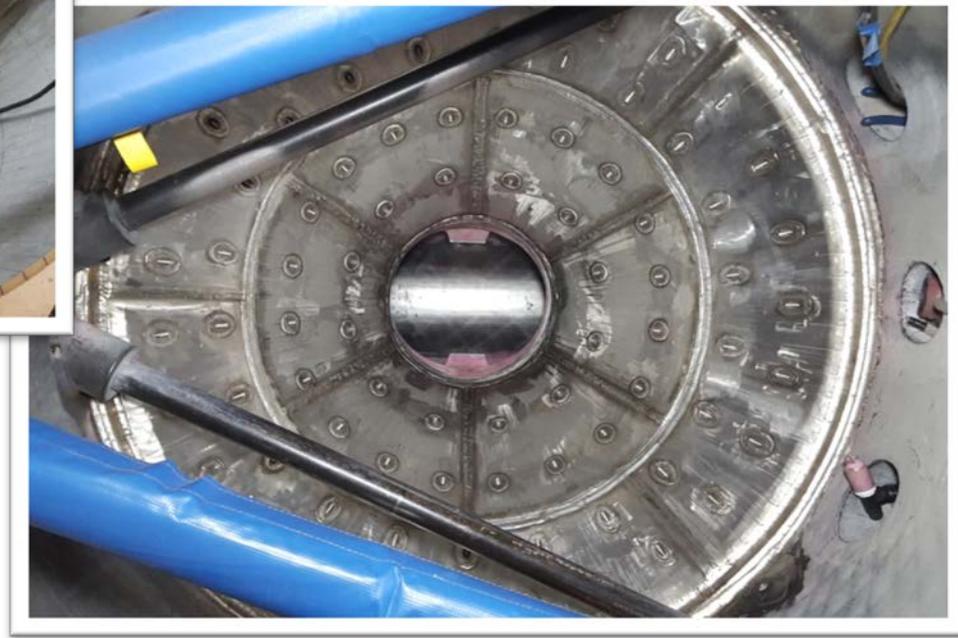


Upper cone and
nozzles

Holes being
drilled in the
upper cone



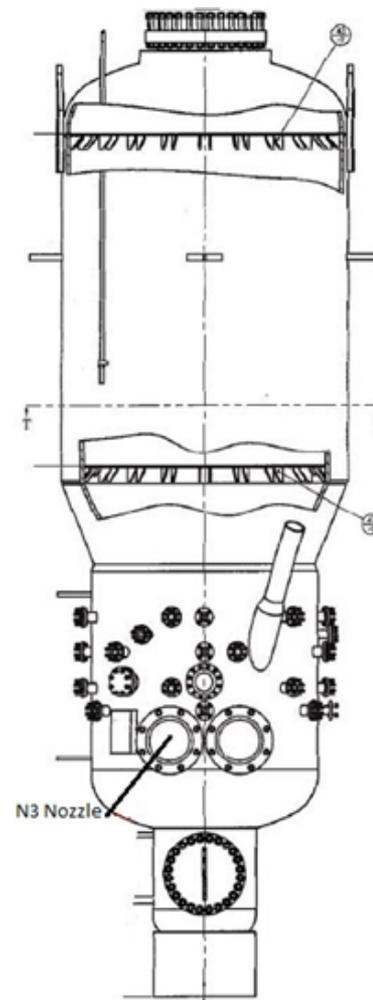
Lower cone sections



Cone and Double Plenum installed in the DMR

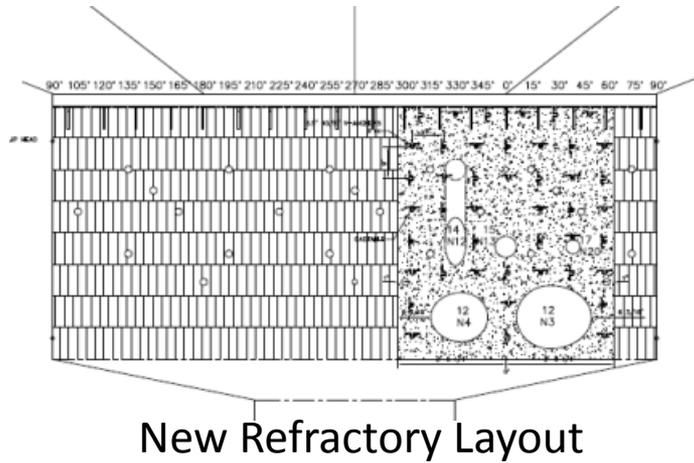
Carbon Reduction Reformer Refractory Repair

- Castable refractory in the CRR developed cracks due to thermal cycling.
- Replaced with brick refractory, small area of improved castable refractory.



Carbon Reduction Reformer

CRR Refractory Repair (cont'd)



New Refractory Layout



Castable Refractory



Brick Refractory

- Complete component and system testing following Outage I facility maintenance and modifications.
- Complete Readiness Review activities.
- Conduct Simulant Run 2
 - Verify satisfactory DMR fluidization
 - Anticipate 30 days of simulated feed
- Conduct Simulant Run 3
 - Verify satisfactory plant operations during long term operations at baseline conditions and at or near boundary conditions
 - Anticipate 50 day period of simulated feed
- Finalize Plan for Phases 3 and 4