



Defense Nuclear Facilities Safety Board
presentation to
Nuclear and Radiation Studies Board

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Defense Nuclear Facilities Safety Board: Overview

- Executive Branch Agency dedicated to providing independent nuclear safety oversight of DOE Defense Nuclear Facilities
 - *Oversight, not regulation*
- Comprised of 5 Presidentially appointed members (including a Chairman & Vice-Chairman)
 - Required by law to be respected experts in the field of nuclear safety with a demonstrated competence and knowledge relevant to the independent investigative and oversight functions of the Board
- Supported by a Technical Staff of ~60 engineers and scientists
- 11 members of the Technical Staff assigned as resident Site Representatives at DOE Defense Nuclear Facilities



Defense Nuclear Facilities Safety Board: Functions & Powers

- **Functions.** With regard to the design, construction, operation, and decommissioning of DOE defense nuclear facilities:
 - Review and evaluate standards
 - Content and implementation
 - Areas requiring additional data or research
 - Investigate any event or practice that adversely affects public health & safety
 - Analyze design and operational data
 - Review facility design and construction
 - Make such Recommendations to the Secretary of Energy as the Board determines necessary to protect public health & safety
- **Powers.**
 - Hold hearings
 - Levy reporting requirements
 - Conduct special studies
 - Station Site Representatives



Defense Nuclear Facilities Safety Board: Purview

- “DOE Defense Nuclear Facility” means:
 - A production facility or utilization facility under the control or jurisdiction of the Secretary of Energy (SOE) and operated for national security purposes
 - A nuclear waste storage facility under the control or jurisdiction of the SOE
- Exclusions:
 - Naval Nuclear Propulsion Program
 - Transportation of nuclear explosives or material (Dept. of Transportation)
 - Any facility owned by the United States Enrichment Corporation
 - Any facility developed pursuant to the Nuclear Waste Policy Act of 1982 and licensed by the Nuclear Regulatory Commission (NRC)
- What this means in practice:
 - Most DOE facilities under the Office of Environmental Management (EM), plus a few in the Office of Science (SC) and Office of Nuclear Energy (NE)
 - Most National Nuclear Security Administration (NNSA, or NA) facilities



Defense Nuclear Facilities Safety Board: Purview

- EM sites of high interest to the Board:
 - Hanford Site
 - Oak Ridge National Laboratory
 - Savannah River Site
 - Idaho National Laboratory
 - Savannah River National Laboratory
 - Waste Isolation Pilot Plant
- NA sites of high interest to the Board:
 - Los Alamos National Laboratory
 - Nevada Test Site
 - Sandia National Laboratories
 - Y-12 National Security Complex
 - Lawrence Livermore National Laboratory
 - Pantex Plant
 - Savannah River Site



Defense Nuclear Facilities Safety Board: Range of Challenges

- Examples of the range of EM Defense Nuclear Facilities:
 - Still being designed & constructed:
 - Hanford Site - Waste Treatment & Immobilization Plant
 - Savannah River Site - Salt Waste Processing Facility
 - Relatively new:
 - Savannah River Site - Modular Caustic Side Solvent Extraction Unit (MCU) / Actinide Removal Process (ARP)
 - Oak Ridge National Laboratory - TRU Waste Processing Center
 - Old but still in use:
 - Savannah River and Hanford Sites – Single Shell High-level Waste Tanks
 - Savannah River Site - H Canyon
 - Active D&D:
 - Hanford Site – Plutonium Finishing Plant
 - Hanford Site - K Basins



Defense Nuclear Facilities Safety Board: Technological Areas

- Examples of the range of EM technologies:
 - Nuclear chemical processing (e.g., spent nuclear fuel, special nuclear material)
 - Fluidized Bed Steam Reforming
 - Wet Air Oxidation
 - Vitrification (e.g., glass, bulk, in situ)
 - Solidification (e.g., cementation, grouting)
 - Mobilization of solids (e.g., salt mantis, sand mantis, fold-track)
 - Transfer & mixing of liquids (e.g., Newtonian, non-Newtonian)



Defense Nuclear Facilities Safety Board: Research Challenges

- Examples of the types of regulatory research that will improve safety within the EM complex:
 - High Efficiency Particulate Air (HEPA) filter service life
 - Airborne Release Fractions / Respirable Fractions
 - Leak path factor modeling
 - Long-term storage container (e.g., 3013 canister) performance
 - High-level waste tank corrosion mechanisms
 - Liquid-air interface corrosion mechanisms
 - Specific products of combustion
 - Combustion product transport mechanisms
 - Seismic Soft Zone Investigation Program



Defense Nuclear Facilities Safety Board: R&D Case Study #1

- Integrated Waste Treatment Unit (IWTU) @ Idaho National Laboratory
 - Converts ~900,000 gallons of sodium-bearing waste to a solid product
 - Uses steam reforming technology
- Key R&D Activity
 - A one-tenth scale pilot plant was constructed at Hazen Research, Inc.
 - Demonstrated integrated operation of the IWTU process
 - Confirmed process chemistry and mass and energy balance calculations
 - Demonstrated acceptability of the waste product and off-gas emissions
 - Valuable lessons learned
 - Acceptability of sintered metal in the high-temperature process gas filter
 - Control set to prevent and mitigate a charcoal adsorber bed fire
- Technical Challenges Identified by the Board
 - Structural adequacy and seismic demands from a shallow-soil site
 - Distributed control system fail-safe logic
 - Rapid shutdown system sensitivity to safety-related operating parameters
 - Mercury adsorber bed over-temperature control set



Defense Nuclear Facilities Safety Board: R&D Case Study #2

- Waste Treatment and Immobilization Plant (WTP) @ Hanford Site
 - Treats waste currently stored in up to 177 high-level waste tanks
 - One key issue involved fire safety design for confinement ventilation systems
- Key R&D Activity
 - Develop an alternative means of protecting the final exhaust HEPA filters
 - Demonstrate equivalency to DOE Standard 1066, *Fire Protection Design Criteria*
- Technical Challenges Identified by the Board
 - Analytical models to demonstrate equivalency to DOE Standard 1066
 - Models require considerable development or modification, followed by extensive V&V
 - Board concern – insufficient time and budget to develop the detailed scientific basis
 - DOE suspended work to pursue a tailored implementation of DOE Standard 1066
 - New design incorporates three important features:
 - Ember screens on the inlets to the system
 - A bypass to allow safe change-out of the second filter stage
 - Fire suppression (added to the hot cell crane and cable)



Defense Nuclear Facilities Safety Board: R&D Case Study #3

- Salt Waste Processing Facility (SWPF) @ Savannah River Site
 - Separates actinides, strontium, and cesium from high-level tank waste
 - Uses a monosodium titanate sorption process and caustic-side solvent extraction
- Technical Challenges Identified by the Board
 - Incomplete design requirements for safety-related flammable gas systems
 - Confinement ventilation system does not meet DOE Standard 1066
 - Seismic demands of a soft-zone site
- Key R&D Activity
 - Experiments (SRNL & INL) to quantify the thermolytic component of H₂ generation
 - Testing confirmed that thermolysis is not an issue for SWPF
 - Evaluation of effects of heat input from air pulse agitators on generation of gasses
 - Air pulse agitator heat input now considered in development of safety basis controls
 - Demonstrate equivalency to DOE Standard 1066, *Fire Protection Design Criteria*
 - Determined ember screens and a manual water spray system are appropriate
 - Currently documenting adequacy relative to DOE Standard 1066
 - Georgia Institute of Technology Soft Zone Investigation Program



Defense Nuclear Facilities Safety Board Vision

- The Defense Nuclear Facilities Safety Board will continue to provide technical oversight of DOE's Defense Nuclear Facilities in order to ensure the safety of workers, the public, and the environment while fulfilling the national defense mission.
- Fulfilling this vision will require the Board to place an enhanced emphasis on DOE's nuclear safety research and development function as a means to foster continuous safety improvement.