



The Role of Performance Assessment through the Multiple Phases of a Nuclear Waste Management Program

**XXXV International Symposium
"Scientific Basis for Nuclear Waste Management"
Buenos Aires, Argentina
October 2-7, 2011**

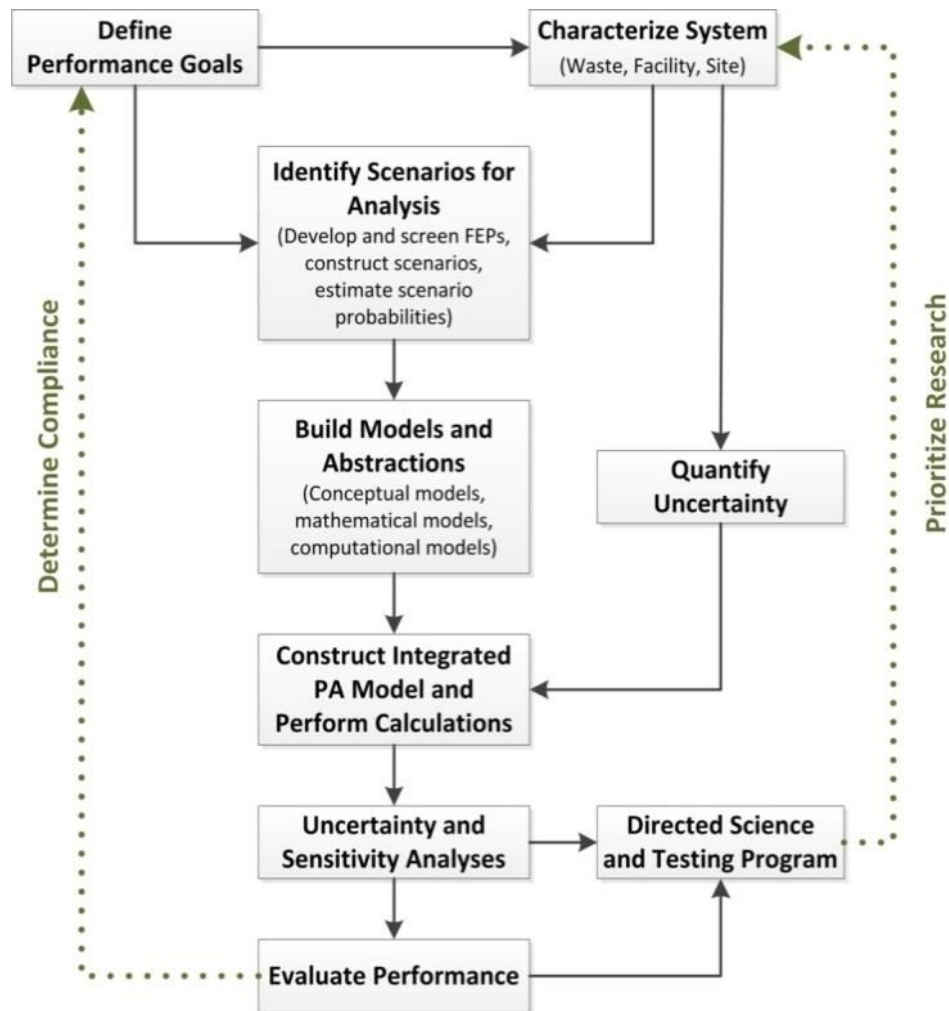
**Evaristo J (Tito) Bonano,
Geoff Freeze
Gordon Appel**



Introduction

- **SNL - applying its performance assessment (PA) expertise for nearly 40 years**
- **Informing key decisions concerning radioactive waste management both in the United States (U.S.) and internationally**
 - **Development of Spent Nuclear Fuel (SNF)/High Level Waste (HLW) PA methodology for the U.S. Nuclear Regulatory Commission (NRC)**
 - **Support to U.S. Environmental Protection Agency (EPA) and NRC for standards and regulatory requirements for SNF/HLW disposal**
 - **Development and demonstration of low-level waste (LLW) PA for NRC**
 - **Environmental assessment of proposed HLW disposal sites**
 - **Development and implementation of PA for the Waste Isolation Plant (WIPP) transuranic (TRU) waste repository certification**
 - **Development and implementation of Total System Performance Assessment (TSPA) for the Yucca Mountain (YM) Repository licensing**

SNL Performance Assessment Methodology





PA Methodology: Theory

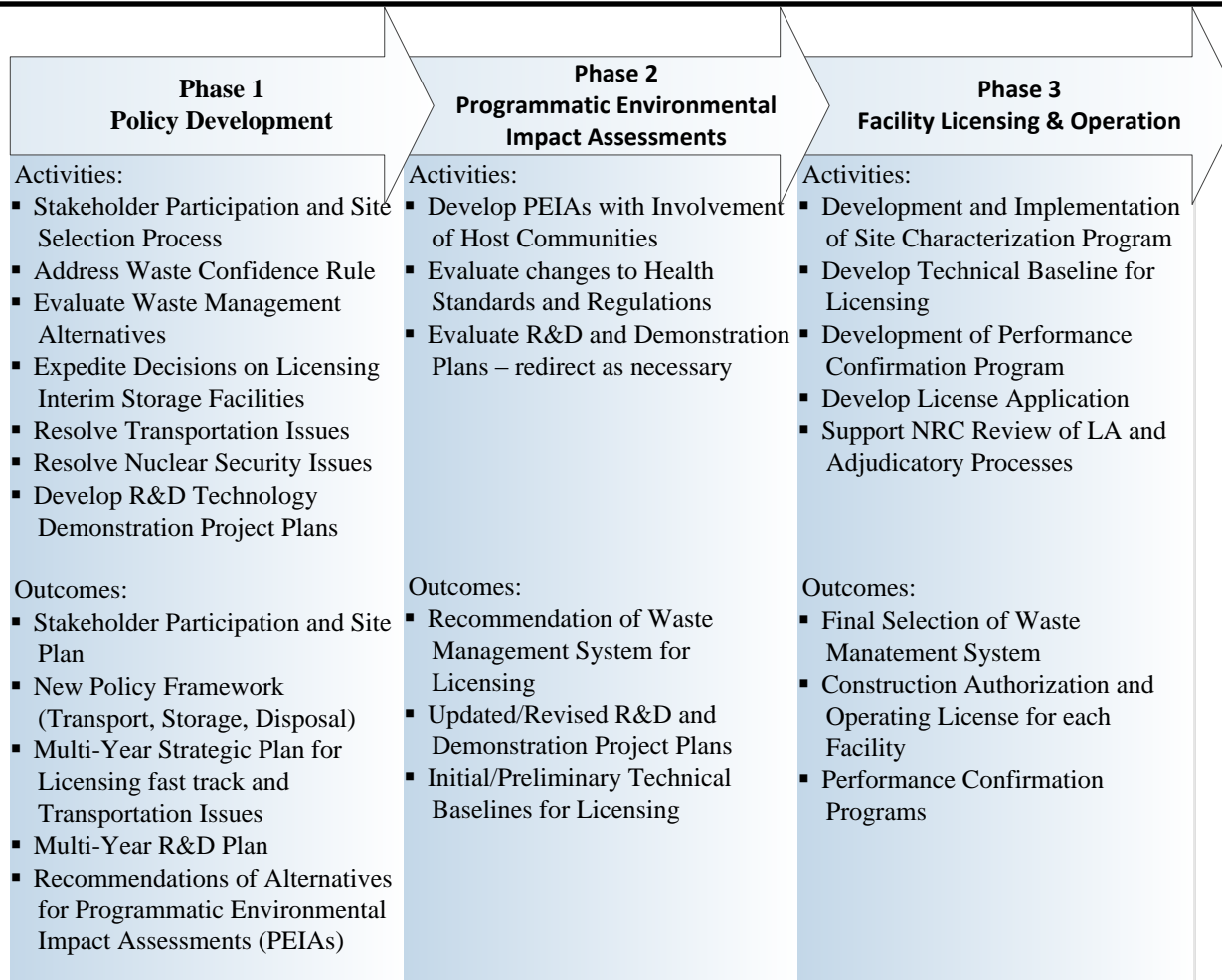
- **What can happen? (i.e., What can go wrong?)**
- **How likely is such an outcome to happen?**
- **If it does happen, what are the consequences?**
- **What is the uncertainty in the answers to the first three questions?**
(Fourth question is necessary because of the large temporal and spatial scales required to analyze radioactive waste disposal systems)



Role of Performance Assessment in Nuclear Waste Management Program

- **PA enables response to changes in national direction.**
- **U.S. Status - significant challenges to solutions for managing commercial and government-owned SNF, defense HLW, naval SNF.**
- **All these wastes need geologic disposal, regardless of the outcome of the current debate about Yucca Mountain.**
- **A coordinated and phased program for developing and implementing long-term solutions is needed.**

Phases for a Coordinated National Policy for the Back End of the Nuclear Fuel Cycle



• PA is integral to each Phase



Phases for a Coordinated National Policy for the Back End of the Nuclear Fuel Cycle

- **Phase 1 Policy development** - activities supporting development of a new national nuclear waste management policy, such as
 - Evaluation of Waste Management Alternatives
 - Stakeholder Participation and Site Selection Process
 - Research & Development (R&D) Investments & Demonstration Projects
- **Phase 2 Programmatic Environmental Impact Assessments**
 - Evaluate suitability of site for development of interim storage facility or repository (or an interim storage facility)
 - Evaluate effects of site characterization activities on the public health and safety and the environment
 - Comparative evaluation of a candidate site with other sites and locations
- **Phase 3 Licensing and Operations**
 - Develop and implement site characterization program
 - Develop the technical baseline
 - Develop and implement long-term performance confirmation program
 - Support the defense of the license application(s)



Application of SNL's PA methodology in the phases of a coordinated waste management program

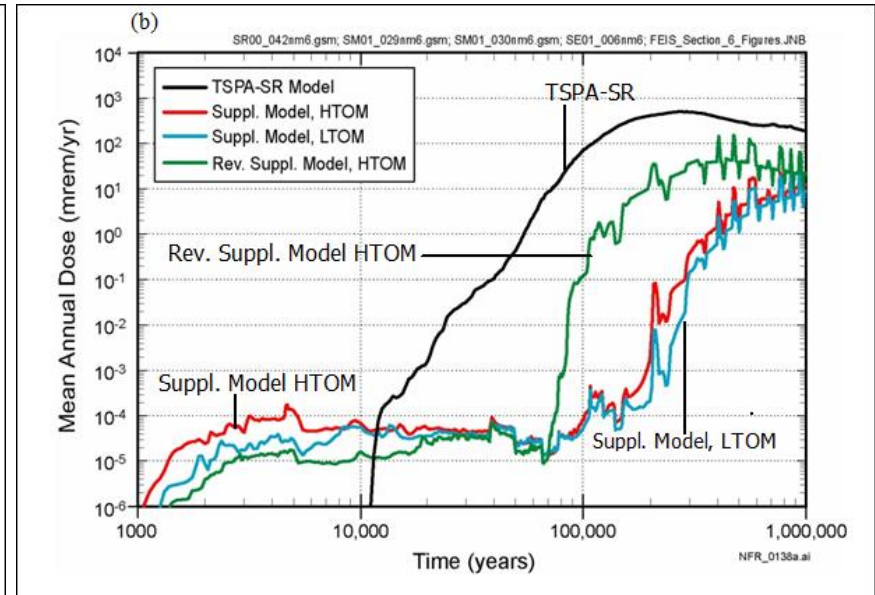
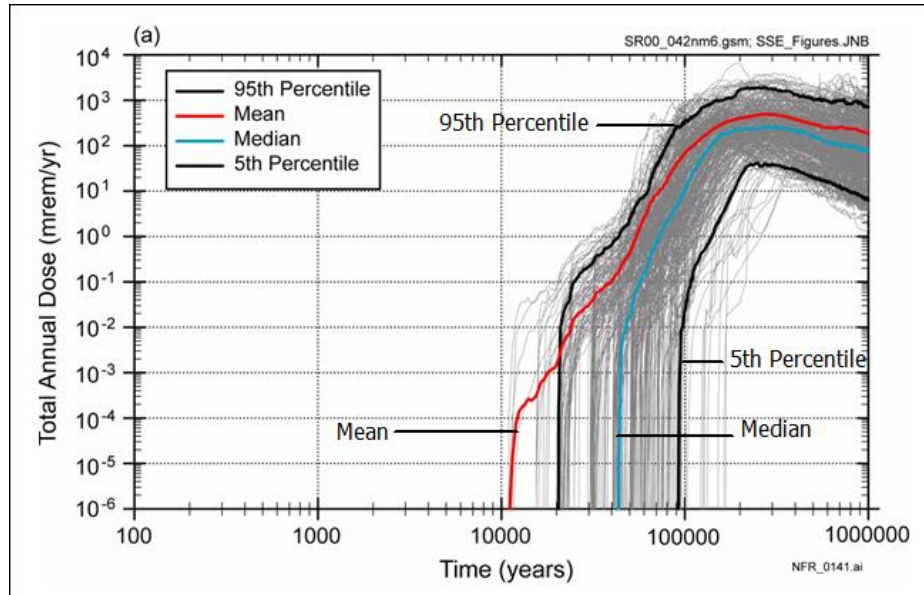
- **SNL application of PA methodology began in 1976**
- **Policy Development**
 - **Evaluation of deep geologic media for disposal of HLW (Bedded Salt, Basalt, and Tuff)**
 - **Demonstrated PA methodology can be appropriately applied independent of geologic media**
 - **Demonstrated PA methodology can be used by NRC to examine regulatory compliance**



Application of SNL's PA methodology in the phases of a coordinated waste management program (cont'd)

- **Programmatic Environmental Impact Assessments**
 - **SNL's WIPP PA studies supported the WIPP EIS**
 - **Demonstrated importance of careful identification of Features, Events, and Processes (FEPS) and scenario development**
 - **Early iterations of SNL's YM PA studies supported the 1986 YM Environmental Assessment**
 - **Early relatively simple assessments progressed to use of stochastic Monte Carlo analysis to address parameter uncertainty**

Application of SNL's PA methodology in the phases of a coordinated waste management program (cont'd)



- (a) Typical Presentation of PA Results;
- (b) PA Results for YM EIS



Application of SNL's PA methodology in the phases of a coordinated waste management program (cont'd)

- **Licensing and Operations**

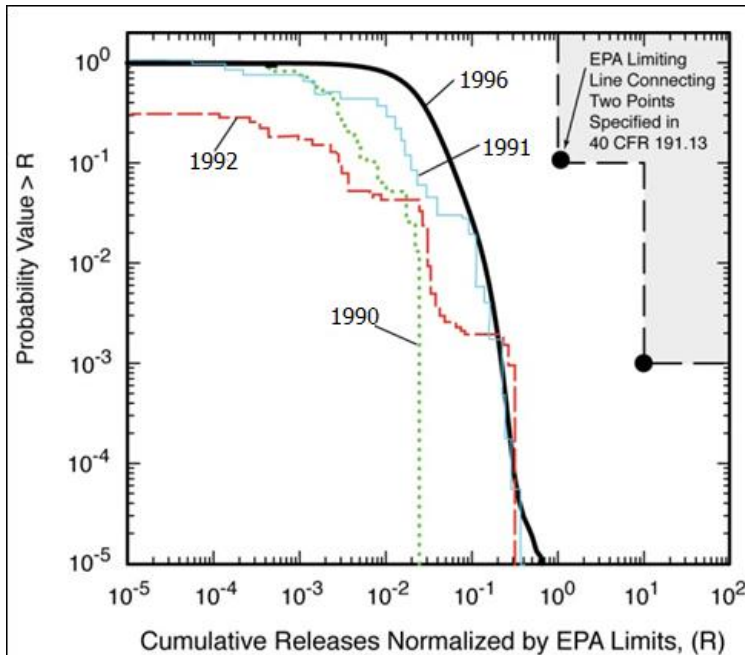
- **SNL's WIPP Compliance Analyses**

- Five distinct analyses culminate in WIPP Compliance Certification Analysis in 1996
 - 1999 WIPP is first deep geologic repository in U.S. to permanently dispose of TRU waste
 - Recertification Analyses in 2004 and 2009

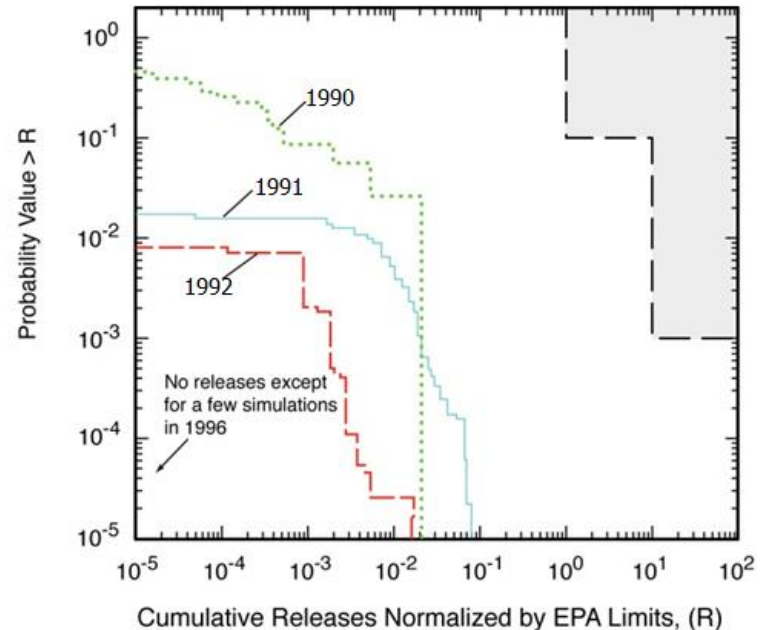
- **YM Total System Performance Assessments (TSPAs)**

- At least nine distinct PAs over nearly 30 years
 - Four discrete scenario classes (nominal case, early waste package failure, igneous disruption, seismic disruption)
 - NRC concluded that the technical approach and results in the TSPA-LA were reasonable

Application of SNL's PA methodology in the phases of a coordinated waste management program (cont'd)



(a) Direct Releases to the Surface during Drilling

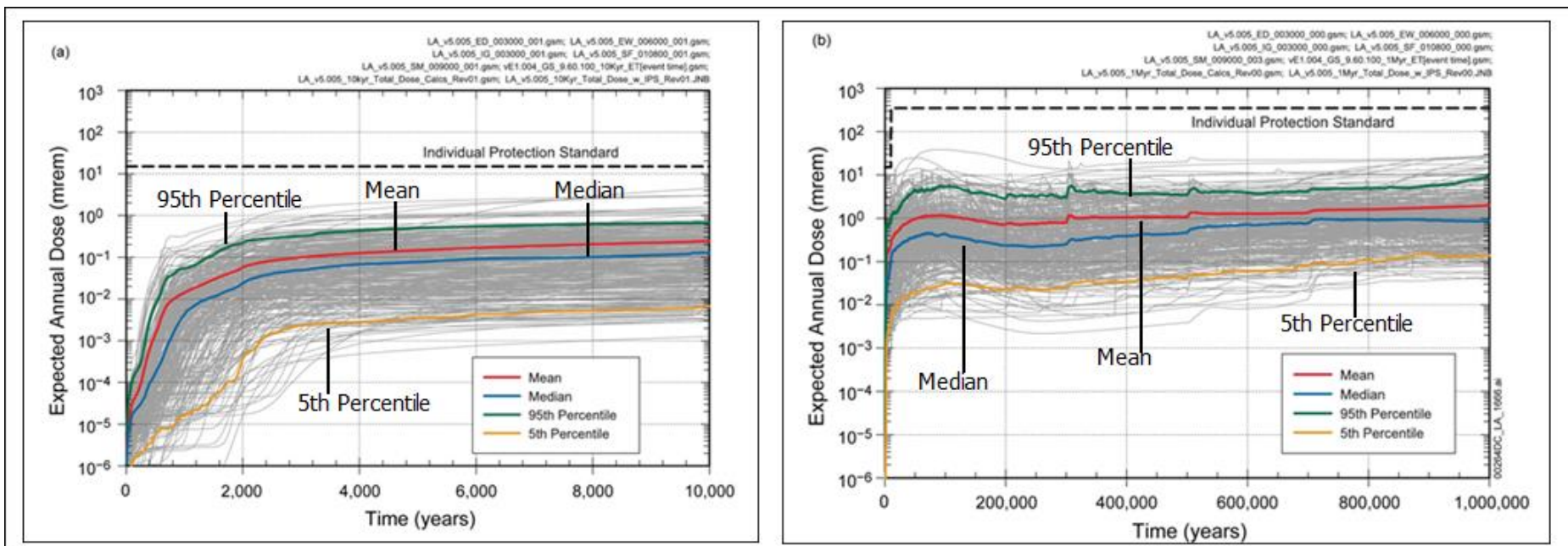


TRI-6342-6012-0

(b) Releases via Groundwater Pathway through Culebra

Comparison of WIPP PA results 1990–1996

Application of SNL's PA methodology in the phases of a coordinated waste management program (cont'd)



Yucca Mountain TSPA-LA results: distribution of total expected annual dose for (a) 10,000 years and (b) 1 million years after repository closure, compared against the individual protection standard from 10 CFR 63.311



Conclusions

- **A coordinated program for long-term solutions for the safe and secure management of nuclear waste needs to be pursued**
- **Objective should be to anticipate and address the challenge of developing and implementing sustainable nuclear waste management solutions related to transportation, storage and disposal**
- **PA is invaluable in each phase of a nuclear waste management program:**
 - policy development;
 - programmatic environmental impact assessments
 - licensing and operation of facilities
- **Iteratively applied PA throughout the phased development of a nuclear waste management program increases the likelihood of technical success and acceptability.**