Defense in Depth

Linda Suttora, DOE; Andrew Wallo, DOE*

DOE Office of Environmental Management
DOE Office of Environment, Health, Safety and Security
Savannah River National Laboratory

July 16, 2014

Defense in Depth Approach

Linda Suttora
Office of Environmental Compliance (EM-11)
DOE Office of Environmental Management

Andrew Wallo III
Deputy Director, Office of Environmental Protection, Sustainability Support and Corporate Safety Analysis (AU-20)
DOE Office of Environment, Health, Safety and Security

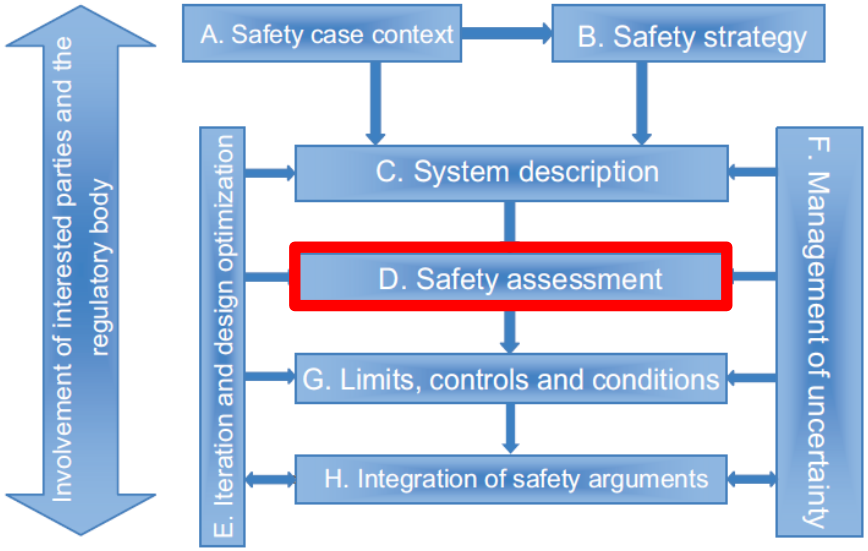
Introduction

DOE has successfully implemented an integrated protection system for near surface disposal for more than 25 years, including:

- DOE Radioactive Waste Management Basis (RWMB) is similar to the IAEA Safety Case approach
- Defense-in-depth and total systems perspective
- Seeking common approaches with other promulgated Federal requirements for near-surface disposal
- Consider recommendations from International organizations
- Risk-informed and performance-based approach with disposal based on site and waste characteristics

DOE System of Regulations for Near-Surface Disposal

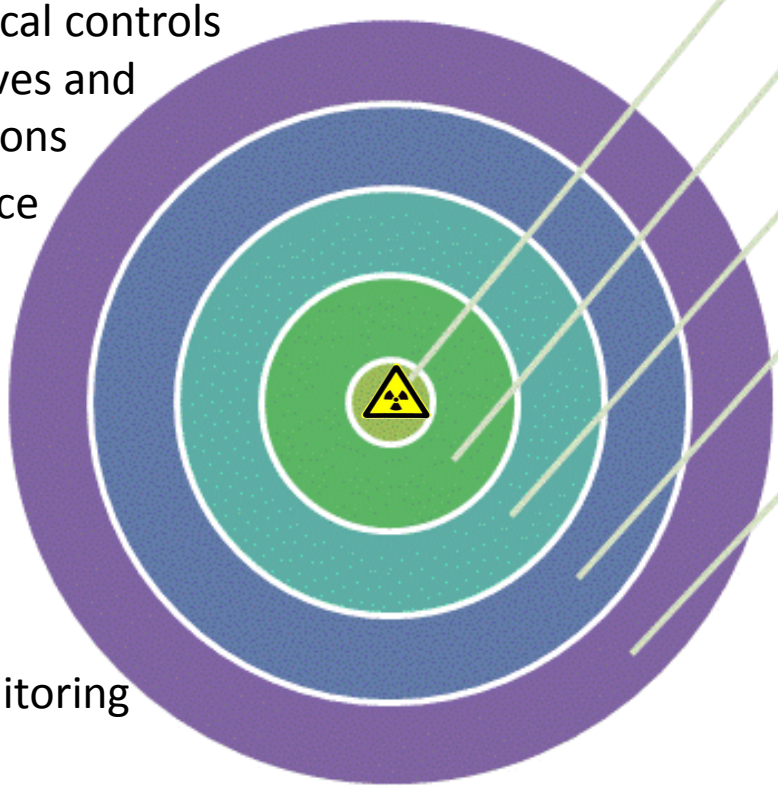
- Integrated approach to safety using defense-in-depth principles (similar to Int'l Safety Case concept)
- Performance Assessments (PAs) are one part of an integrated approach to safety
- Consistency with other regulations for near-surface disposal and consideration of int'l recommendations
- Risk-Informed, Performance-Based for more than 25 yr



IAEA Safety Case Concept

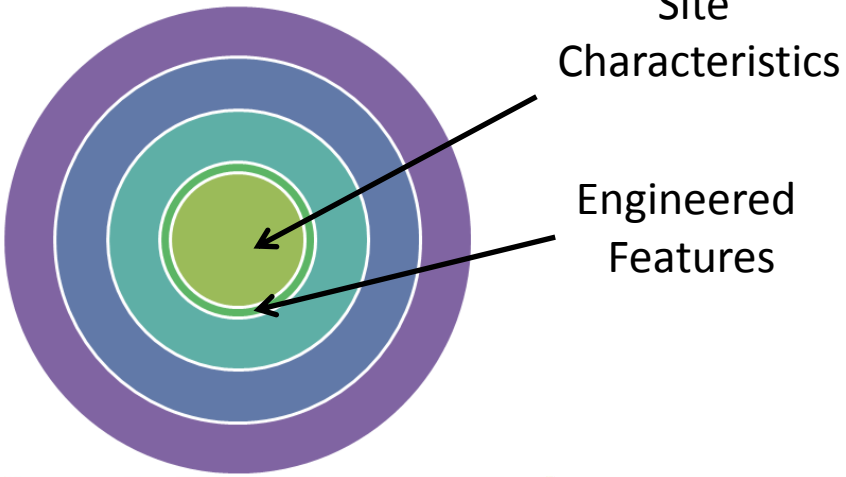
Defense-in-Depth

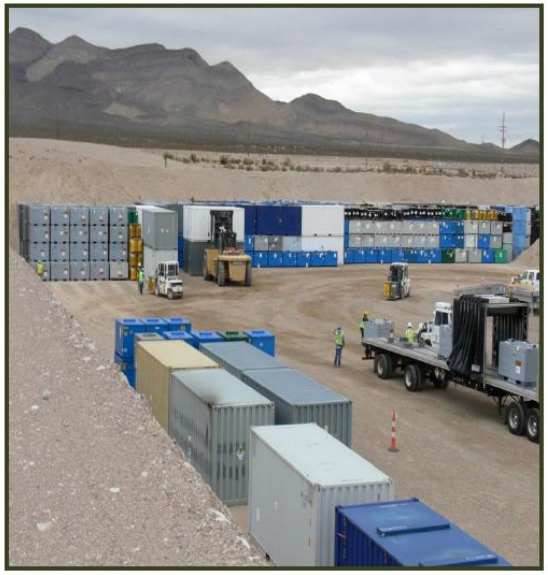
- Integrated, total systems approach to safety
  - Site characteristics which provide geologic and hydrologic barriers
  - Facility design – Engineered barriers
  - Administrative & technical controls
- Conservative bias in objectives and assumptions for PA calculations
- Site-specific waste acceptance criteria and rigorous waste generator certification
- Federal ownership and necessary buffer zones until site can be released
- Commitment to continuous improvement with PA maintenance, including monitoring
- Permanent maintenance of records



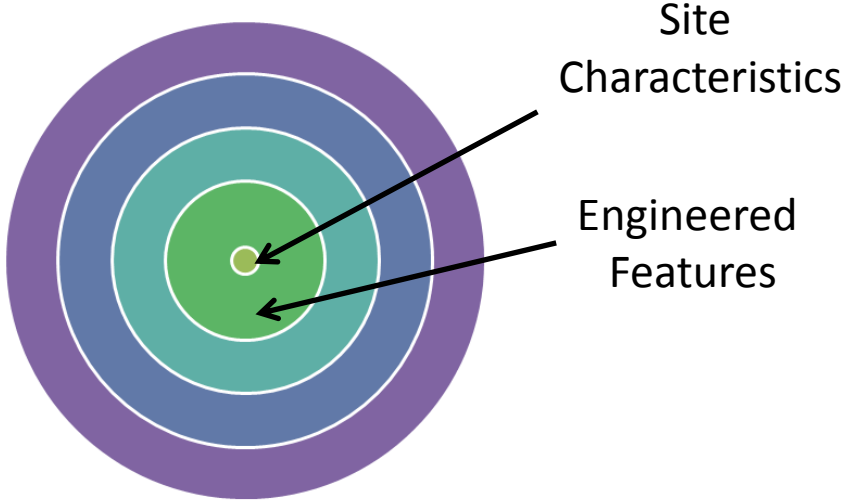
Site-Specific Implementation

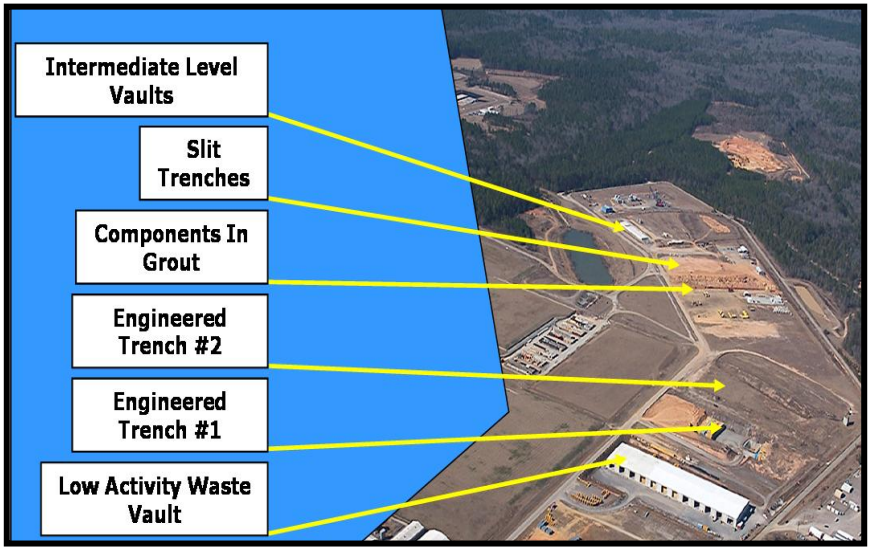
Nevada





Savannah River





Low-Level Waste Disposal Facility Federal Review Group

LFRG is part of DOE's regulatory process and comprises representatives from each site office with a disposal site and specific HQ organizations

Roles and Responsibilities

- Develop and conduct formal review processes
- Review compliance documentation submitted by sites in support of disposal authorization statements
- Track and report preparation of compliance documentation
- Provide LFRG recommendations to senior managers
- Prepare disposal authorization statements for disposal facilities
- Monitor maintenance activities
- Conduct other reviews and assessments as directed by senior management (e.g., waste determinations and transuranic waste disposal performance assessments)

Annual Summaries

Annual summaries routinely report activities that are relevant for the disposal facility, for example:

- Disposal volumes and inventories relative to projections
- Status of PA/CA maintenance activities
- UDQEs and any unforeseen circumstances
- Summary of demonstrations and field/laboratory studies
- Monitoring results with comparisons to model results
- General conclusions about the continued adequacy of the assumptions for the PA and CA

Continuous Improvement – PA Maintenance

- Recognize that waste disposal decisions must be made under uncertainty
- Increased use of structured sensitivity and uncertainty analysis to focus efforts
- Approach has evolved to a confidence building context to manage uncertainties:
  - Demonstrations & field studies (uncertainty)
  - Monitoring
  - Unreviewed Disposal Question Evaluations (e.g., design, container, waste form or inventory changes)

Sharing of Information - Community of Practice

- DOE-EM sponsored organization to share assessment experience
- Mission
  - Reduce regulatory and technical risks related to PA implementation
  - Foster continuous improvement in the quality, credibility, consistency, and efficiency of DOE's PA and risk-based decision-making
  - Maintain enduring performance and risk assessment capability and knowledge base
- Sponsored technical exchanges, webinars, workshops and technical support

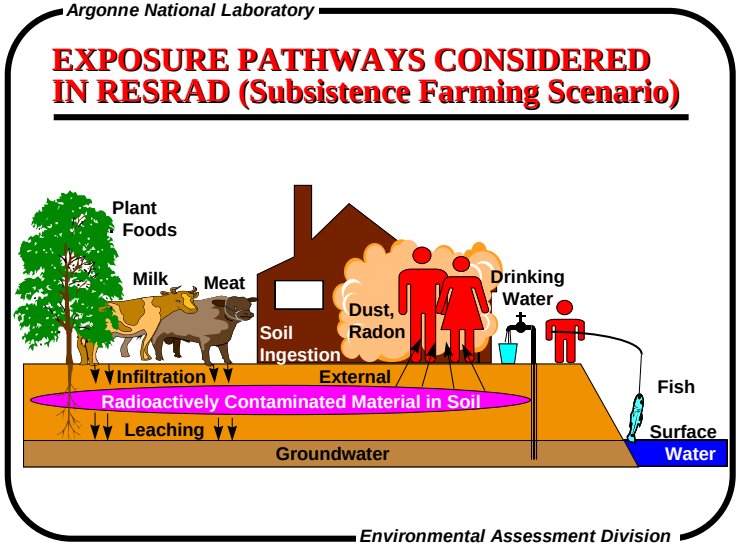
Defense-in-Depth - PA Context

Compliance decisions are made in the context of multiple layers of safety factors, for example:

- 0.25 mSv/yr (25 mrem/yr) is 25 times less than the average annual dose received in the United States (6.3 mSv/yr, NCRP) and a factor of 4 less than the dose limit of 1 mSv/yr
- Assumed that all memory of the facility will be lost (DOE commitments, land use agreements, etc. will be ineffective at some time)
- Future residents will not test well water or be able to recognize that contamination is present underground
- General intent for conservative bias in PA approach (e.g., “highly exposed individuals”, barriers or processes are not credited in calculations in lieu of defending their performance)

Exposure Scenarios in Context

- Start with general assumption that someone will eventually reside at the site at the peak (probability of one)
- Habits are biased to reflect a more highly exposed individual, for example
  - Resident drills a well for water use at location and time of peak concentration
  - Resident farmer habits (e.g., beef/milk cows, garden for consumption)
- Other scenarios specific to a site
- Also consider that an inadvertent intruder can potentially excavate basement and drill well immediately following loss of institutional controls



Summary

- DOE's LLW disposal approach involves many features intended to provide for safety (e.g., engineered, administrative, conservative-bias in assumptions)
- DOE has implements an approach similar to the international safety case concept, where PA is just one part of the overall system for safe disposal
- Independent reviews involving experts not involved in the development of the PA, but with substantial experience in PAs
- Annual reporting, research and development focused on key uncertainties, active sharing of information, etc. contribute to continuous improvement