U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

Integrated Waste Treatment Unit Overview and Status Defense Nuclear Facilities Safety Board

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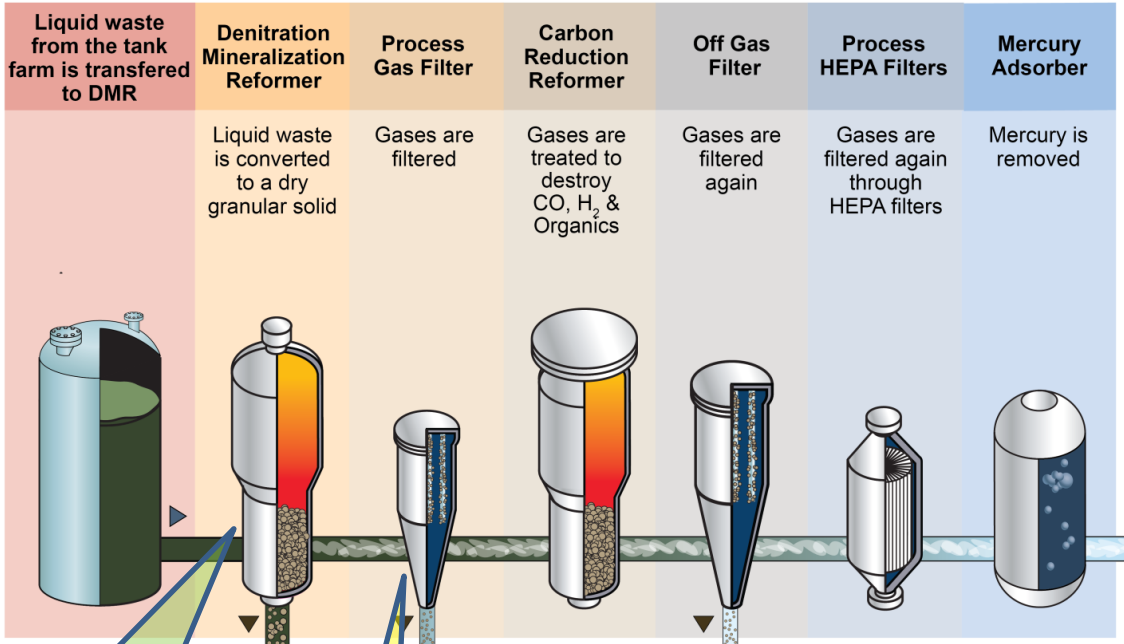
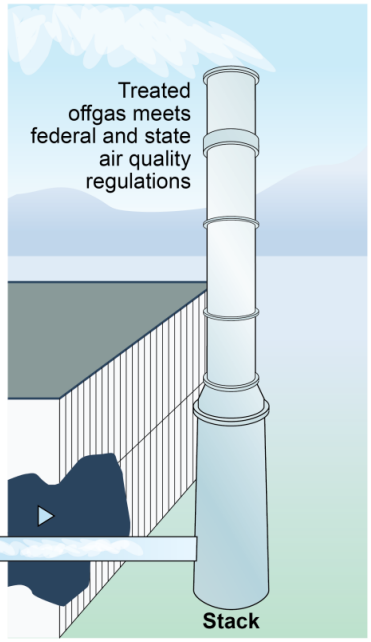
Topics of Discussion

- Background Information
- Denitration Mineralization Reformer Issues—Resolved
- Demonstration Run 2 Accomplishments
- Process Gas Filter Issue Resolution
- Facility Enhancements for Radiological Controls
- Demonstration Run 3 Objectives
- Summary

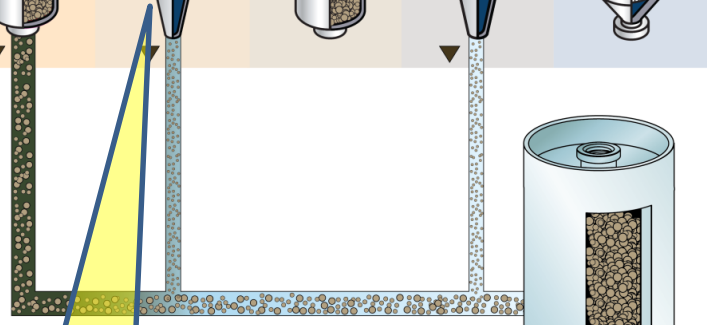
Integrated Waste Treatment Unit Process Flow

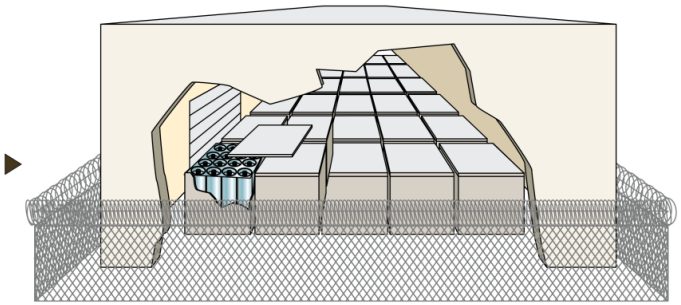




Main process issues associated with the DMR and Auger-Grinder resolved in Run 2

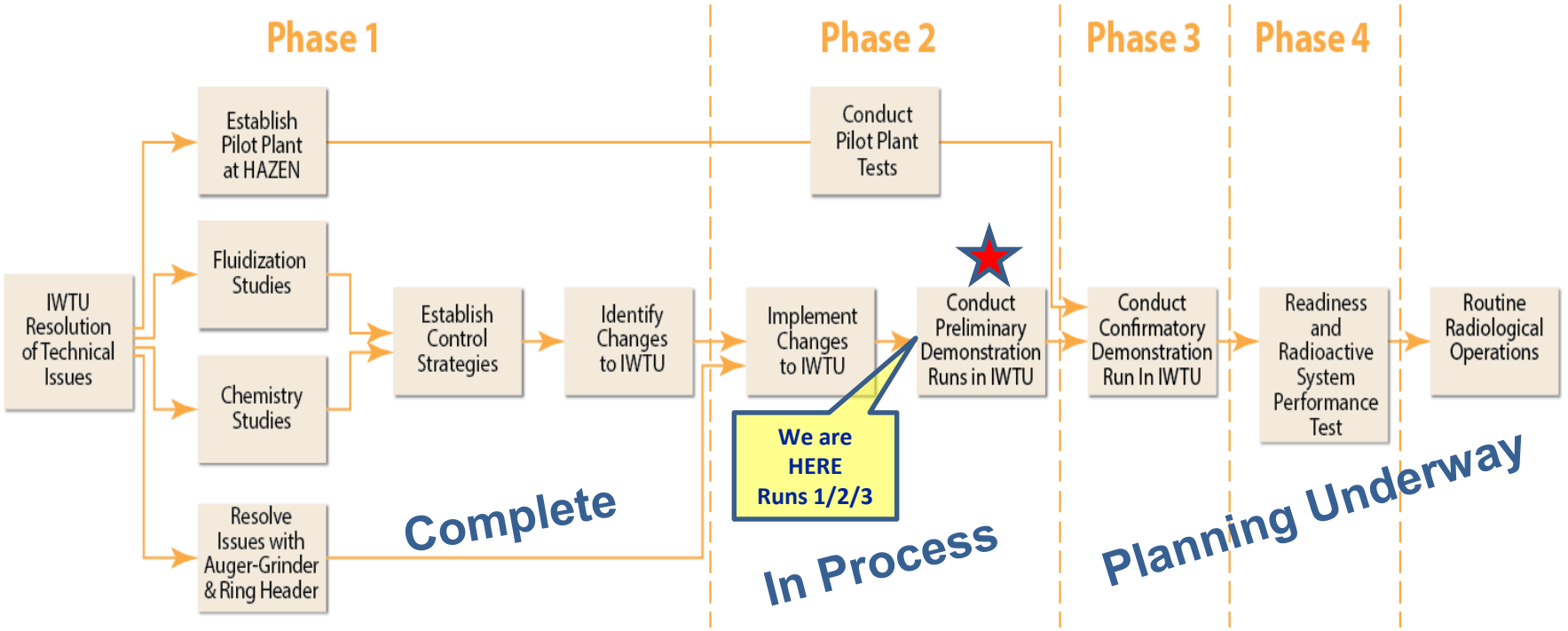
New issues identified with the Process Gas Filter (PGF)





The stainless steel canisters are then moved into concrete vaults each holding 16 canisters.

4-Phased Approach for the Integrated Waste Treatment Unit

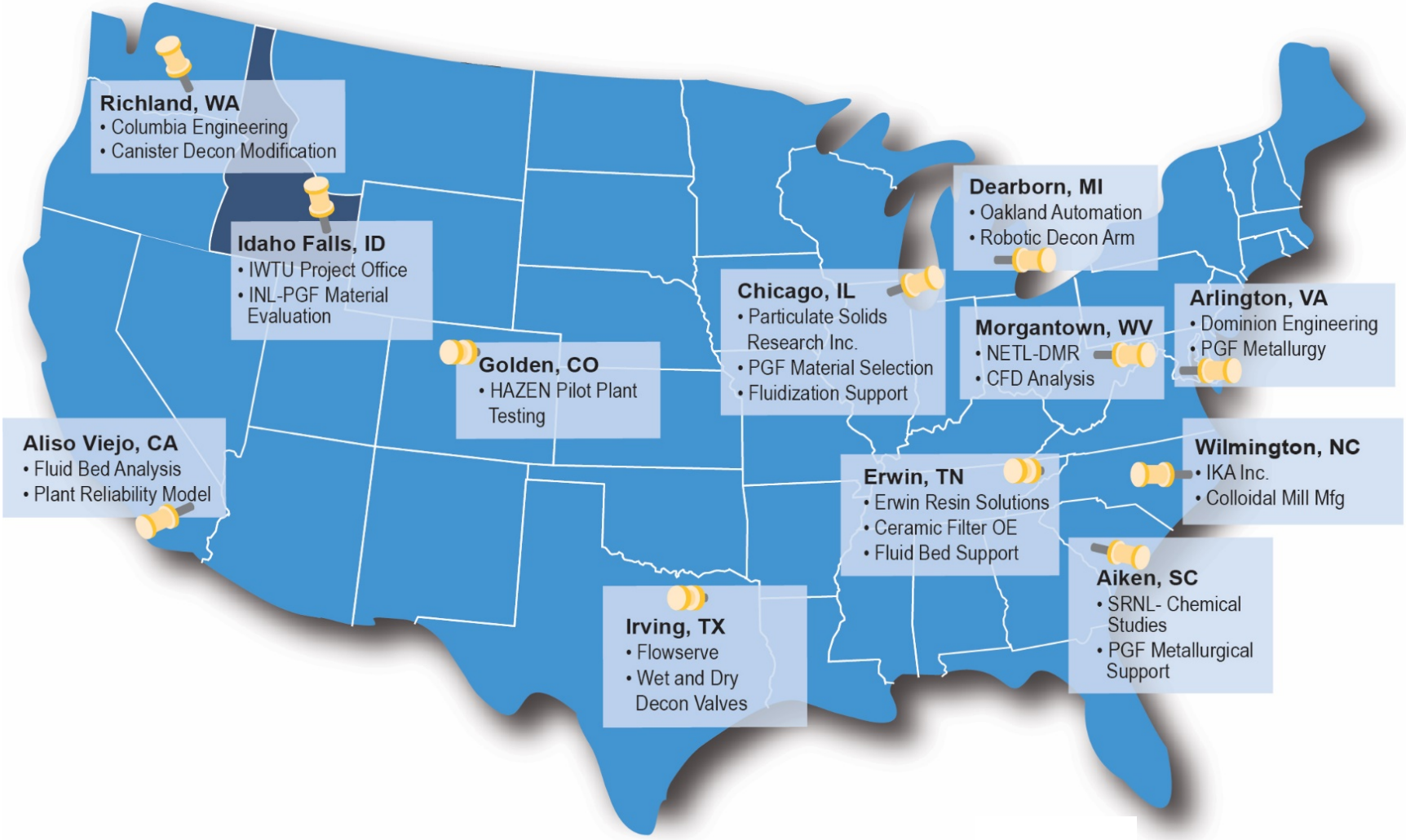


Objectives:

- Close Knowledge Gaps
- Confirm Operational Strategy & Implement Fixes
- Plant Mods & Confirm Fixes
- Conduct System Performance Test

The focus has been to resolve technical issues to get the plant operational. Emphasis is continuing on preparations for Rad Ops.

National Resources to Resolve Issues



Denitration Mineralization Reformer Issues--Resolved

Excellent Progress - Underpinned by Engineering and Scientific Principles

Wall Scale Formation and Control Mechanisms Defined

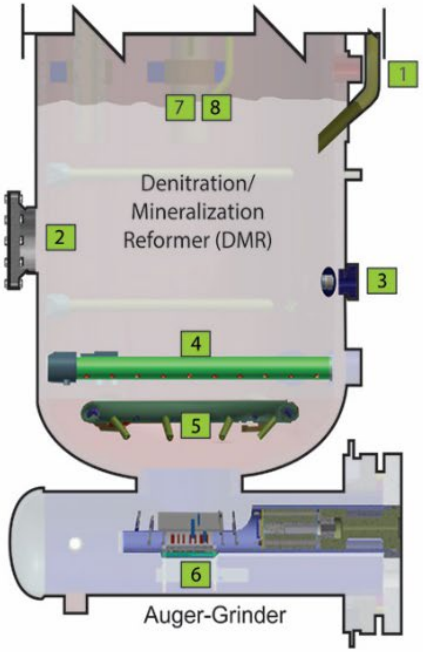
Wall Scale	
Observation	Wall Scale
Impact	Build-up of Scale Deposits
Solution	Reduce Waste Feed Rate
	Use all Three Waste Feed Injectors
	Increase DMR Operating Temp
	Implement Particle Size Control
1 3 7 8	Increased DMR Bed Depth

RESOLVED

Sandcastle Formation Mechanisms Understood. Implementing Changes

Formation of Sandcastles	
Observation	Sandcastles / Agglomerations
Impact	Temperature Fluidization Instabilities
Solution	Refine Fluidization Strategy
	Modify Fluidizing Gas Rails
	Implement Seeding Control
1 2 3 4	Requires Manway Access
5	Insure Sufficient CO_2

RESOLVED



DMR Instabilities are Primarily due to Sandcastles

DMR Instabilities	
Observation	Temperature Excursions
Impact	Instabilities, Shutdown
Solution	Refine Fluidization Strategy
1 4 5 7	Modify Fluidizing Gas Distributor
8	Implement Particle Size Control

RESOLVED

DMR Access Approach Resolved. Replace Ring with Alternative

Ring Header Damage	
Observation	Erosion of Ring Header
Root Cause	Jet from Fluidizing Gas Rails
Solution	Modify Fluidizing Gas Distributor
2 4 5	Requires Manway Access

RESOLVED

A-G Issues Successfully Addressed

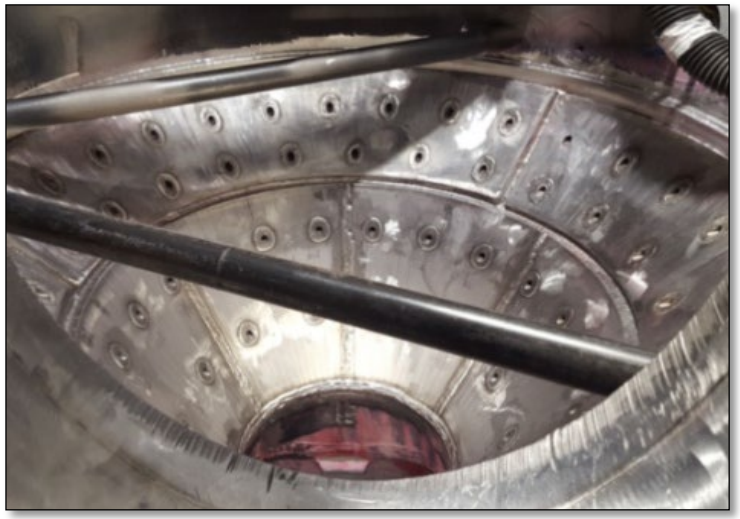
Auger Grinder Failure	
Observation	Auger-Grinder Locked Up
Impact	Inability to Transfer Product Results in Plant Shutdown
Solution	Auger Grinder Root Cause Analysis
	Industry Expert Consultant
	Extensive Prototype Testing
	Improved Purge Gas Strategy
	Improve Mechanical Design
6	Recovery Capability

RESOLVED

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

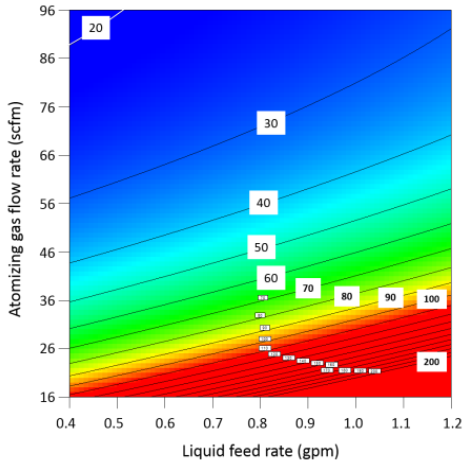
Phases 1/2 Accomplishments—Denitration Mineralization Reformer Modifications

Water Jet Cut of Denitration Mineralization Reformer, Fabricated Manway and Installed



Denitration Mineralization Reformer Double Plenum

Developed and Validated New Auger-Grinder During Demonstration Run 1



Waste Feed Nozzle Tests to Confirm Performance

Demonstration Run 2—Accomplishments

- Approximately 30-day Demonstration Run July 22, 2018 – August 22, 2018
- 53,380 gallons of sodium bearing waste simulant processed
  - 107,700 pounds of product transferred to 48 canisters
- New Denitration Mineralization Reformer Conical Distributor with dual plenum successful
  - No sand-castling or agglomerations
  - Minimal wall scale
- Achieved stable fluidization
- Increased Process Gas Filter differential pressure observed during Demonstration Run led to shutdown

Phases 1/2 Issues
Process Gas Filter Plugging

Approach / Status

- Formed data analysis team with members from
  - Particulate Solids Research Institute (PSRI)
  - Porvair Filtration Group Inc.
  - Dominion Engineering, Inc. (DEI)
  - Savannah River National Laboratory/Idaho National Laboratory (Battelle Energy Alliance)
- Charter
  - Identify additional potential causes of the Process Gas Filter plugging
  - Identify data, testing and analyses to be performed to identify the cause(s)
  - Make recommendations for issue resolution
- Short term goal – perform Demonstration Run 3
- Long term goal -- determine best strategy and modifications needed to complete mission

Process Gas Filter - filter bundle - caked

Radiological Control Enhancements

- Enhancing in-cell canister decontamination capabilities
  - Canister surveying and cleaning will utilize robot suction, and wiping
  - Plan to install and test decontamination system during next outage
- Designing wet and dry decontamination systems
  - Reduces source term prior to maintenance of process vessels and piping
  - Wet Decontamination system collects nitric “wash” from process vessels
    - To be returned to Waste Feed Tank or NWCF
  - Dry Decontamination system removes product material from DMR dual plenum
    - To be returned to solids handling system

Product canister in fill cell

Demonstration Run 3

- Primary Test Objective
  - Verify that the plant can be operated reliably
  - Remains within operating ranges
  - Able to recover from operating at or near the operating range limits
- Secondary Test Objectives
  - Perform “dry-run” off-gas emissions testing
    - Validate off-gas emissions testing procedures
  - Denitration Mineralization Reformer manway seal evaluation
  - Verify Product Receiver Cooler cross-connect duct
  - Assess solid product characteristics and storage requirements
- Feb 6 - Startup for Demonstration Run 3 initiated
  - Feb 20 – momentary power outage caused plant shut-down
  - Indications of Off Gas Filter hold-up during plant shutdown; cause was jet erosion
- Recovery actions are complete
  - Off Gas Filter jet repaired
  - Off Gas Filter to be evaluated during Demonstration Run 3

Overall Status / Perspective

- Demonstration Run 2 verified process flow sheet viability
  - Stable Denitration Mineralization Reformer temperature
  - Stable product particle size control
  - Effective product transfers
  - No Denitration Mineralization Reformer sand castles with minimal and manageable wall scale
- Process Gas Filter path forward
  - Expert based evaluation (PSRI, Porvair, National Lab, etc.)
  - Extensive pilot plant testing to confirm corrective actions
- Demonstration Run 3
  - Define plant operational boundaries
  - and conduct System Performance Test dry run
- Continued focus on radiological readiness and plant improvements