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Confirmation Monitoring of Repositories in the United States

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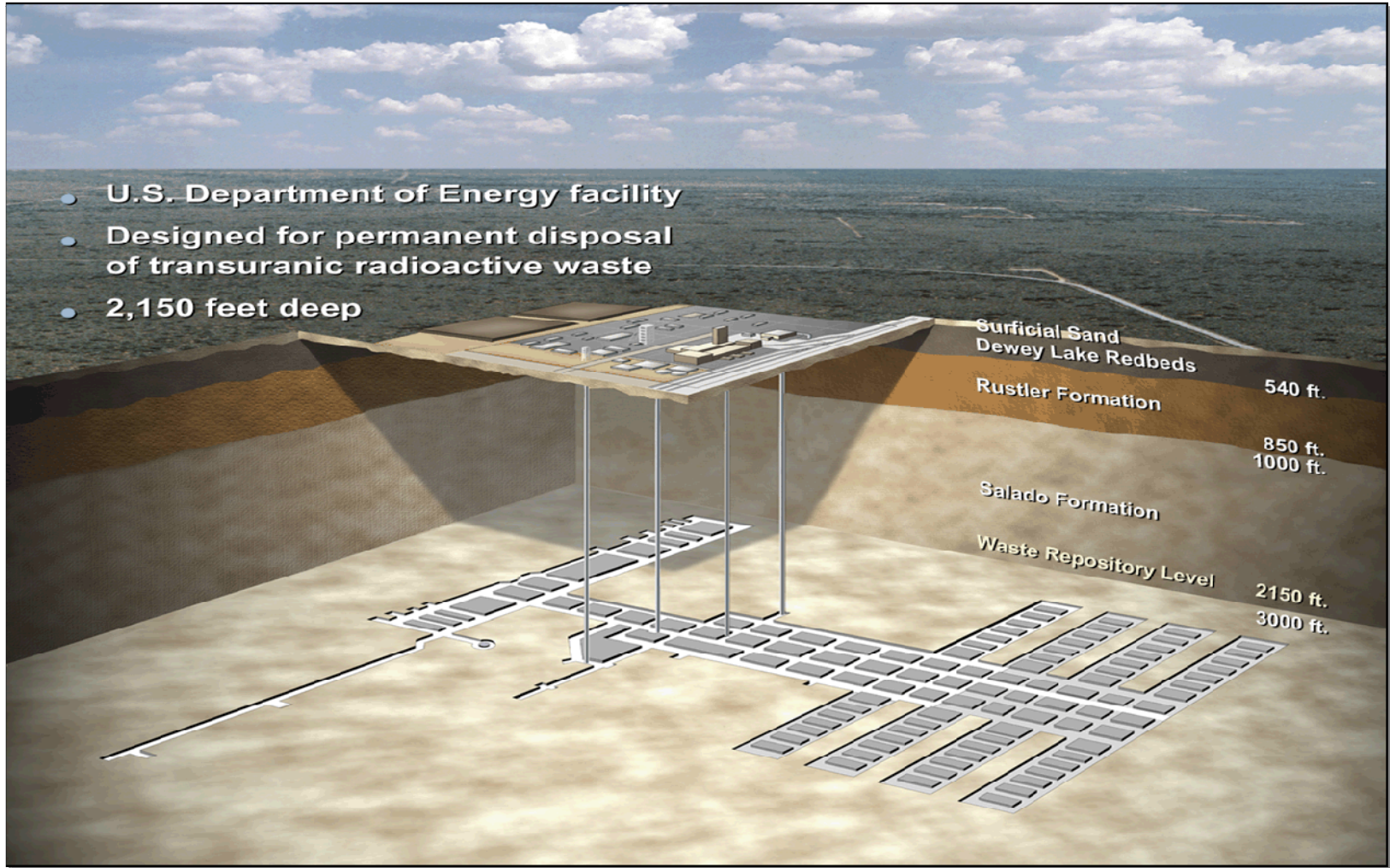
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Outline

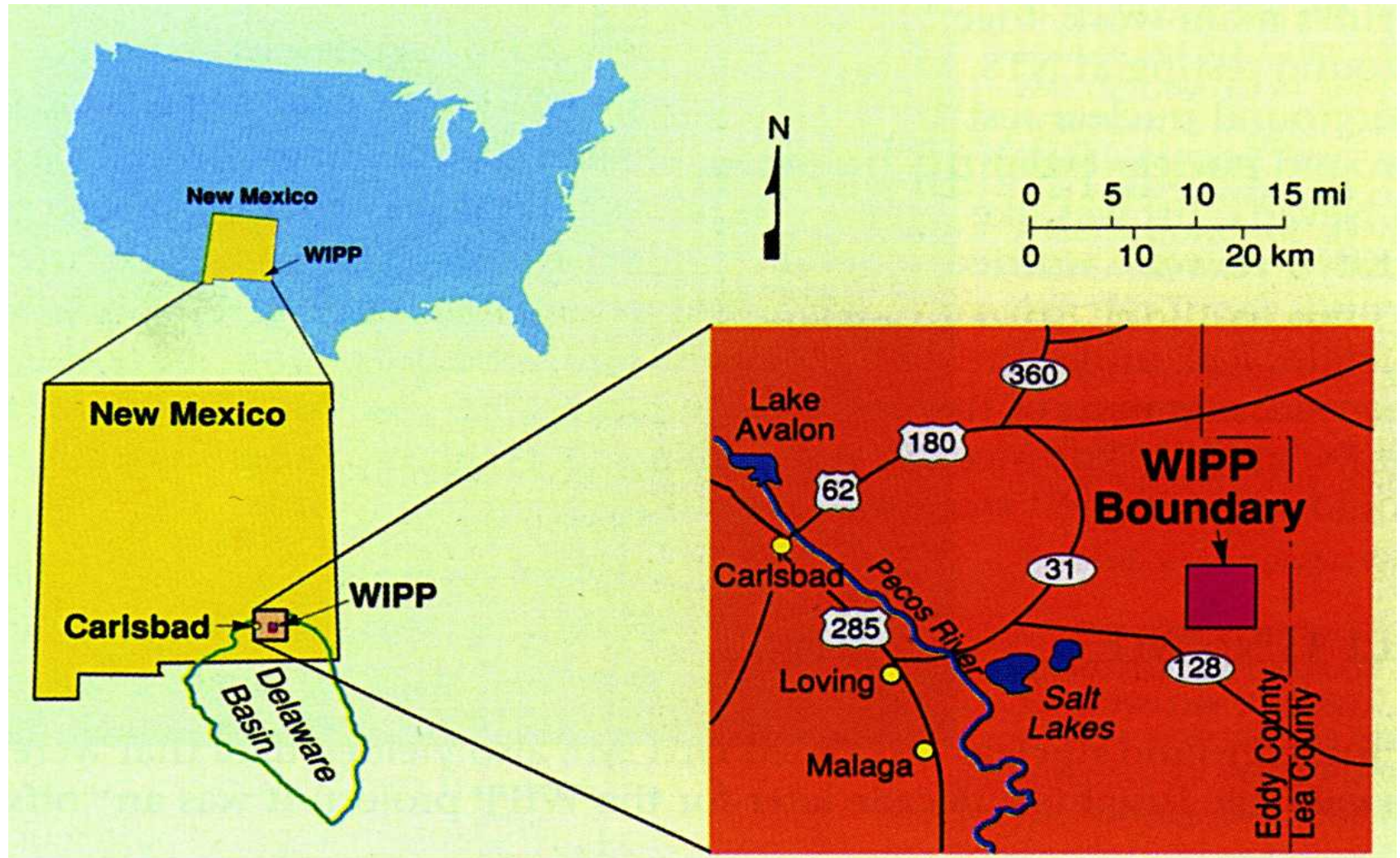
- What is WIPP
- How Performance Confirmation became an important element of WIPP
- The Evolution of Performance Confirmation
- WIPP Pre- and Post-Operational Performance Confirmation Programs
- Performance Confirmation Example

What is WIPP

- U.S. Department of Energy facility
- Designed for permanent disposal of transuranic radioactive waste
- 2,150 feet deep



What is WIPP



What is WIPP



How Performance Confirmation Became an Important Element of WIPP

- 1960's & 1970's
 - At first it was believed that site characterization data and a technical performance demonstration would provide the answers needed to ensure all stakeholders that a repository would be safe to dispose of radioactive waste. The project had no real plan for performance confirmation monitoring
- 1980's
 - Failed attempt to site a facility at Lyons Kansas – loss of trust
 - Switch from DOE self-regulation to EPA disposal standards
 - Federal, State and multiple Stakeholders became involved
- Other “Assurances” needed beyond a technical performance demonstration
 - EPA Regulations Included performance confirmation elements
 - State of New Mexico agreement includes confirmation-related experiments and monitoring

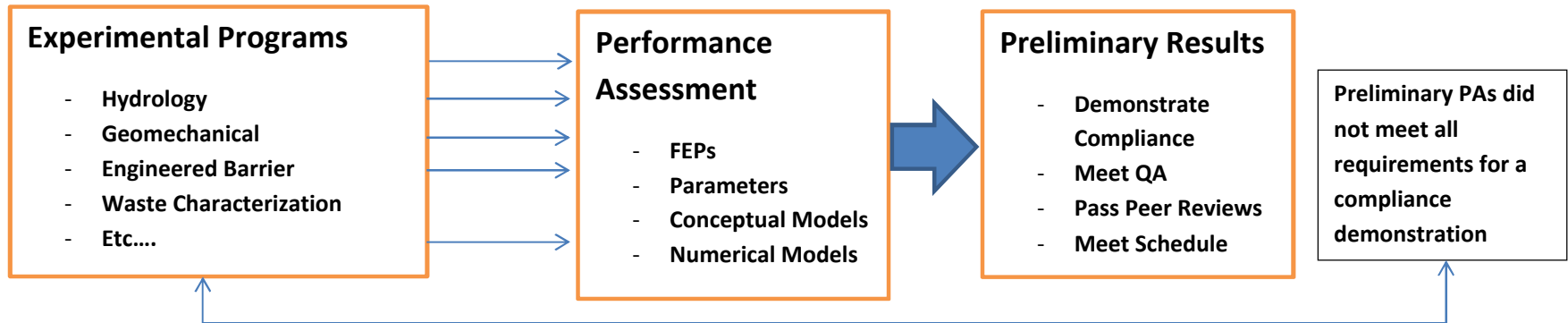
WIPP Performance Confirmation

- Multi-phase program with different goals/objectives
 - Site characterization Testing and Monitoring
 - To Build a Performance Assessment (safety case)
 - Operational Phase Monitoring
 - To verify basis of Performance Assessment/Results
 - Post-Closure Monitoring
 - To enhance institutional controls and long-term stewardship

Site Characterization Testing and Monitoring

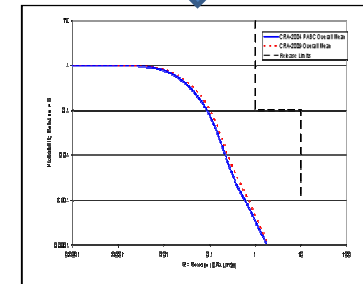
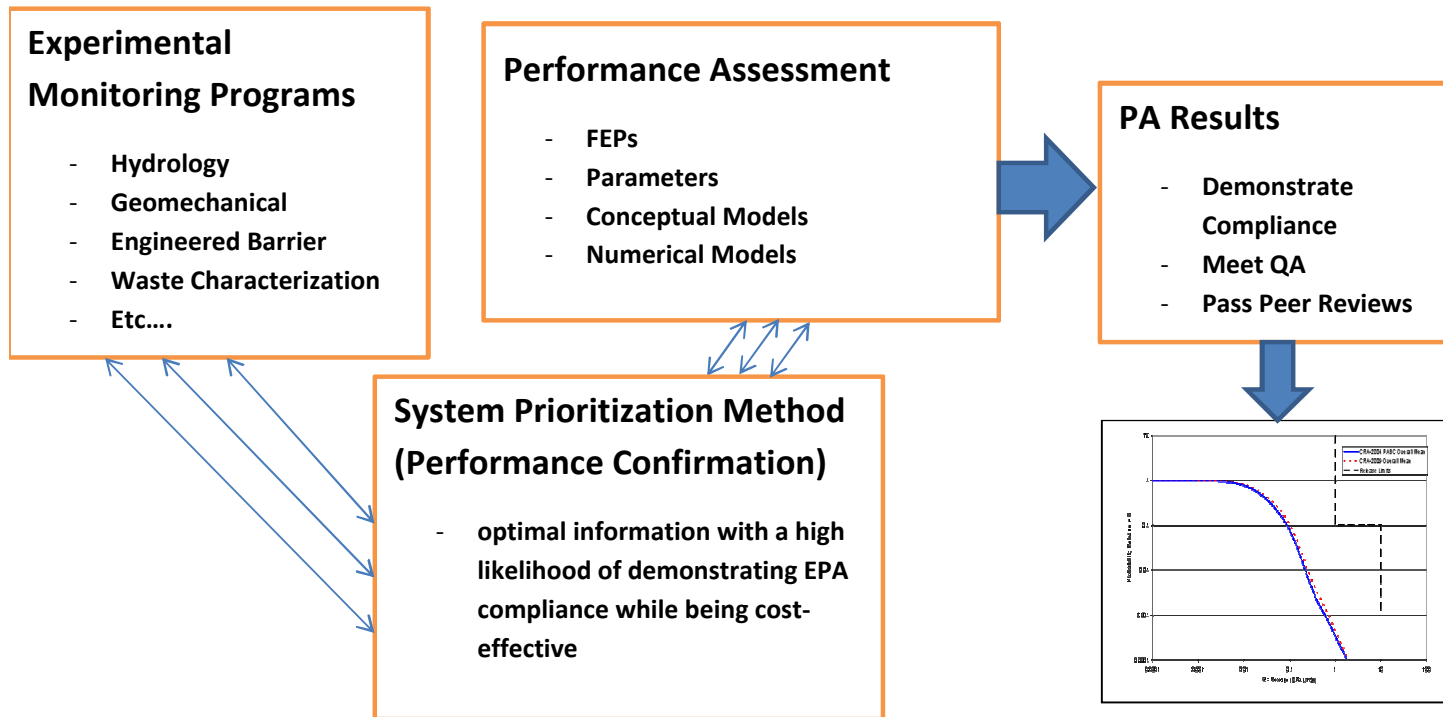
- Information was needed to build a defensible PA model.
 - Site characterization investigated host rock, geologic structure, hydrology, seals/rock interactions, waste/brine chemistry, geochemistry, gas generation, Kds and many other aspects of the system
- Resources and timelines limit the depth that scientific research can investigate a particular aspect of the system
 - What information is important or needed
 - What information can be developed
 - What is known

Without Performance Confirmation Considerations



Limited \$\$\$ and Time

With Performance Confirmation Considerations



WIPP Pre-Operational Monitoring

- The important elements identified for further monitoring related to:
 - Concentrations and Transport of Colloid Carriers
 - Culebra Fracture/Matrix Flow Laboratory Studies
 - Multi-Well Tracer Test
 - Rock Mechanics
 - Studies of Short- and Long-Term Shaft Seal Components
 - Blowout Releases
 - Dissolved Actinide Solubilities for Oxidation States +III to +VI
 - Chemical Retardation for Th, Np, Pu, U and Am

WIPP Operational-Phase Monitoring

- EPA Regulations govern program
 - Monitoring is an Assurance Requirement
 - *“The Department shall conduct **an analysis of the effects of disposal system parameters on the containment of waste in the disposal system**
The results of the analysis shall be used in developing plans for pre-closure and post-closure monitoring....”*

WIPP Operational-Phase Monitoring

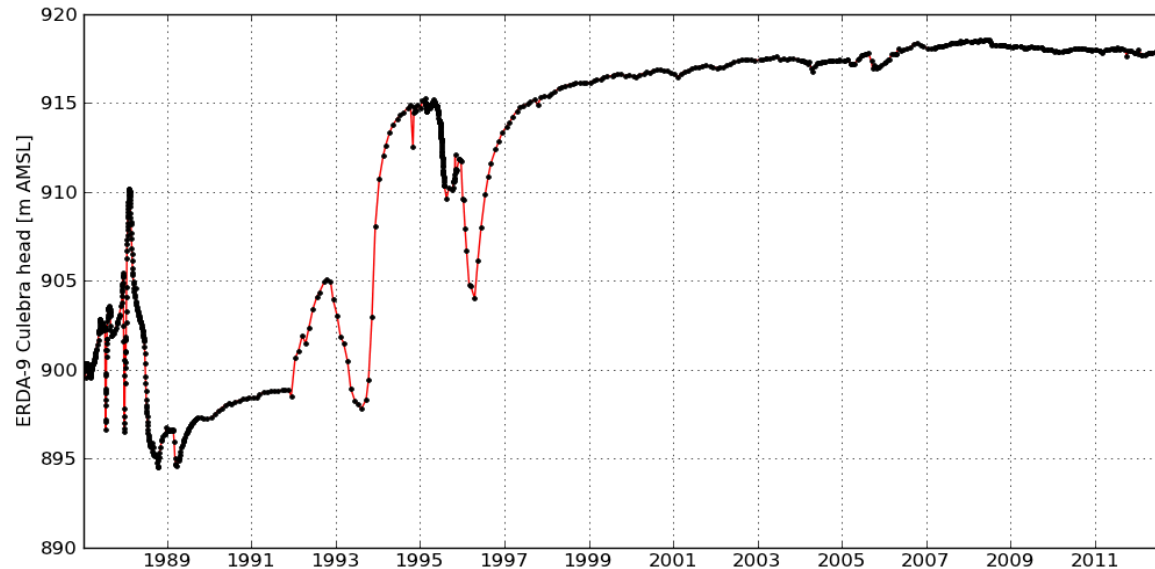
- Analysis addressed significant disposal system parameters defined by their:
 - effect on the system's ability to contain waste
 - effect on the ability to verify predictions about the performance of the disposal system
- Addressed an important disposal system concern
- Obtained meaningful data in a short time period
- Will not violate disposal system integrity
- Complemented existing monitoring programs

WIPP Operational-Phase Monitoring

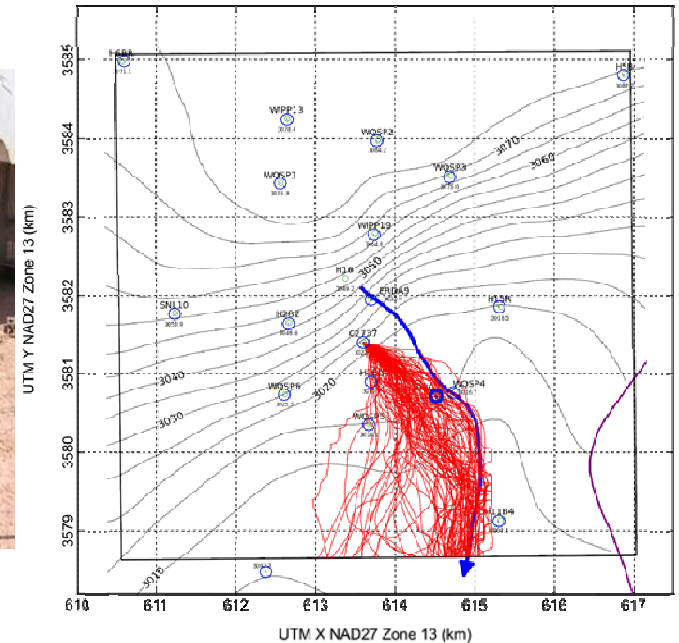
- Repository Monitoring
 - Creep Closure and Stresses
 - Extent of Deformation
 - Initiation of Brittle Deformation Displacement of Deformation Features
 - Subsidence Measurements
 - Waste Activity Monitoring
- Hydrology Monitoring
 - Culebra Ground Water Compositions
 - Change in Culebra Ground Water Flow
- Human Activity Monitoring
 - Drilling Rate
 - Probability of Encountering a Castile Brine Reservoir

Performance Confirmation Example

- PA assumes steady-state conditions in the WIPP groundwater model used for flow and transport calculations
- Water levels in 17 of 32 monitoring wells exceeded the range used in PA for these wells



Performance Confirmation Example



- 4 year investigation into the potential cause and possible modeling corrections
- Results – a refined WIPP ground water conceptual model; passed Peer Review; approved by EPA

Performance Confirmation Example

- This example shows how the WIPP Monitoring program
 - Identified a condition outside PA expectations
 - Researched the cause and effects
 - Modified the modeling of the system to account for the new information.
- This Performance Confirmation action resulted in a more defensible and robust understanding of the disposal system – the goal of any Performance Confirmation program

Summary

- Performance Confirmation Monitoring is an important element of the WIPP's program
- Performance Confirmation is useful during the site characterization phase and operational phase of a repository
- Actions of a Performance Confirmation program can increase understanding of repository conditions and defensibility of the repository's performance predictions