Implementation of Safety In Design for the Waste Solidification Building Project

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DOE ISM Champions Workshop
The Safety Component of Design

Biographies

Dennis Conrad

Over 33 years of nuclear industry experience covering a variety of processes including Reactors, Separations, and Waste Management with 16 years in technical management and 17 years in engineering. Have served on project teams for the past 13 years. Education consists of a B.S. in Physics from Georgia Institute of Technology and an M.S. of Physics from Purdue University. Currently providing engineering support for the WSB project providing direction for Safety Document development and configuration management.

Sterling Robertson

Over 30 years of nuclear industry experience including Metallurgy Laboratory, Reactor Materials, Tritium, Chemical Separations, Waste Management and Environmental with assignments in Engineering, Operations, Safety Basis and Project Management. BES in Mechanics and Materials Science Engineering from the Johns Hopkins University. Currently Design Authority Manager for the Waste Solidification Building Project.

"I expect safety to be fully integrated into design early in the project. Specifically, by the start of preliminary design, I expect a hazard analysis of alternatives to be complete and the safety requirements for the design to be established. I expect both the project management and safety directives to lead projects on the right path so that safety issues are identified and addressed adequately early in the project design."

Deputy Secretary of Energy
December 5, 2005

Outline

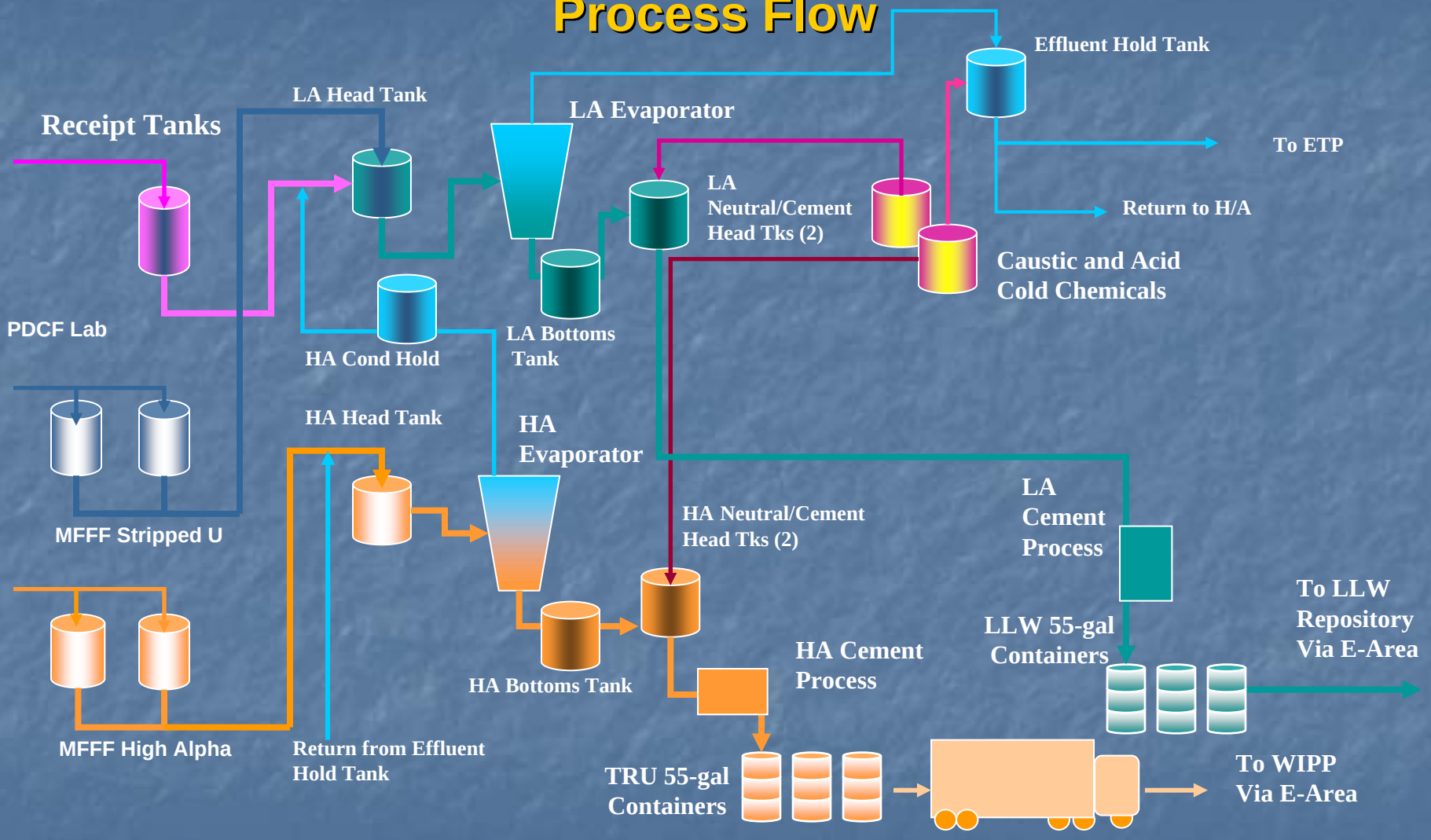
- WSB Project Overview
  - Process information
  - Safety Systems
- Impacts of DOE-STD-1189 to the WSB Project at CD-2/3
  - Timeline
  - Implementation Details
- Lessons Learned

WSB Project Overview

WSB Functions

- High activity (Am-241) and low activity liquid waste receipt and storage
- Liquid waste treatment (Wastewater treatment permitted facility)
  - Evaporation for liquid waste decontamination
  - Concentrated waste solidification by cementation
- Waste packaging and shipment for disposal

Waste Solidification Building Process Flow



WSB Description

- Hazard Category 2 Facility (per DOE-STD-1027)
- PC3+ seismic criteria and PC3 for other NPH for Safety equipment credited in NPH related DBAs
- >30,000 sq. ft. structure of reinforced concrete that is NPH qualified to survive seismic and tornado events
- HA process in stainless steel lined reinforced concrete seismically qualified process room with seismically qualified fire barrier walls
- NFPA code compliant wet pipe fire suppression system throughout WSB
- Active Confinement Ventilation Systems throughout facility (Process Vessel Ventilation System, Room Ventilation Systems, Glovebox/Hood Ventilation Systems, Building Ventilation System)
- HA process tanks, vessels and piping PC3+ seismically qualified
- LA process tanks, vessels and piping PC2 seismically qualified (negligible source term)

Passive Safety Systems

- Reinforced concrete seismic and tornado-resistant building structure
- Reinforced concrete seismic three hour fire barrier walls (surrounding HA Process Rooms, Cementation Areas & each Process Vessel Ventilation System)
- Stainless steel seismic HA tanks, piping and vessels
- Fire resistant construction in HA process rooms
- Jacketed transfer lines seismic (MFFF to WSB, samples, and process room to cementation)
- 3 Enclosures (Cementation, Sample and Lab)
- Overflow lines HAW vessels to prevent spills and protect time to CLFL

Active Safety Systems

- Fire Suppression in HA Process Area and Cementation Areas (not credited for post-seismic fire)
- HA Process Room and Enclosures Ventilation System (not credited for post seismic event)
- Diesel Generator
- HA Process Vessel Ventilation System (credited for post seismic hydrogen explosion prevention however, filtration not credited for post-seismic fire release mitigation)
- Evaporator Interlocks for red oil explosion prevention
- SC Evaporator Vent Path for red oil explosion prevention

WSB Implementation of 1189 Time Line

- Final Design re-started – 8/06
- DOE-STD-1189 issued – 3/08
- DNFSB dedicated project review & NNSA direction to implement DOE-STD-1189 – 4/08
- Design complete – 5/08
- CD-2/3 Package including PDSA submittal – 7/08

Keys to Successful 1189 Implementation Strategy

- SRS engineering practices required early integration of safety with design
- SRS and NNSA worked closely together with safety strategy development and integration
- Reasonable conservatisms employed early on with safety analysis and control selection

Print
Close

Project & Safety Timelines

Topic	Project	Safety	Risk
2002		May – HC-2 Determination May – Preliminary Hazards Evaluation Rev. 0 June – PHE Rev. 1	July – ROAR Rev. 0 Sept – ROAR Rev. 1 Nov – ROAR Rev. 2
2003	Feb - Preliminary Design Initiated July – Preliminary Design Complete	Jan – PHE Rev. 2 Feb – Safety Basis Implementation Plan Rev. 0 & PDSA draft start June – PHE Rev. 3 Sep – FPD direction on seismic	Dec – ROAR Rev. 3

Project & Safety Timelines

Topic	Project	Safety	Risk
2004	Feb – Project Suspended		
2005	Suspension		
2006	Feb – Preliminary CD-2 submittal Oct – Design Team re-established	Nov – DNFSB Recommendation 2004-2 evaluation started	

Project & Safety Timelines

Topic	Project	Safety	Risk
2007	CD-2/3 being pursued	Jan – Consolidated Hazards Analysis Process initiated April – Safety Basis Strategy Rev. 0 May – Draft CHAP issued October – Safety Design Strategy Rev. 0	

Project & Safety Timelines

Topic	Project	Safety	Risk
2008	July – CD-2/3 package submittal	Mar – DOE-STD-1189 issued Apr – DNFSB Project Review & NNSA decision to implement DOE-STD-1189 May – CHAP Rev. 0 and DOE-STD-1189 impl. strategy approved June – CHAP Rev. 1 July – PDSA issued and SDS Rev. 1 Nov – SDS Rev. 2	June – ROAR Rev. 4 Nov – ROAR Rev. 5

SRNS Engineering Practices Generally Address STD-1189 Elements

- Multidisciplinary teams perform Consolidated Hazard Analysis (CHA)
  - Vulnerability analyses
  - DBA used for preliminary hazard analysis identification
  - Equipment functional classification
  - Design hazard analysis
- Risk & Opportunities analysis

WSB Safety Documentation

- Safety documentation developed for WSB
  - Preliminary Documented Safety Analysis
  - Facility dose calculations
  - Nuclear Criticality Safety Evaluation
  - Active confinement system evaluation
  - Unmitigated & mitigated consequence analysis
  - Design Process Hazards Review
  - Fire Hazards Analysis
  - Radiological Sabotage Analysis

WSB Safety Approach

Develop & Implement Controls

- Base safety documentation development on conservative inputs – don't sharpen the pencil
- Based on the safety documentation developed, implement facility features to minimize dose to:
  - Off site public
  - Co-located Workers
  - Facility Workers – classify
- Active Confinement Ventilation System
  - Ensure that the building ventilation is maintained during identified accident scenarios
- Fire Protection Systems
  - Credit structures for NPH events and fire suppression for non-NPH events

DOE-STD-1189 Implementation

- Implementation authorized through formal documented change control process
- Established scope/strategy (what to include as appropriate for final design while "respecting" project timeline) for modification of PDSA
- Perform evaluations and reviews
- Revised PDSA to include DOE-STD-1189 implementation required changes

Scope

- Instead of rewriting PDSA to match DOE-STD-1189 format guidance, utilize crosswalk to “map” existing content to DOE-STD-1189 format outline
- Only the deliverables that DOE-STD-1189 requires for final design were considered. For example a DOE Order 420.1B crosswalk, CSDR, PSDR, were not included
- No update is needed to Safety Basis Strategy, QAP, FDD, SDD, or Risk Assessment

Implementation

- Add Chapter 18 to PDSA to illustrate compliance with DOE-STD-1189 to include
  - Table of revised unit curie consequence calculation from 1189 X/Q methodology
  - Discussion of additional events that require controls
  - Chemical evaluation
  - A format/content crosswalk between 3009 and 1189
  - A Seismic Analysis Crosswalk
  - CIPT and SDIT crosswalk
  - Reference SE List, Draft procedures, and Operator Qualification requirements

Results

- Chemical Analysis did not identify the need for any controls
- Fire scenario dose value of 7.3 Rem exceeds 5 Rem, Safety Significant controls were justified
- Identified 10 additional events requiring SS controls for the co-located worker
  - The confinement ventilation system proved adequate for 4 events
  - The process vessel ventilation system adequate for 1 event
  - The transfer line and jacket were adequate for 4 events
  - Revisited accident scenario assumption to prevent exceeding CW dose limits for 1 event
- Previous seismic analysis was conservative relative to DOE-STD-1189 methodology
- Existing SRS methods for Integration of Safety with Design met intent of DOE-STD-1189 for early identification of safety requirements and effective teaming of stakeholders

Lessons Learned

- Early and often integration of safety with design helps to avoid last minute surprises (WSB experienced only minor changes)
- Strong and effective relationships between contractor, customer and “regulators” are essential
- Communicate, Communicate, Communicate
- A reasonably conservative, don’t sharpen the pencil approach, worked very well (Choose where to spend your time and money – on controls or on calculations)
- Creative strategy for “11th hour” implementation successful

Questions

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