General Training On Methodologies For Geological Disposal in North America

IAEA Network of Centers of Excellence

WIPP Site Selection and Early Site Studies

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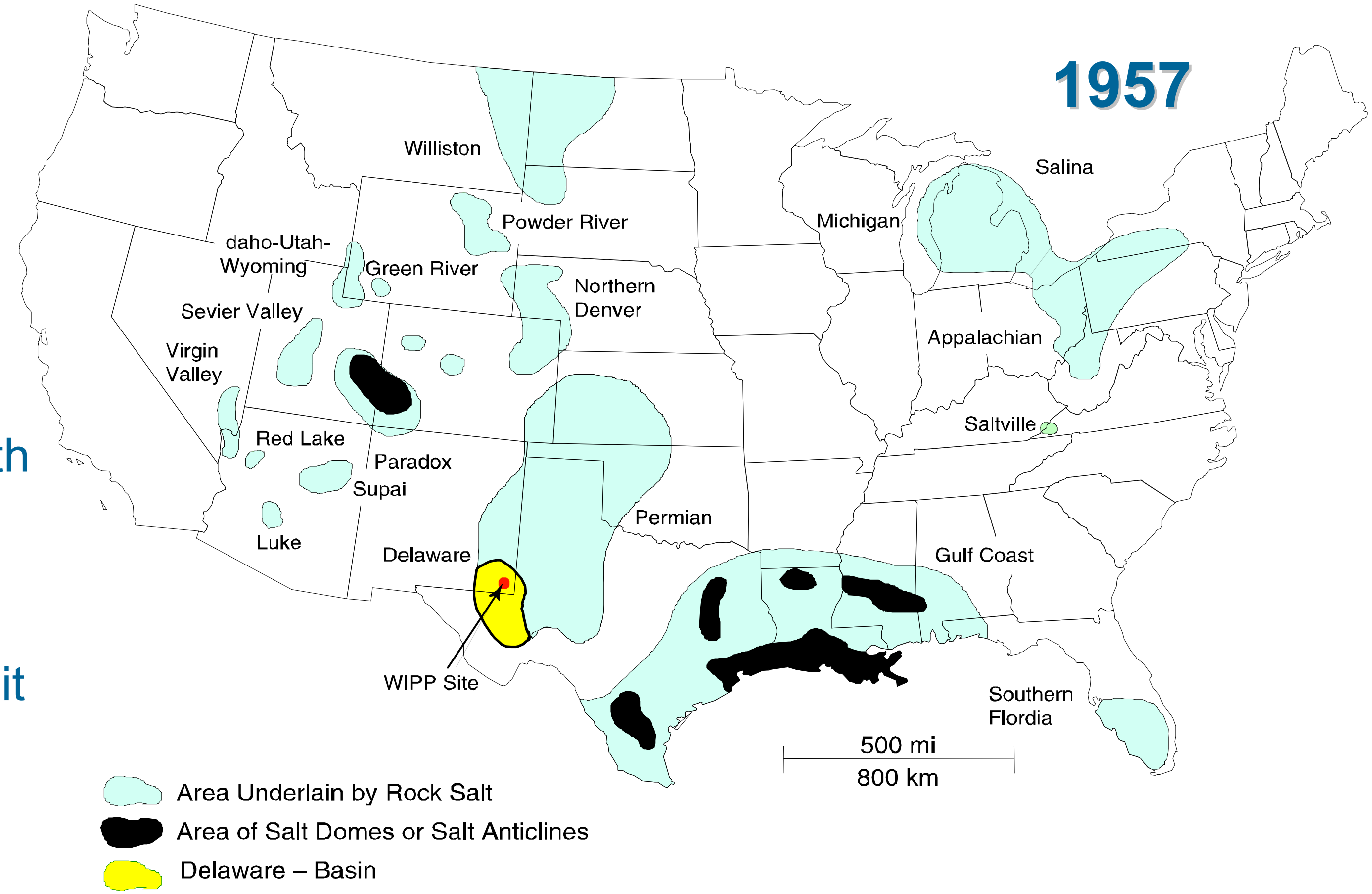
National Academy of Sciences (NAS) concludes that the most promising disposal option for radioactive wastes is in salt deposits.



"Salt at great depth 'flows.' It will encapsulate any waste placed at depth and isolate it from the surface environment for eons."

"The great advantage is that no water can pass through salt. Fractures are self healing.."

Bedded Salt
Chosen Purposefully, for Siting US Defense Nuclear Wastes

- **Salt can be mined easily**
- **Salt is known to flow slowly under the pressure of overlying beds, and therefore will consolidate around the waste and isolate it in place**
- **Salt is essentially impermeable**
- **Fractures in salt are self healing**
- **Salt that has existed underground for millions of years will almost certainly remain stable for millions of years into the future**
- **Salt has high thermal conductivity compared to most crustal rocks**
- **Wide geographic distribution (many potential sites)**

Site Selection Criteria*

(established in 1960's by early investigators [ORNL])

Geological Criterion - The geology must protect the repository from breaching by natural phenomena. The geology must also permit safe operation of the repository

Hydrology Criterion - The hydrology must provide high confidence that natural dissolution will not breach the site. Accidental penetrations (unintentional human intrusion) should not result in undue hazards to intruder or subsequent generations.

Tectonic Stability Criterion - Natural tectonic processes must not result in a breach of the site and should not require extreme precautions during the operational period of the repository.

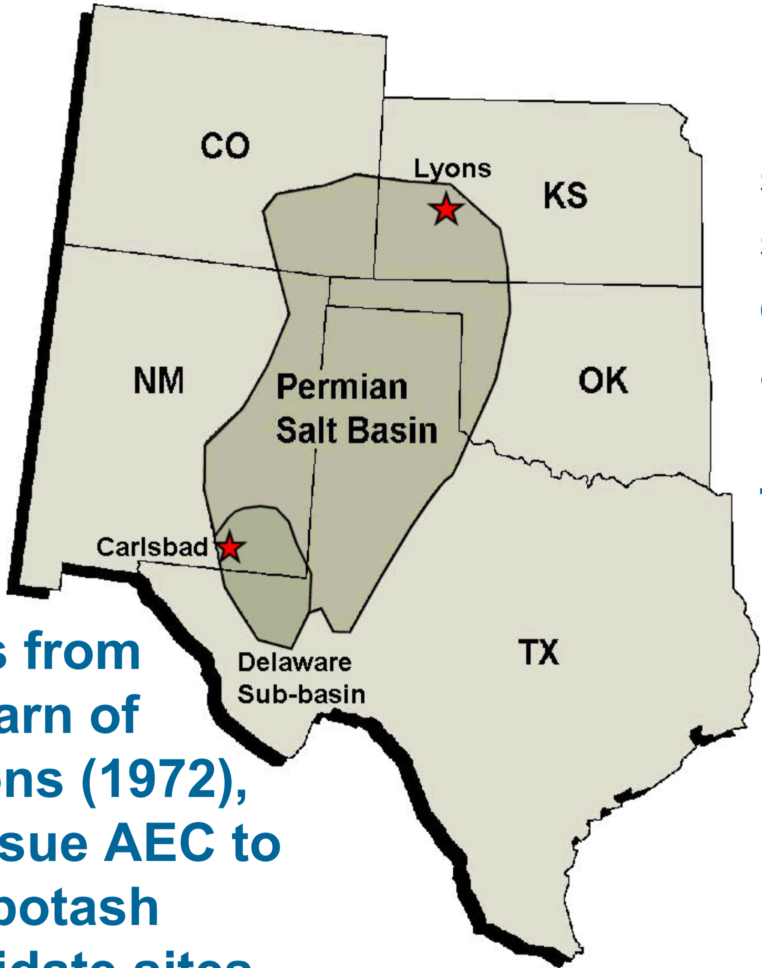
Physical-Chemical Compatibility - The repository medium must not interact with the waste in ways which create unacceptable operational or long-term hazards.

Economic/Social Compatibility Criterion - The site must be operable at reasonable economic cost and should not create unacceptable impact on natural resources or the biological/sociological environment.

* while the waste poses a significant hazard to man

Initial candidate sites are soon focused on bedded salt deposits in relatively remote areas

1968-1971 experiments at existing salt mines near Lyons Kansas



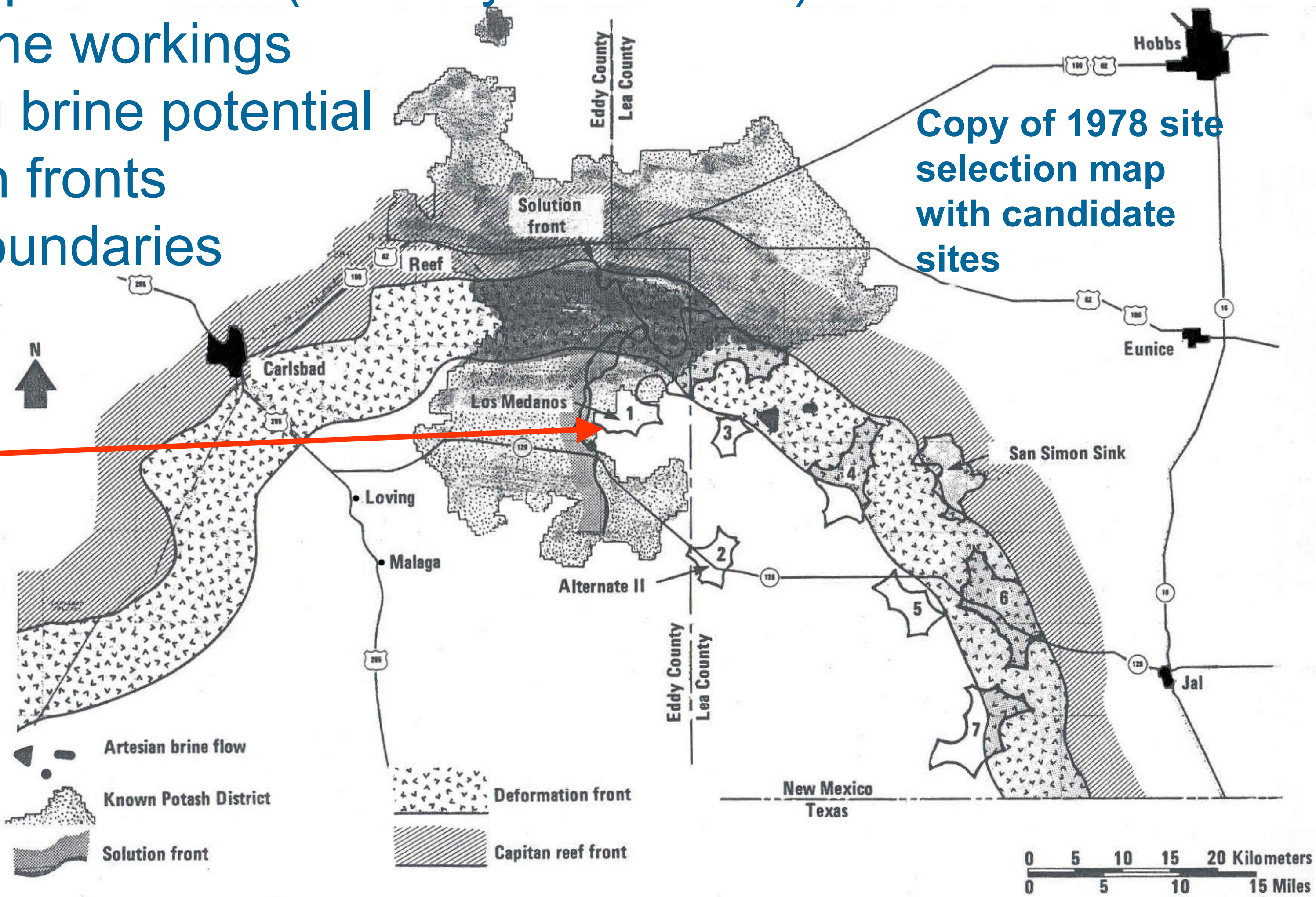
Nearby oil production (holes through a shallow and thin salt salt section) provided easy targets for critics and the Lyons site became politically troubled very quickly

Local politicians from Carlsbad, NM learn of problems at Lyons (1972), and actively pursue AEC to explore nearby potash district for candidate sites

Delaware Basin turns out to be deepest and thickest, but nearby oil production and potash mining still make site selection controversial

Site Selection Constraints

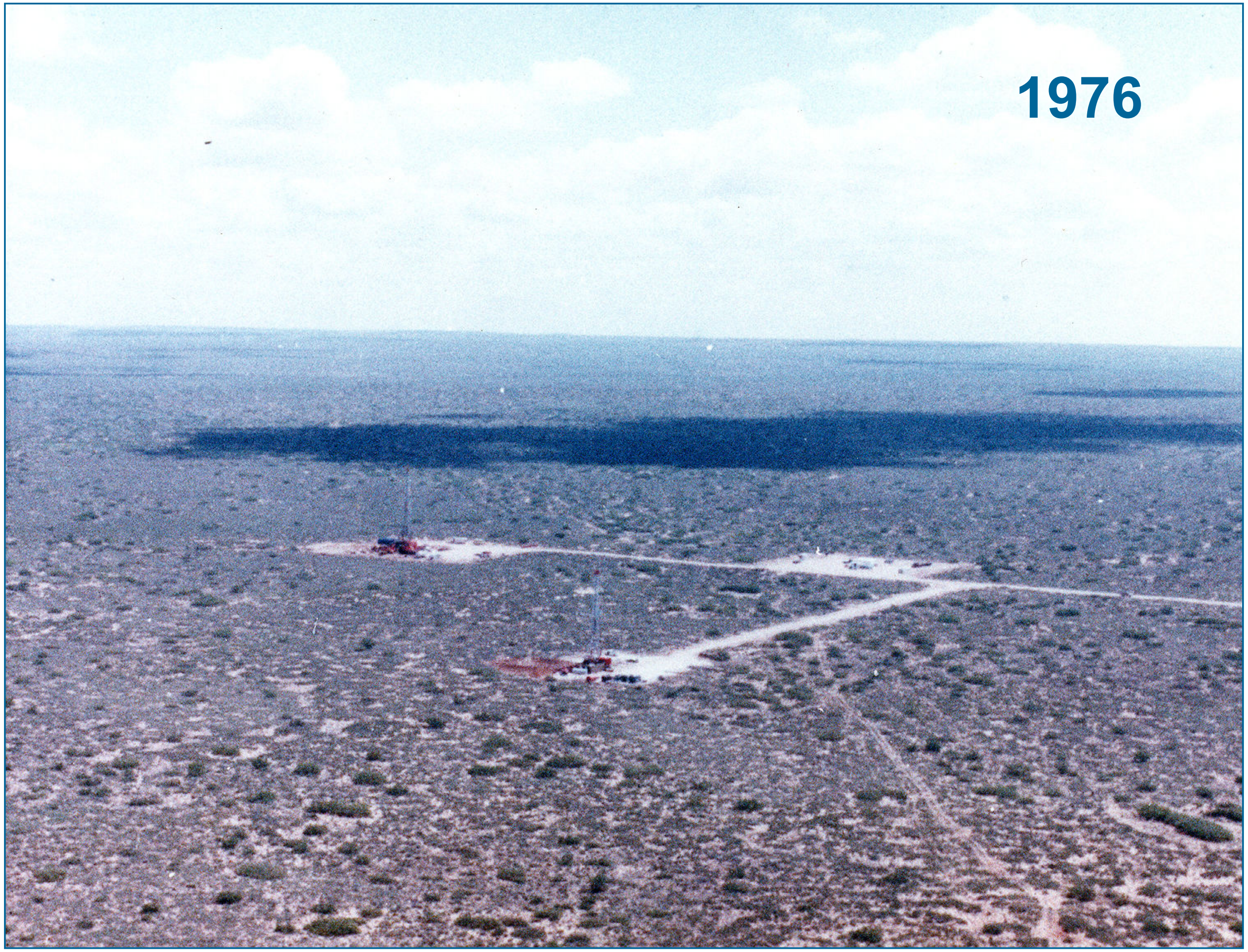
- Nearby oil production (arbitrary 2-mile limit)
- Nearby mine workings
- Underlying brine potential
- Dissolution fronts
- Political boundaries



Copy of 1978 site selection map with candidate sites

Final site selection (Los Medanos) only after several nearby changes and consideration of county line

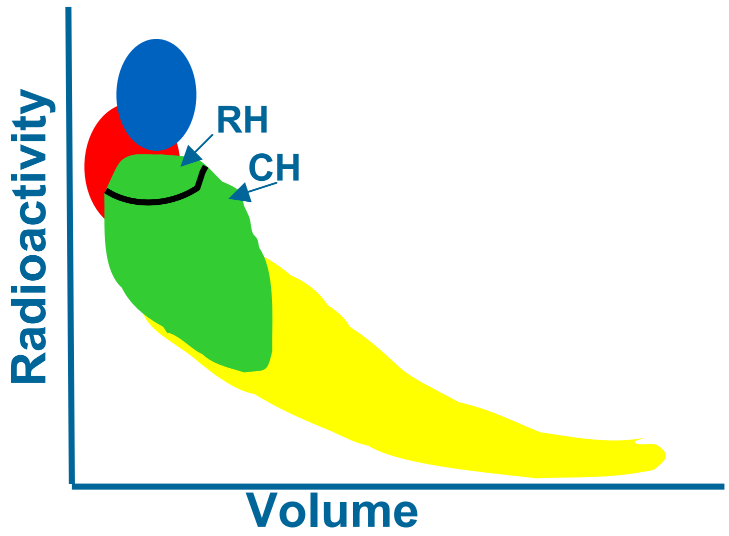
Initial characterization (minimize disturbance)

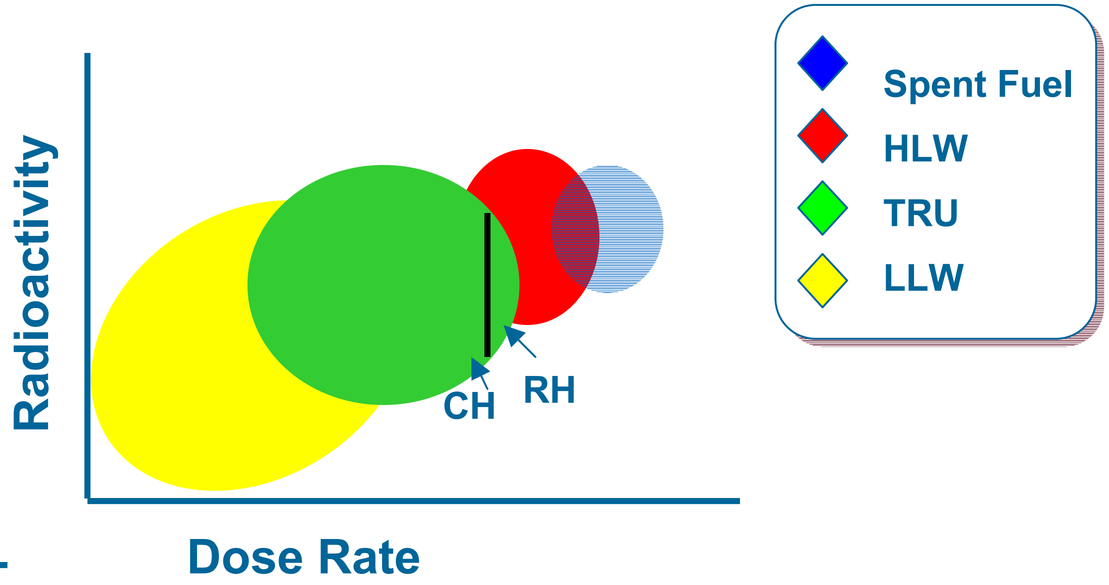


In the meantime…..

….disposal options for waste from power production versus weapons production begins to diverge in the 1970's

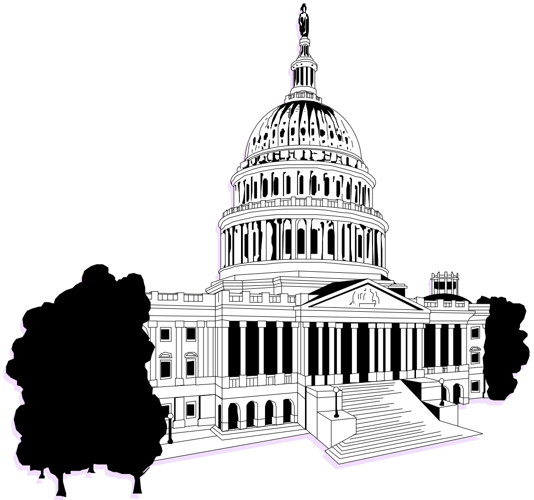
1970 - AEC establishes new category for transuranic waste, distinct from low-level radioactive waste. Land disposal of TRU terminates and retrievable storage begins





Congress passes the *DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980.*

Act authorized DOE to construct WIPP and to seek New Mexico endorsement to operate a geologic repository for waste generated for defense purposes (weapons development waste). Firmly separated weapons production waste disposal from power production waste disposal in the US.



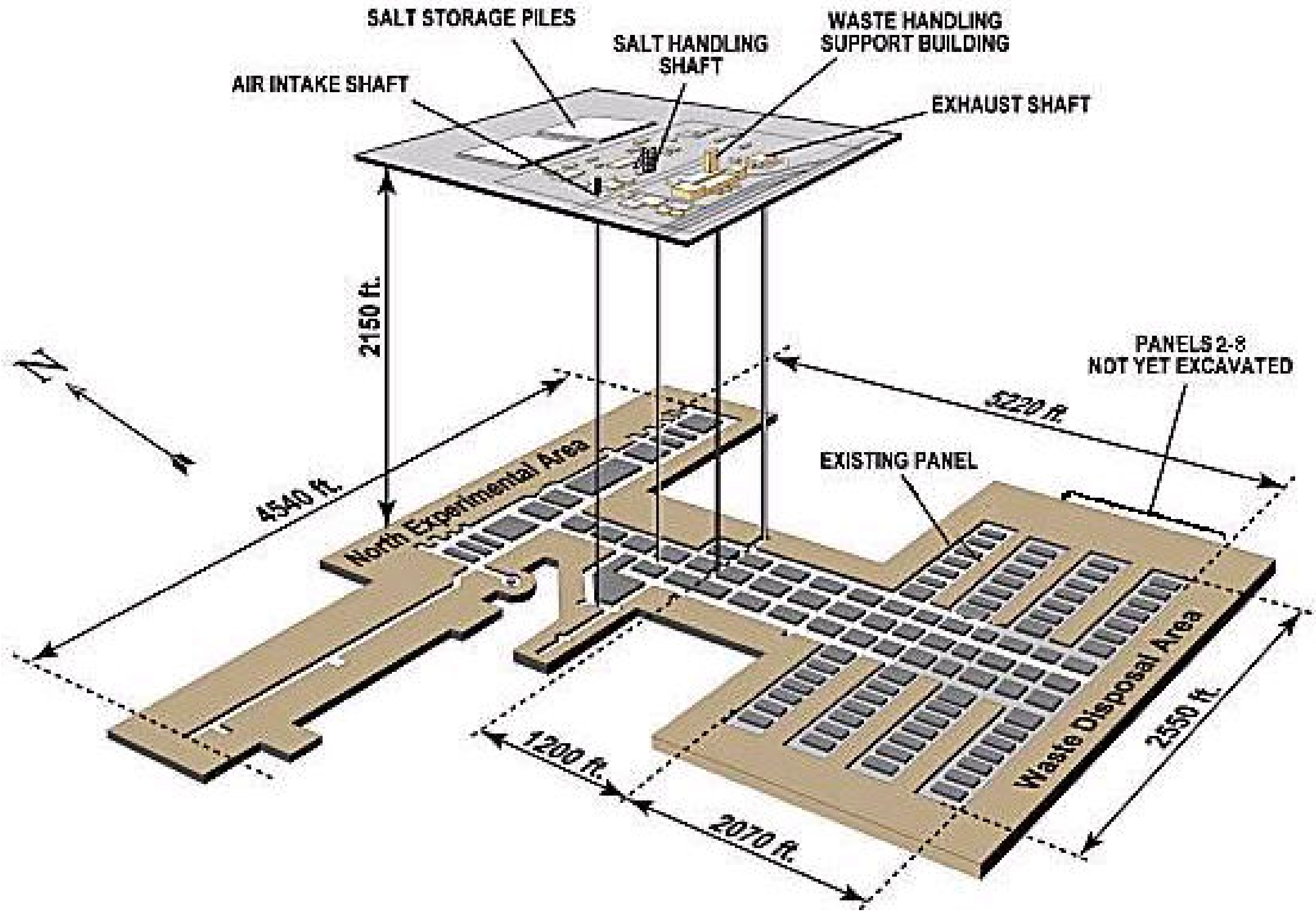
December 29, 1979

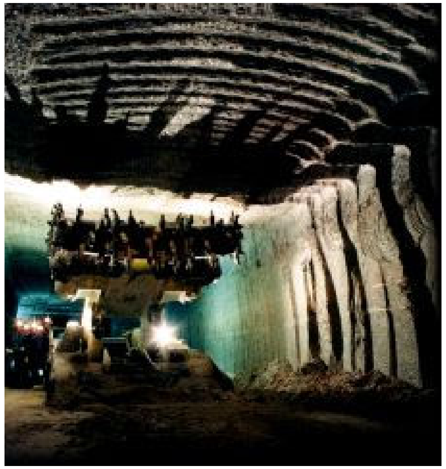
Substantial influence by both local and state politicians to proceed. Economic impact (jobs) drove influence but “good science” demanded at every step!

Senator Pete Domenici

Surface construction of WIPP begins 1981

Underground excavation at WIPP begins. First underground rooms are completed in 1983.





1988 – Engineered Facility – Ready for Waste Disposal

But…..11 more years required to gain regulatory approval

Major WIPP events (1 of 3)

1957 NAS recommends geologic disposal especially in salt

1968 Experiments begin in salt at Lyons, Kansas salt mine

1972 Lyons site rejected (both politically and technically)

1972 By August, ORNL begins Carlsbad studies

1975 Initial WIPP site selected (several nearby changes made as site specific characterization proceeds)

1979 Public Law 96-164 authorizes WIPP for Defense TRU waste
- separates weapons waste disposal from power production

1980 FEIS Published

1981 Site and design validation work begins

1983 Site validation, full-facility construction starts

1985 EPA issues 40 CFR 191

1987 DOE applies RCRA rules to WIPP

1988 WIPP technically ready – but politics steps in………

Major politically motivated WIPP events after 1988 facility readiness (2 of 3)

1989	No migration variance petition filed with EPA
1990	EPA grants conditional NMVP
1991	DOE again grants WIPP readiness
1991	DOE obtains WIPP Site Administrative Land Withdrawal
1991	State of New Mexico files for preliminary injunction
1992	Injunction issued, later PARTIALLY overturned
1992	WIPP Land Withdrawal Act passed; transfers land from DOI to DOE; established EPA as regulator
1993	In situ test plans with radioactive waste at WIPP site issued and then abandoned (tests to be performed at a national laboratory)
1995	DOE submits draft compliance application to EPA; draft RCRA permit to NMED

The steps to final regulatory approval - major WIPP events (3 of 3)

1996 Amendment to WIPP Land Withdrawal Act removes WIPP land disposal restrictions from RCRA

1997 WIPP Disposal Phase Final Supplemental EIS issued

1998 EPA certifies that WIPP complies with 40CFR191

1998 NMED issues drafts of RCRA Part B Permit

1998 DOE announces intent to dispose of non-mixed waste

1998 New Mexico AG and others file suit over EPA certification

1998 NMED protests but later confirms initial LANL waste is non-mixed

1999 1992 injunction voided by Judge Penn

1999 WIPP receives first non-mixed waste from LANL on March 26
~500 local citizens gather at WIPP to celebrate at 4:00am

Keys to Successful Siting & Licensing of WIPP (1 of 3)

- **National need: Clean up the US nuclear weapons production complex**
- **Existence of federal legislation authorizing and enabling WIPP to exist**
- **Existence of a clear "benefit" for citizens of the state and local jurisdiction in which the repository is sited**
- **Solid local support (with "clout")**
- **Competent technical oversight by the State of New Mexico (via EEG)**
- **Phased approach: feasibility, viability, licensing**
- **Science focused on compliance: knowing when enough is enough**
- **Basic understanding of physical processes at work in and around the repository, coupled with**
- **Conservative bounding cases, and**
- **Persistence**

Keys to Successful Siting & Licensing of WIPP (2 of 3)

- **Single scientific decision-making authority (Sandia National Lab.)**
  - **In-state**
  - **Independent**
  - **High integrity**
  - **Technical excellence**
  - **Solid reputation**
  - **Reputation enhanced through involvement in WIPP**
- **Intense and early public outreach**
- **Peer review**
  - **First electively by WIPP**
  - **Eventually required by the federal regulator**

Keys to Successful Siting & Licensing of WIPP (3 of 3)

- **Rigorous quality assurance from the early stages of the project:**
  - **Traceability**
  - **Transparency**
  - **Independent Review**
  - **Reproducibility**
  - **Retrievability**

  Applied to
  - **Data**
  - **Models**
  - **Parameters**
  - **Software**

Things to Avoid, If Possible

- Becoming a "tool" for politicians to use for enhancing their visibility (election opportunity)
- The necessity to qualify existing scientific data
- Imbalance among regulatory entities relative to the risk to public health and safety each seeks to regulate (hazardous [chemical] waste versus radioactive waste)
- Do not ignore the emotional methods of the anti-nuclear activists
    - fear of trivial dose
    - deception
    - claims of falsification
    - attributing trivial errors to intent to deceive

Technical and Regulatory Lessons Learned at WIPP

- One is most confident of the site and repository issues at the beginning of detailed investigation
- Site studies will inevitably find “issues” the critics will utilize to pursue their case
- Do not oversell or over-simplify the attributes of the site until they are confirmed
- The site and repository design must be robust enough to withstand uncertainties in models or natural variation in physical parameters as detailed knowledge of site and relevant processes unfold
- Independent expert review is essential to scientific credibility
- Quality assurance must be applied reasonably and thoroughly on all project activities important to licensing
- Data / information management is critical in regulatory review

Philosophical Lessons Learned at WIPP

- **Reliable and powerful local political support prior to licensing and construction is worth any cost**
- **Credibility is paramount, both its establishment and its maintenance**

  Remember, an uninformed majority must be able to decide between a (credible) project position and the less than complimentary picture portrayed by critics
- **Repository science must be focused on compliance**
- **There must be something credible to comply with**

  Setting repository performance criteria <u>before</u> siting studies begin provides a target to aim for
- **Persistence pays**

For more information, visit www.wipp.ws