Sodium Bearing Waste Treatment Project Overview

U. S. Department of Energy

Office of Waste Processing Technical Exchange

Denver, Colorado

May 20, 2009

Keith Lockie, Deputy Federal Project Director

Project Mission/Contract

- **Mission**
  - The Sodium Bearing Waste Treatment Project (also known as the Integrated Waste Treatment Project) mission is to provide treatment of approximately 900,000 gallons of tank farm waste – referred to as sodium bearing waste (SBW) - stored at the Idaho Tank Farm Facility to a stable waste form suitable for disposition at the Waste Isolation Pilot Plant - (Idaho Settlement Agreement requires treatment by 2012)
- **Contract**
  - This project is part of the Idaho Cleanup Project contract, awarded to CH2M-WG Idaho, LLC (CWI) in May 2005.

Sodium Bearing Waste (SBW) Origin

- The SBW is comprised mainly of the tank waste remaining when calcination was stopped in 2000. It is a mixture of:
  - Decontamination solutions from cleanup of equipment and facilities, laboratory wastes, spent fuel basin water treatment discharges, off-gas cleanup scrub solutions, condensate from tank farm transfer equipment, contaminated facility sump water, other low activity miscellaneous plant wastes - collected over INTEC's history
  - Tank heel solids
  - Some 2nd/3rd cycle reprocessing wastes
  - Small volume of 1st cycle waste (reuse of 1st cycle waste tanks for SBW storage, without completely removing all 1st cycle waste from the tank bottoms – now commingled with SBW [~1 percent by volume])

General Characteristics of SBW

- Highly acidic, radioactive liquid (~ 1-3 molar H^+), slightly more dense than water (Specific Gravity ~ 1.3)
- Relatively homogeneous due to evaporation and consolidation activities – no distinct "layering" inside the tanks
- A volume of solid particles exists on the bottom of tanks in use for storage
  - The solids form a layer on the tank bottoms
  - Solids are typically light and relatively easy to move
- Contains constituents identified as "hazardous" under the RCRA - acid, metals, trace organics, requiring regulation by the State of Idaho

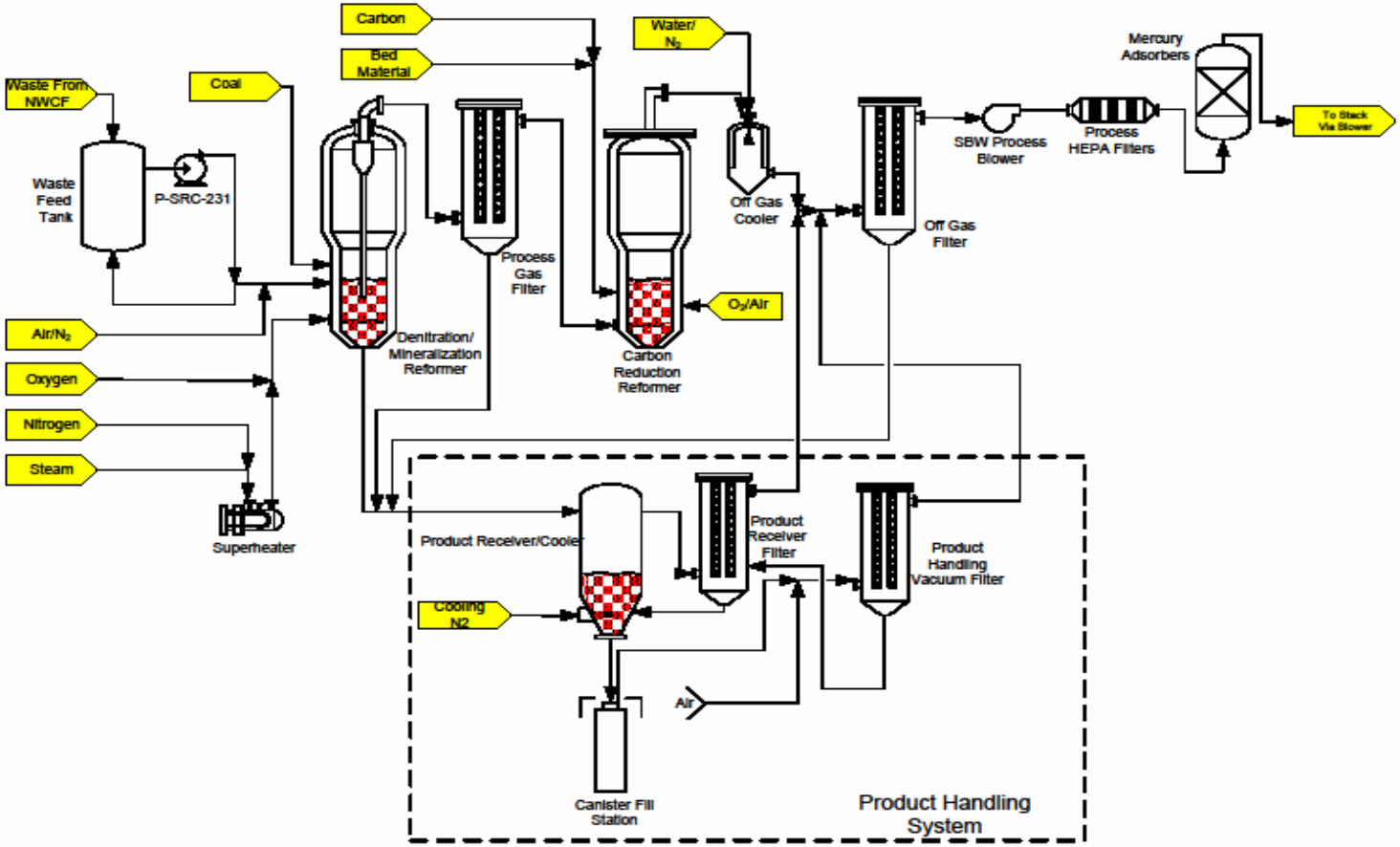
Project Description

- Steam Reforming technology converts acidic radioactive liquid waste to solid carbonate particles
- Process Building includes Performance Category 3 reinforced concrete process cells
- Produces ~ 650 remote-handled TRU waste canisters
- Product Storage Building provides interim storage for entire product volume

Steam Reforming Process

- Feed Collection/Transfer System
- Two Reformer Units
  - Denitration Mineralization Reformer (~640º C)
    - Bed fluidized by superheated steam
    - Steam/added oxygen react with carbon for process heat
    - Destroys trace organics, nitric acid/nitrates – converts dissolved chemicals into solid carbonate particulate product
  - Carbon Reduction Reformer (~950º C)
    - Added carbon/oxygen provide process heat
    - H_2, CO, short-chained organics oxidized to CO_2 and water vapor
- Process Gas Filter, Off-Gas Cooler, Off-Gas Filter, HEPA filters, and Mercury Adsorbers for off-gas clean-up
- Product Handling System
  - RH-TRU canisters
  - Concrete storage vaults hold a 4 X 4 array of loaded canisters

Steam Reforming Process Flow



		Waste Feed Tank	Denitration Mineralization Reformer	Process Gas Filter	Carbon Reduction Reformer	Off Gas Cooler	Off Gas Filter	HEPA	Mercury Adsorber	Product Receiver Cooler	Product Reciever Filter	PH Vacuum Filter
Material		304L SS	Haynes 556	Haynes 556	Carbon Steel/ Refractory Lined	AL6XN/ Hasteloy C-276	AL6XN	Hasteloy C-22	AL6XN	316 SS	316 SS	304L SS
Design Temperature	°F	174	1292	1256	730	800	482	437	392	1000	842	482
Design Pressure	psig	50	14	13	10	10	10	5	25	50	50	50

Product Waste Form

- Carbonate particulate waste form, suitable for disposal at WIPP as a remote-handled transuranic waste
- Disposal at WIPP requires a Class III permit modification
- Due to small volume of commingled reprocessing waste, some type of waste determination may be needed to conclude the waste is transuranic and not high-level waste
- Risk Mitigation includes designing and constructing the facility so that it could be converted to treat the waste for alternate waste disposal at Yucca Mountain if needed – design allows operation at higher temperatures (and footprint availability for clay additives) to produce a more durable, leach-resistant mineralized waste form

Product Disposal

- Facility has capability to provide interim storage of entire carbonate waste form, pending future approvals for disposal

Future Mission Potential

- Original facility design included capability for packaging and load-out compatibility with existing Idaho calcine waste
- Risk Mitigation for the project also includes designing and constructing the facility so that it could be converted for calcine treatment if necessary
- Required change from Performance Category (PC) 2 to PC-3 – significantly higher design loadings and analysis, resulting in:
  - enlargement of the process cell mat foundation
  - thickening of the process cell walls
  - changes from steel plate to concrete on some of the process cell walls
  - addition of strip footers (i.e., tie-beams) in the foundations under the process building
  - an increased number of columns in the process building to support building size increase, and
  - significant structural bracing growth.

Welding Issues During Fabrication of Process Vessels

- Denitration Mineralization Reformer and Process Gas Filter vessels fabricated from ~1 1/2 to ~ 2-inch thick Haynes 556 alloy material.
- Small cracks in the welds were discovered during weld examination of vessel heads
  - Cracks were determined to be caused by “hot tears” resulting from residual stresses generated during welding
  - Several month delay to develop improved weld process and determine maximum allowable flaw size prior to resuming production welding

Haynes 556 Vessel Fabrication

PGF cone section

DMR and PGF top heads

Project Cost and Schedule Changes

- Major changes to project scope/schedule since contract award
  - Risk mitigation design changes
    - alternative waste form capability – mineralized form
    - future calcine treatment mission capability
  - One-year delay in hot startup date to mitigate 2009 site funding limitations and project cost growth associated with design changes/design maturity/commodity price increases
- Baseline Change approved January 2009 increased total project cost from $461 M - $571 M, and delayed hot startup from July 2010 to August 2011

Pilot Plant Testing

STAR Center, Idaho Falls (2003 – 2004)

pilot-scale tests utilized 6” ID fluidized bed steam reformers

Engineering Scale Demonstration

Specification for Hazen Engineering Scale Facility:

First stage reformer: 15” ID fluidized bed (DMR)

Second stage reformer: 17”/24” ID fluidized bed (CRR)

Full flow sheet process with all unit operations

Carbonate Product – FY 2006

Mineralized Product – FY 2007

Construction Status

- Early site work began July 2007
- Weather enclosure erected November 2007 to maintain schedule during winter months
- Structural concrete placements on Process and Packaging Cells nearing completion
- Structural Steel erection in progress in Off-Gas and Mechanical Buildings
- Product Storage Building Foundation work commenced
- Weather enclosure removed April 2009
- Fabrication/delivery of major process vessel skids to complete by September 2009 – major milestone to set skids in cells to allow building enclosure by next winter

Facility Readiness and Start-up Planning

- Inspections, Tests, and Analyses, Acceptance Criteria (ITAAC) system being used by contractor to ensure facility systems have been constructed/installed/tested consistent with design requirements
- Procedure development and hiring of operations personnel in progress — plans to begin operator training program by September 2009.
- Integrated system testing to be performed in FY 2011 with waste simulant, along with a Comprehensive Performance Test to demonstrate operations within RCRA permit conditions
- Sequential contractor and DOE ORR planned, consistent with DOE Order 425.1C
- Operations campaign of ~ 15 months

Project Baseline Summary Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
IWTU Summary Schedule				
IWTU031	Fabrication	508	24MAR08	31MAR10
IWTU021	Procurements	806	24MAR08	20JUN10
IWTU041	Construction	597	24MAR08	09AUG10
IWTU011	Design Support	692	24MAR08	23DEC10
IWTU001	Permitting	790	24MAR08	17MAY11
IWTU042	Set IWTU Process Modules in Place	0		08SEP09*
IWTU051	Equipment System Checkout Testing	119	24MAY10*	09NOV10
IWTU071	Perform MSA for ORR	105	14JUN10*	09NOV10
IWTU043	IWTU Construction Turnover Complete	0		09AUG10
IWTU061	Test/SU Integrated Site Test/Simulant Run (SAT)	62	10NOV10*	13JAN11
IWTU081	CWI ORR	17	14JAN11	07FEB11
IWTU091	DOE ORR	48	08FEB11	14APR11
IWTU111	DOE Issue Approved CD-4 for IWTU	0		14APR11
IWTU121	Initiate Hot Startup	0		16APR11
IWTU123	Schedule Contingency	135	17APR11	31AUG11
IWTU131	IWTU Operations	413	01SEP11	17OCT12
IWTU141	Settlement Agreement Commitment Met	0		17OCT12

Start Date	26SEP05
Finish Date	17OCT12
Data Date	24MAR08
Run Date	30SEP08 15:27

Early Bar
Progress Bar
Critical Activity

LVL2 **IWTU Summary Schedule**

Date	Revision	Checked	Approved
30SEP08	EIR Comment Incorporation		

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Artist Rendition – SBW Treatment Facility Location at INTEC

July 16, 2007 Early Basemat Formwork

October 15, 2007 Weather Enclosure Installation

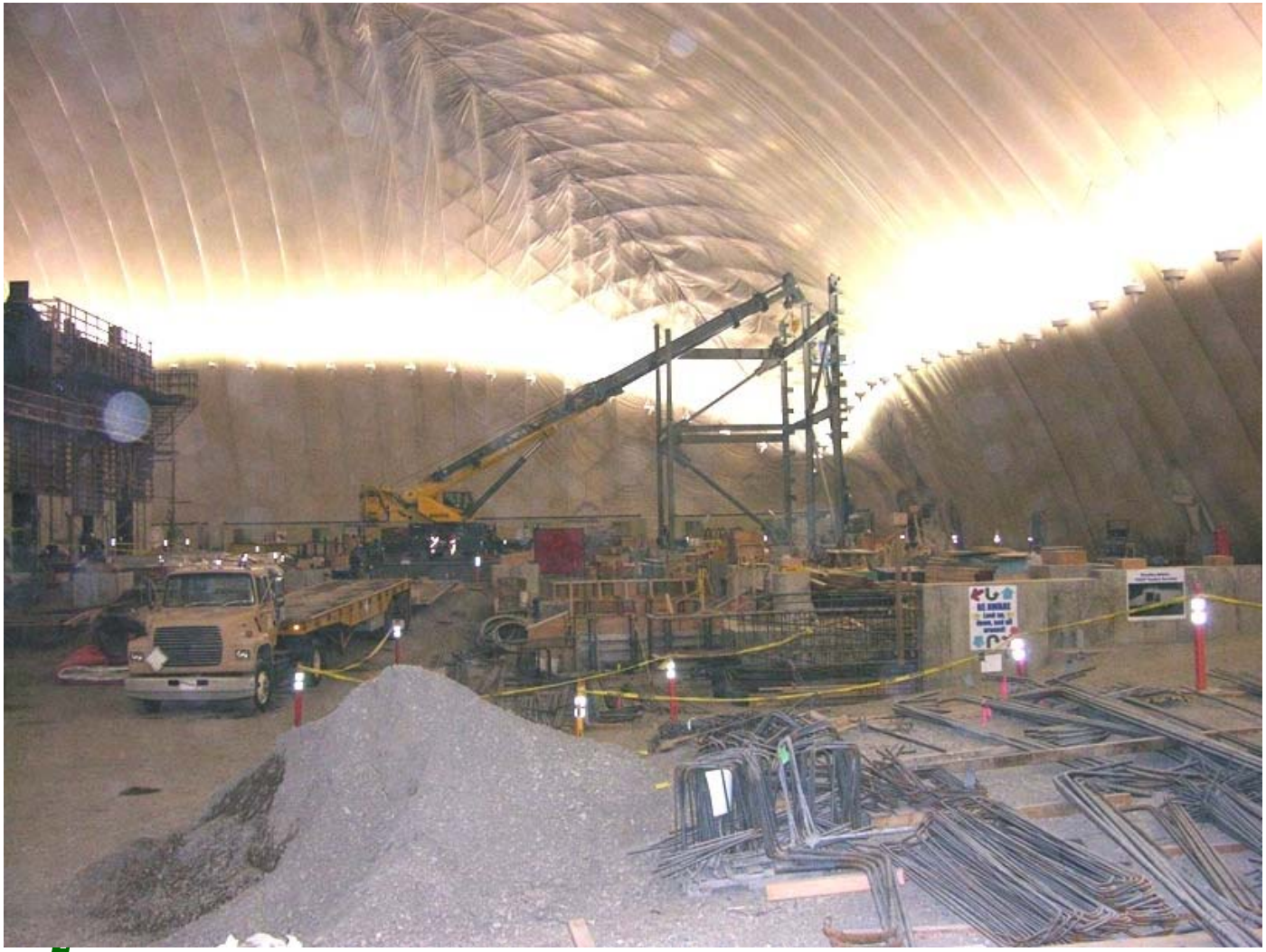
November 5, 2007 - Weather Enclosure In Place

March 10, 2008 Shield Wall Formwork in Progress

May 12, 2008 Rebar Density for Process Cells

September 16, 2008 Process Cells Concrete Work

December 16, 2008 Structural Steel Erection Commences



March 24, 2009 Concrete Formwork for Vault Load-out Area

April 17, 2009 Weather Enclosure Removal

April 29, 2009 Structural Steel Work Continues

May 7, 2009 Off-Gas Building Structural Steel

Questions?/Contacts

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