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Performance Confirmation Strategies for the Waste Isolation Pilot Plant – A Historical Perspective from an Operating Disposal Facility
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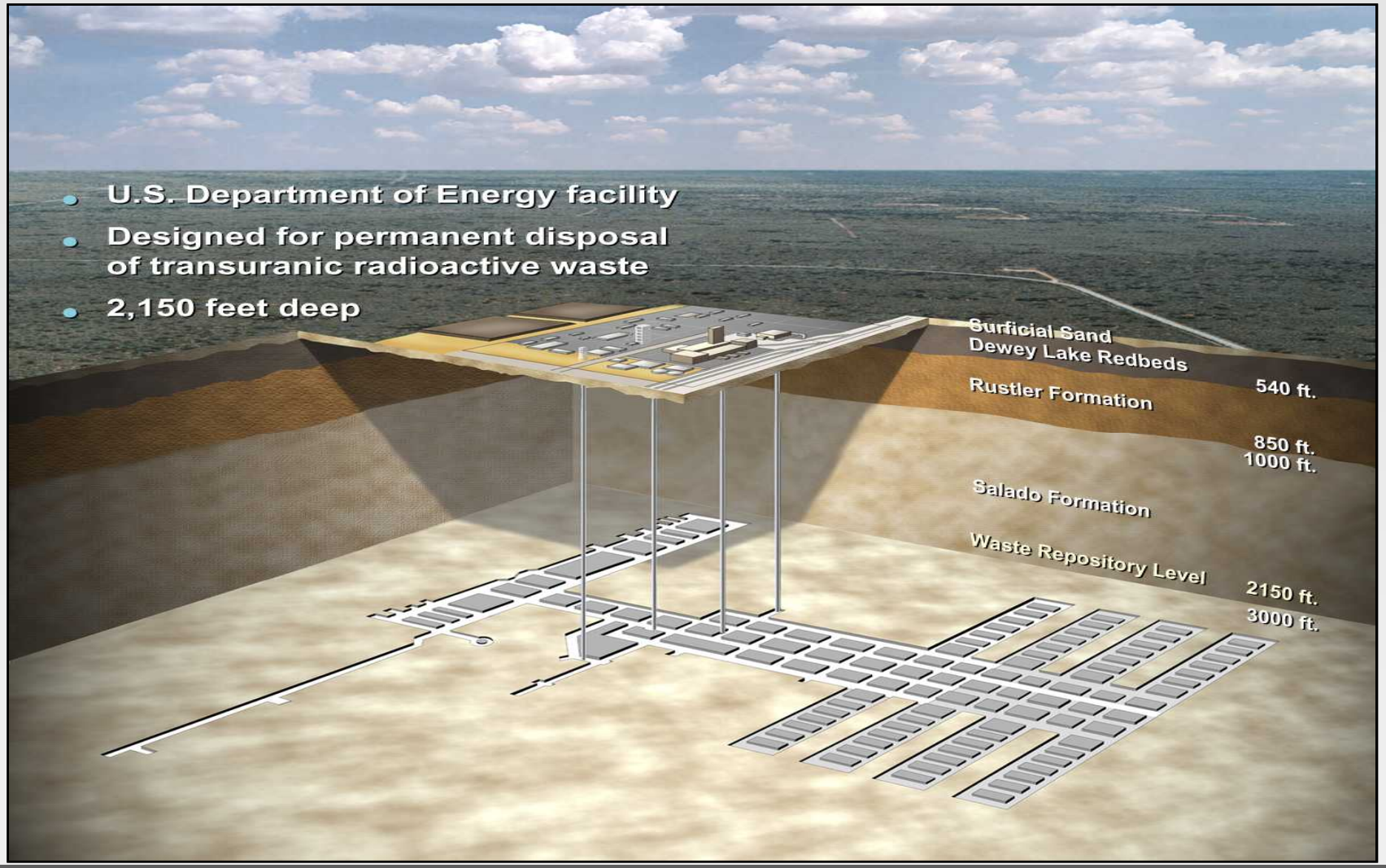
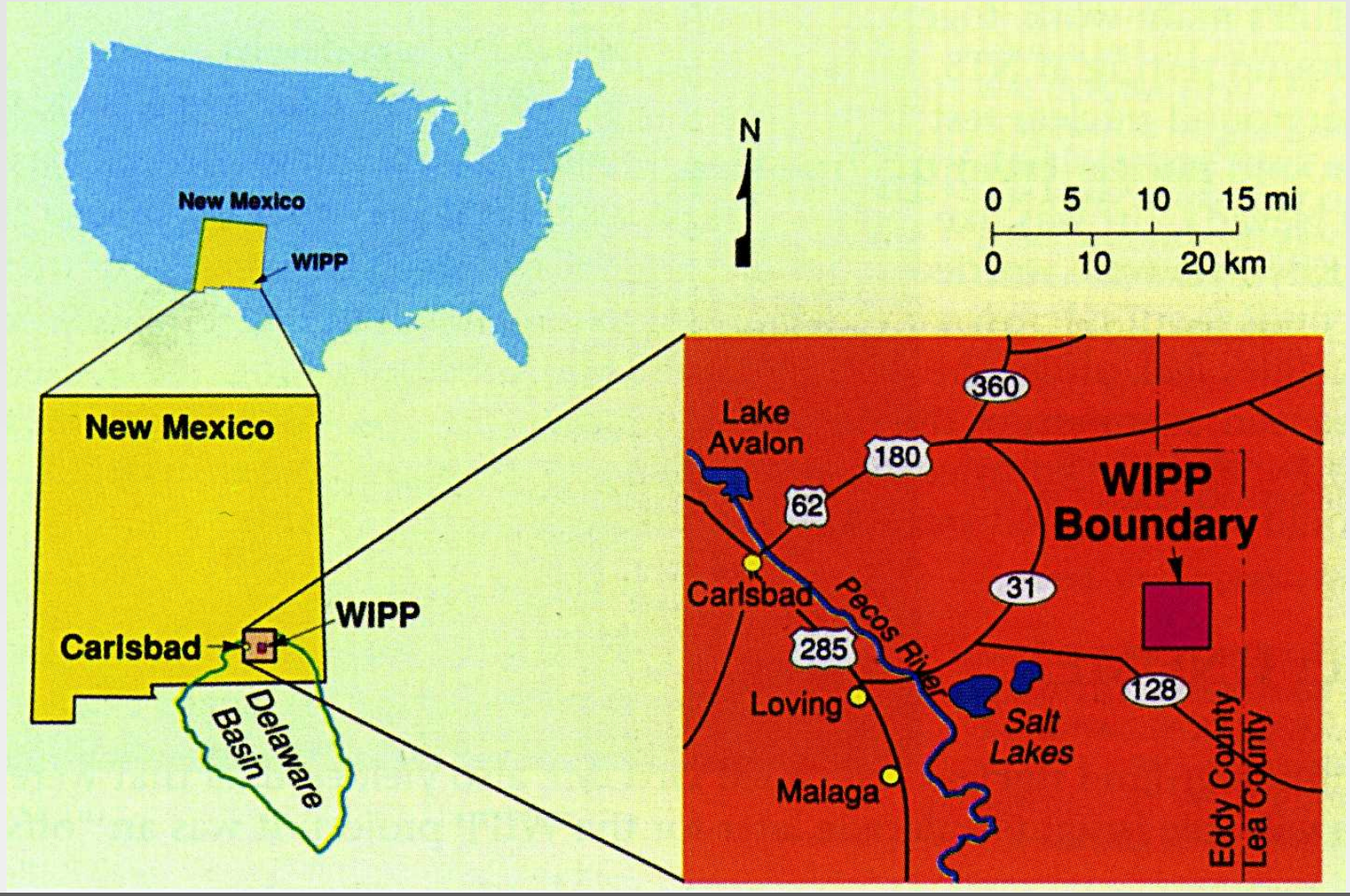
Summary

- What is WIPP
  - Some History
- How Performance Confirmation (PC) became an important element of WIPP
  - The Evolution of Performance Confirmation
  - WIPP Pre and Post-Operational Performance Confirmation Programs
- Performance Confirmation (PC) in Action
  - An Example

What is WIPP


U.S. Department of Energy facility
Designed for permanent disposal of transuranic radioactive waste
2,150 feet deep
Surficial Sand
Dewey Lake Redbeds
Rustler Formation
540 ft.
850 ft.
1000 ft.
Salado Formation
Waste Repository Level
2150 ft.
3000 ft.

What is WIPP


New Mexico
WIPP
New Mexico
Carlsbad
WIPP
Delaware Basin
N
0 5 10 15 mi
0 10 20 km
Lake Avalon
360
180
62
WIPP Boundary
Carlsbad
Pecos River
31
285
128
Loving
Salt Lakes
Malaga
Eddy County
Lea County

What is WIPP

The Evolution of PC

- Disposal in Salt Formations
  - After abandoning a site at Lyons Kansas, the Delaware Basin was chosen to characterize new pilot project in 1972
  - First borehole in 1974, first shaft in 1981
- These activities generated data needed to determine the site's suitability for long-term radioactive waste containment

The Evolution of PC

- At first it was believed that site characterization and a technical performance demonstration would provide the answers needed to ensure stakeholders that the repository would be safe
- Federal, State and Stakeholder involvement
  - Switch from DOE self-regulation to EPA disposal standards
    - Includes performance confirmation elements
  - State of New Mexico agreement includes confirmation-related experiments and monitoring

What is PC

- A program used to analyze the current repository conditions and its surroundings to ensure the basis for long-term containment predictions is valid.
- Basis
  - PA parameters, assumptions, conceptual and numerical models that are used to predict or validate repository performance

WIPP Pre-Operational PC

- Information was needed to build a defensible PA model.
  - Site characterization investigated host rock, geologic structure, hydrology, seals designs, actinide chemistry, gas generation and 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

WIPP Pre-Operational PC

- A decision-analysis tool called the “Systems Prioritization Methodology (SPM) was developed to help prioritize the important parameters and experiments needed for PA and the EPA compliance demonstration.
- DOE used the results to select activities that would provide the optimal information with a high likelihood of demonstrating EPA compliance while being cost-effective.

WIPP Pre-Operational PC

- The important PC elements identified for further study included:
  - 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 PC

- EPA included ***Assurance Requirements*** in its disposal standards that relate to Performance Confirmation
  - *"Assurance requirements were included in the disposal regulations to compensate in a qualitative manner for the inherent uncertainties in projecting the behavior of natural and engineered components of the WIPP for many thousands of years."*
  - *"[The] Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance."*

WIPP Operational PC

- *"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 PC

- Analysis addresses 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
- Addresses an important disposal system concern
- Obtains meaningful data in a short time period
- Will not violate disposal system integrity
- Complement existing monitoring programs

WIPP Operational PC

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

WIPP PC in Action

- 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

WIPP PC in Action

- 4 year investigation into the potential cause and possible modeling corrections
- Results – Peer Review of a refined ground water conceptual model

WIPP PC in Action

- This example shows how the WIPP PC program identified a condition outside PA expectations, researched the cause and effects and modified the modeling of the system to account for the new information. This PC action resulted in a more defensible and robust understanding of the disposal system – the goal of any PC program

Conclusion

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