SAND2011-8038P

Gaining Social Acceptance for Nuclear Waste Disposal: Theory and Practice

Paul E. Shoemaker

Senior Manager, Carlsbad Programs Group

Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

Sandia National Laboratories

THEORY

Sandia National Laboratories

Objective

- Remove from the accessible environment approximately 170,000 m^3 of nuclear waste
- Waste characteristics
  - More than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years
  - Much of the waste can be directly handled; that waste has a surface dose rate ≤ 200 millirem per hour
  - Some of the waste (approximately 5% by disposed volume) must be transported and handled in lead-shielded casks
  - This "remote-handled" waste must have no more than 23 curies per liter per canister and, in total, there can be no more than 5.1 million curies of this type of waste in the disposal environment

Proposal

- Place the waste in a variety of packages (drums, boxes, special containers)
- Transport the waste from the sites at which it was generated (and is now “stockpiled”) to a disposal site
- Place the packages in an underground repository
- The repository will be mined out of salt beds deep below the surface
- The intention is to permanently dispose of the waste in that repository (retrieval, while technically possible, is not intended to happen)

Sandia National Laboratories

Challenges

- Building a regulatory regime
- Identifying and interacting with one or more government regulators
- Ensuring that the affected jurisdictions (national, regional, and local) are consulted and that information about the proposal is fully and transparently shared
- Identifying suitable sites for the repository
- Assessing the risks associated with placing the waste in a repository located at each site identified

Sandia National Laboratories

Challenges (continued)

- Assessing those risks will involve . . .
  - Scientific research and quantitative modeling of the risks
  - Characterizing the sources of hazard (radionuclides and other hazardous constituents in the waste)
  - Identifying possible pathways by which these sources might be transported to the accessible environment
  - Calculating the probability of release along the identified pathways
  - Identifying possible effects on humans and the environment associated with releases from the repository
  - Determining whether the probability and size of releases falls below the threshold set by the regulator(s)

Sandia National Laboratories

Public and Other Interactons

- ASSUMPTION: The rules pertaining to the siting, opening, and operation of a nuclear waste repository require that regional and local authorities and the public do not stand in opposition to the activity.

- If the assumption is true, those entities sponsoring the proposal to site, open, and operate a nuclear waste repository must present to special interest groups, the media, and the public the results of the risk assessment work discussed above.
- For those receiving the information, these results amount to a set of claims about the safety of the proposed activities.

Public and Other Interactions (con't.)

- Stakeholders with whom to share risk assessment results include . . .
  - Sponsoring government agencies
  - Pertinent regulatory agencies
  - Regional officials
  - Local officials
  - Media
  - Special interest groups
  - Public
- Gaining acceptance (or at least enough confidence to forestall active opposition) is particularly challenging in the case of almost anything "nuclear"

Sources of Technical Data

- Technical data (i.e., assessments of risk) about nuclear waste disposal activities come from many sources:
  - Scientific societies
  - Scientists employed by the sponsoring government agency
  - Scientists affiliated with special interest groups
  - Scientists employed by regional/local entities
  - Scientists interviewed by the media

Sandia National Laboratories

Elements of Risk Perception

- Level of knowledge about nuclear waste
- Level of trust in those entities associated with nuclear waste transportation and disposal
- Influence of the media
- Imposition of the risk vs. consultation about the risk

Sandia National Laboratories

Risk Assessment Dialogues with the Public

- Before engaging in risk assessment dialogues with the public (or their representatives), consider the following questions:
  - What are the prior beliefs held by the public that will have to be addressed in assessing the safety of nuclear waste disposal activities?
  - In what regard is the scientific process of risk assessment held?
  - How are different prospective sponsors, scientific organizations, potential critics, and others with a stake in the decisions to proceed viewed by the public?

Sandia National Laboratories

Reactions of the Public

- When presented with technical data, the public will tend to filter what is said about the safety of the waste disposal activity through prior beliefs about the potential hazards of "things nuclear"

- The public may also give more or less weight to the technical data
  - depending upon the affiliation of the scientist(s) presenting the information, and
  - depending upon whether the perceived bias of the scientist matches or opposes the bias of the member of the public who is hearing the data

Sandia National Laboratories

Reactions of the Public (con't.)

- With regard to the nuclear waste disposal activities, members of the public are generally more willing to believe risk-increasing assertions than risk-decreasing assertions
- Public perceptions of science and scientists in general also serve to shape public perceptions of risk
  - Scientists are objective and the results they present are not influenced by the objectives and biases of those who pay the scientists to do their work … results suggesting disposal will be safe are more believable
  - Scientists are advocates for a cause and their results are influenced by those who pay them to do their work … results suggesting disposal will be safe are unreliable

Sandia National Laboratories

Reactions of the Public (con't.)

- Public perceptions of the credibility of those presenting technical data (whatever they may initially be) can erode quickly in the face of
  - Known or revealed inaccuracies
  - Incompetence in translating technical results into sound advice for decision-making
  - Perceived lack of concern for human health and the environment

Sandia National Laboratories

Reactions of the Public (con't.)

- Success for those who wish to convince the public that nuclear waste disposal activities will be safe is highly dependent on
  - Developing and maintaining a strong sense of the credibility of the scientific process underlying the risk assessment process (perhaps through cultivation of independent expert review)
  - Exhibiting and sustaining the scientific integrity of the organizations and scientists who perform and then present the risk assessment

Sandia National Laboratories

Social Acceptance (or Tolerance)

- Perform the risk assessment with high integrity
- Make it evident to the public that funding for the risk assessment will not be tied to the reaching of a particular conclusion about the safety of the nuclear waste disposal activity
- To the degree possible, rely upon independent scientists to conduct the risk assessment work (rather than "hired guns")
- At the very least, involve scientific organizations with very high levels of public trust and confidence in very visible ways

Acceptance /Tolerance (con't.)

- **Refrain from both the fact and the appearance of having made a decision about the acceptability of nuclear waste disposal activities before the risk assessment work is complete, presented, and properly vetted**
- **This can be very difficult, since the very nature of the process for obtaining regulatory approval to engage in nuclear waste disposal activities obliges the sponsoring government agency to use the risk assessment results to make arguments *for* compliance and to respond to critics who argue *against* compliance**
- **This regulatory approval process often moves in parallel with the conduct of risk dialogues with the public**

Sandia National Laboratories

References

The Role of Risk Perception and Technical Information in Scientific Debates Over Nuclear Waste Storage. 1998. H. C. Jenkins-Smith, et. al. Institute for Public Policy, University of New Mexico. Albuquerque, NM.

Assessment of Public Perception of Radioactive Waste Management in Korea. In-process. S. Cho, et. al. Myongji University, Bangmo College of Basic Studies. Gyeonggi, S. Korea.

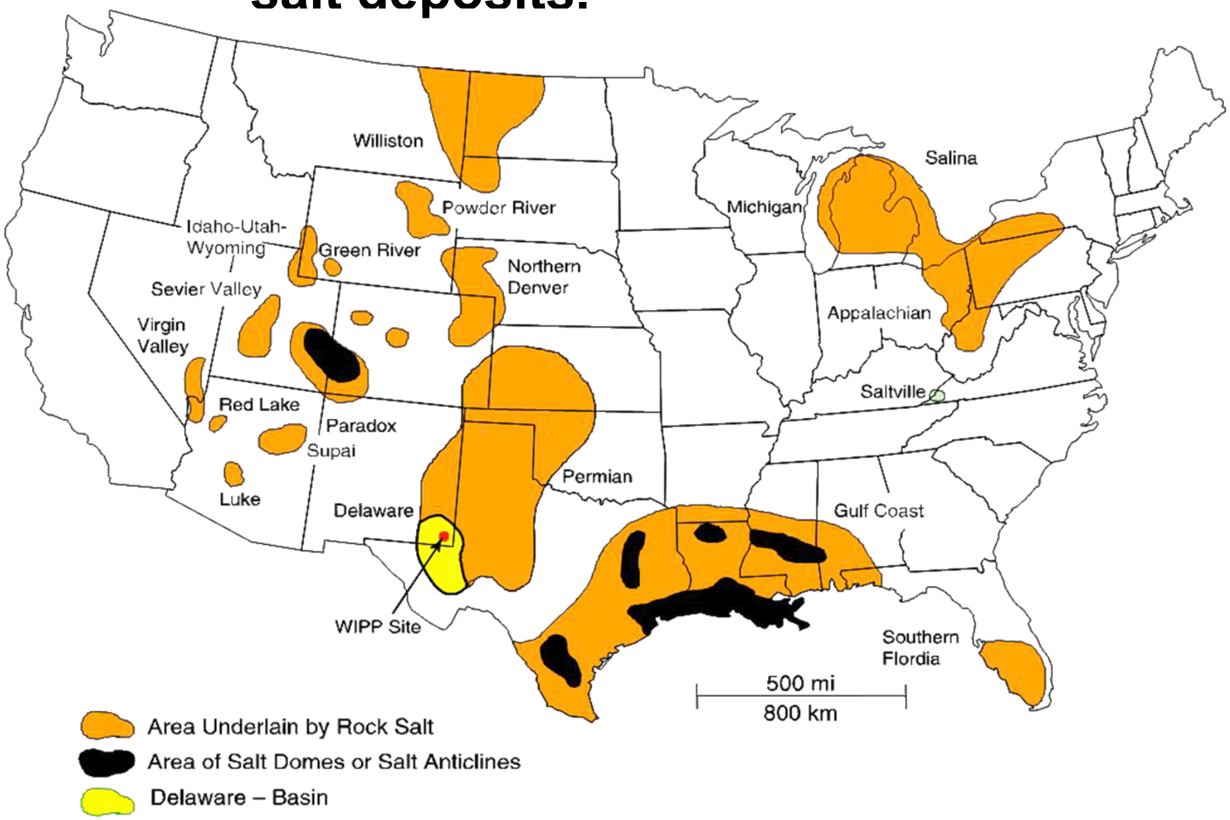
Sandia National Laboratories

PRACTICE

National Academy of Science

1957

- **National Academy of Sciences 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."*

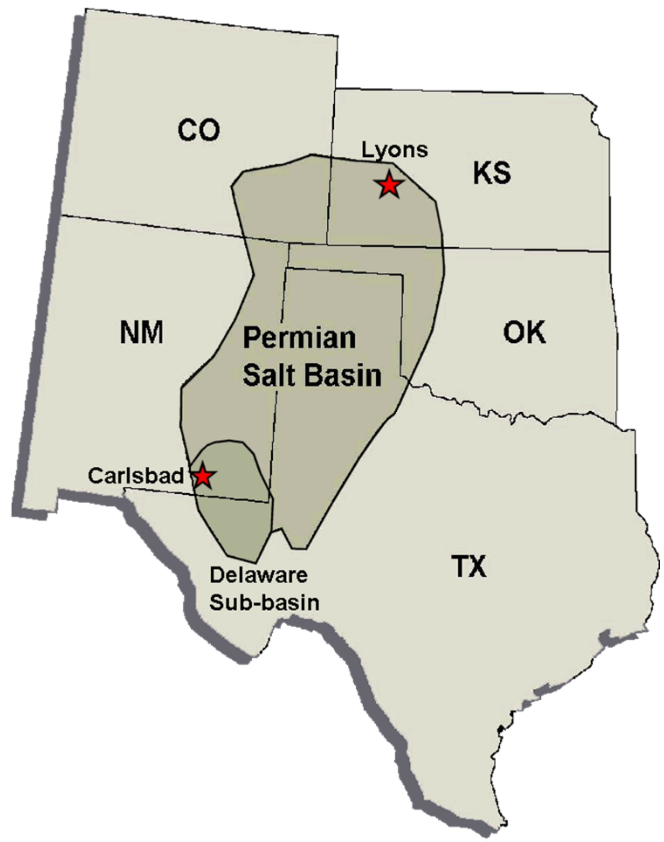
–*"The great advantage is that no water can pass through salt. Fractures are self healing…."*

Sandia National Laboratories

Initial Candidate Sites Focused on Bedded Salt

1968
1971

- **Project Salt Vault near Lyons Kansas.**
  - **Nearby oil production provided easy targets for critics and the Lyons site became politically troubled very quickly.**



1972

- **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.**

Sandia National Laboratories

DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980

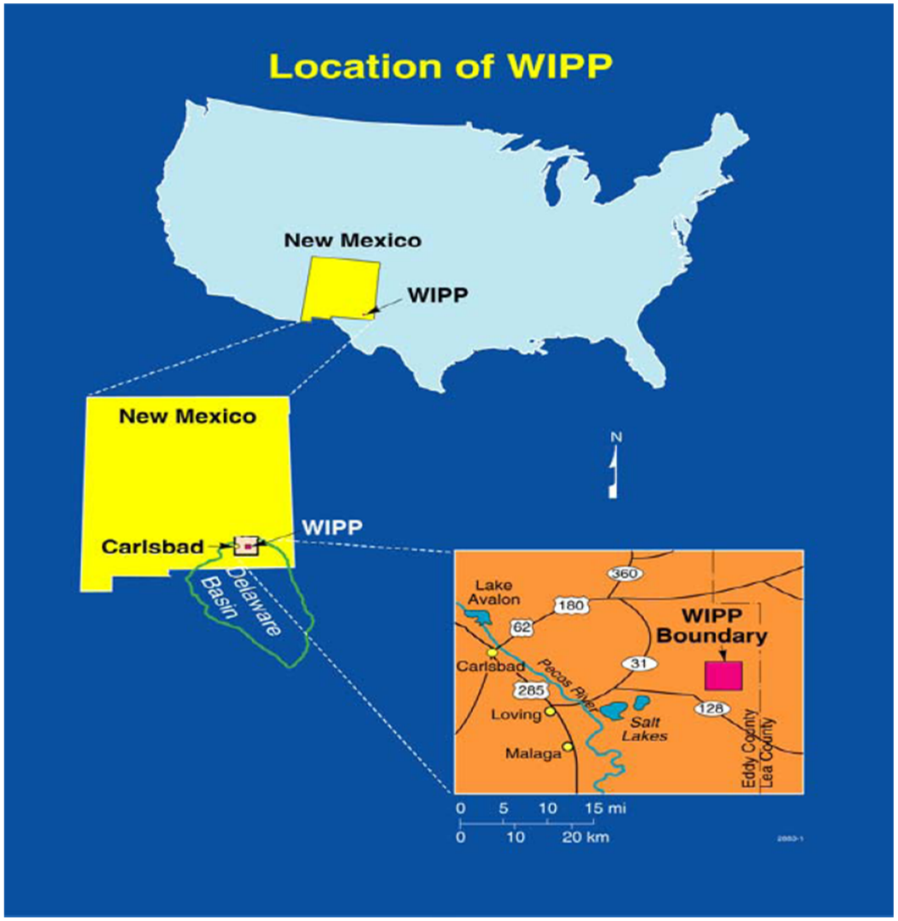
1979

- 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).
  - Act does not allow disposal of waste from civilian power production.

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

Sandia National Laboratories

WASTE ISOLATION PILOT PLANT (WIPP)



WIPP, located approximately 42 km southeast east of Carlsbad, New Mexico, is the first deep geologic repository certified in the U.S. to safely and permanently dispose of transuranic waste generated from the research and production of nuclear weapons.

TRU waste is the U.S. equivalent to Europe's intermediate-level waste, between low-level waste (LLW) and high-level waste (HLW), and requires long-term isolation in a deep geologic repository.

Sandia National Laboratories

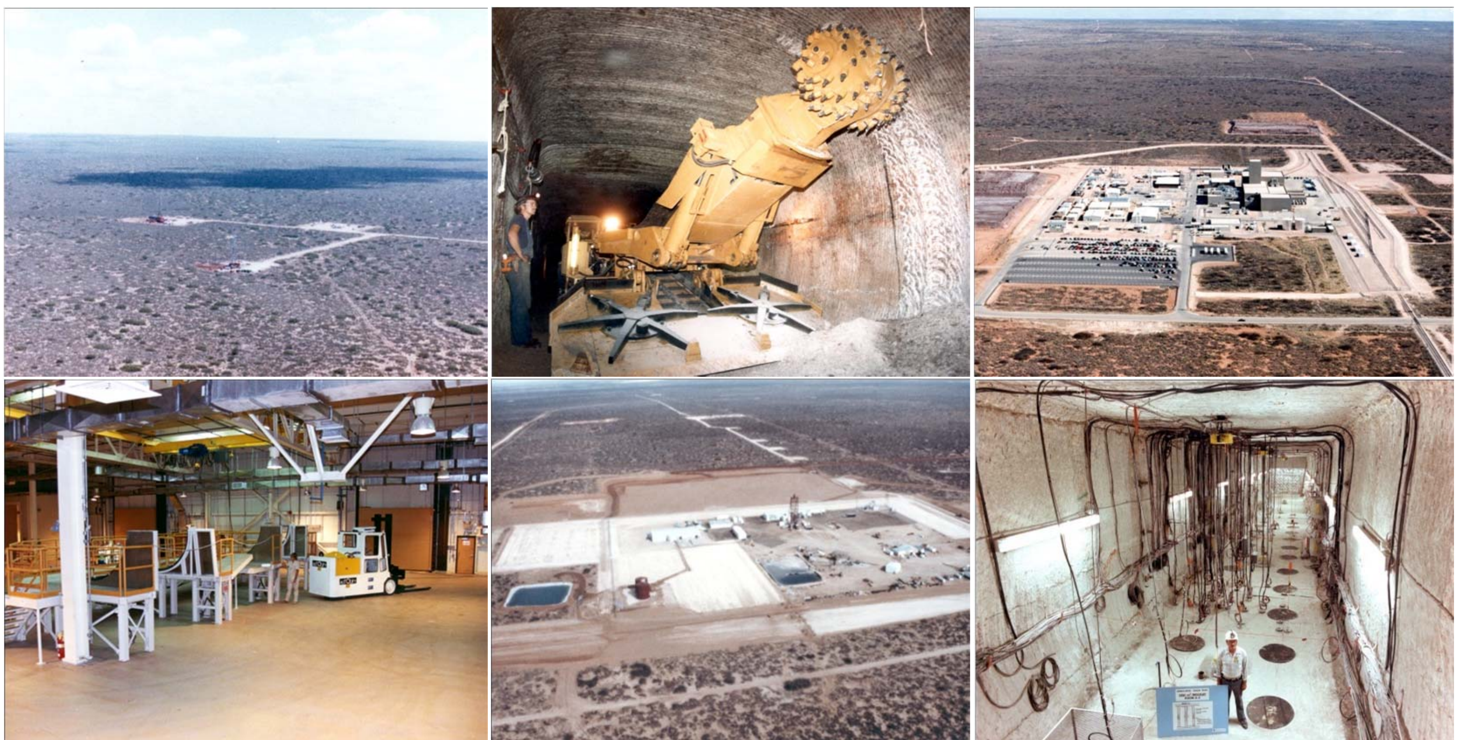
Site Selection

Construction of WIPP

1981 • Surface construction of WIPP begins.

1983 • First underground rooms are completed.

1988 • Engineered facility is ready for waste disposal.



Sandia National Laboratories

WIPP Today

Sandia National Laboratories

Major WIPP Events After the Facility Readiness

- **1989** • Nuclear Regulatory Commission certifies the TRUPACT-II shipping container
- **1992** • WIPP Land Withdrawal Act designates EPA as WIPP's primary regulator
- **1993** • EPA issues radiation standards for waste containment.
- **1996** • EPA issues criteria for compliance
- **1998** • EPA certifies that WIPP complies with 40CFR191
- **1999** • First shipment of TRU waste from Los Alamos National Laboratory
- **1999** • New Mexico Environment Department issues a Hazardous Waste Facility Permit
- **2004** • Recertification CRA-2004
- **2007** • Begin Remote Handled Waste Disposal
- **2009** • Recertification CRA-2009


CARLSBAD
CURRENT-ARGUS
stand (36 cents home-delivered) 26 Pages SUNDAY April 18, 1999 Serving Eddy County, New Mexico

It's official: WIPP's open for business

Richardson, N.M. congressmen on hand for grand opening ceremony

By Victoria Parker-Stevens

CARLSBAD — As a thank you to those who worked more than 25 years to see a nuclear waste repository open, the Waste Isolation Pilot Plant held special ceremonies Saturday morning.

While the first shipment arrived at the plant March 26 with hundreds of onlookers

"Today I'm especially proud to be an American and associated with those who made this possible."

LOUIS WHITLOCK RD

Sandia National Laboratories

Land Withdrawal Act Summary

- LWA authorized WIPP
  - Withdrew public land for disposal operations
  - Defined DOE and EPA responsibilities
  - Required EPA to promulgate Certification Criteria
  - Set limits for waste
  - Defined transportation requirements
  - Requires DOE to demonstrate continued compliance with the EPA's disposal requirements (recertification) every 5-years

Sandia National Laboratories

Waste Characterization

- **WIPP waste is thoroughly characterized to assure that it meets WIPP waste acceptance criteria**
  - **For transportation requirements**
  - **For disposal criteria**
  - **For health and safety requirements**

Sandia National Laboratories

Types of TRU Waste at WIPP

- Contact-Handled (CH)
  - Has a maximum dose rate of 200 mrem/hr at the surface of the inner package
  - Can be physically handled by operators
  - May be mixed with hazardous constituents

- Remote-Handled (RH)
  - Has a maximum dose rate of 1000 rem/hr at the surface of the inner package
  - Robotics and machinery are required
  - May be mixed with hazardous constituents

Sandia National Laboratories

WIPP Transportation

- Monitored by satellite tracking system
- Drivers are highly trained
- Emergency responders are trained
- Robust packaging

–72-B Cask for RH Waste

•Double confinement
•3 drums, 240 PE-Ci, 60 watts
•Total vehicle weight ≈ 36,300 kg
•Primary option for RH transportation

–TRUPACT-II for CH Waste

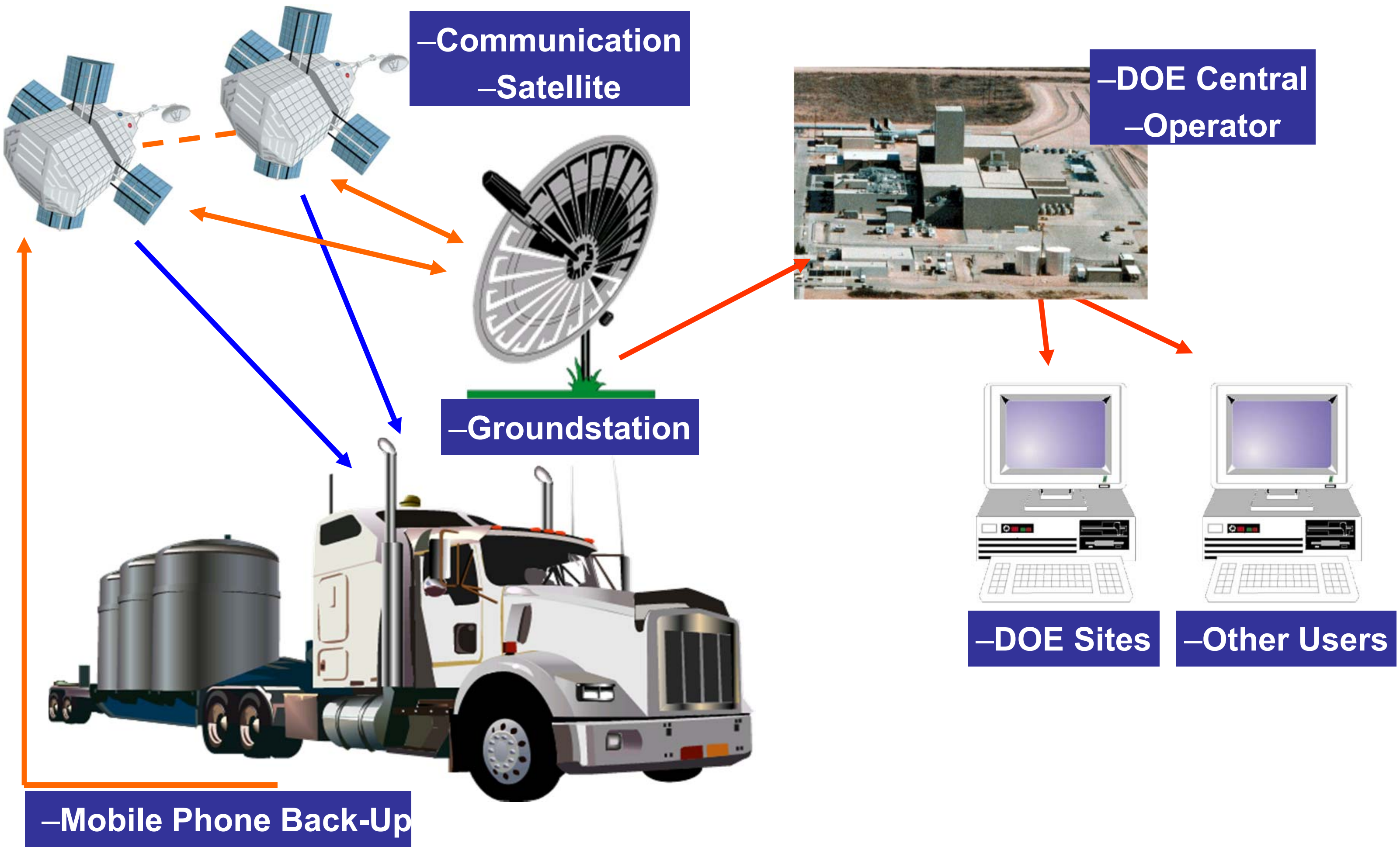
–The TRUPACT-II is a dual containment Type B shipping container used in shipments of contact-handled waste from generator sites to WIPP.

–As of October, 2011, more than 10,000 shipments of waste have come to WIPP

–WIPP transports have traveled more than 19 million kilometers

Sandia National Laboratories

TRANSCOM Tracking System



Sandia National Laboratories

NRC Type B Package Testing

- 800° C burn
- 9.1 m drop
- Computer modeling to equal immersion in 15.2 m of water

Sandia National Laboratories

WIPP – Approved Shipping Routes

Sandia National Laboratories

Training Along Shipment Routes

- **OSHA certified the WIPP training program in 1993 as required by the 1992 WIPP Land Withdrawal Act**

- **WIPP's Training and Education Program has trained more than 20,000 emergency response professionals**

- **Classes address**
  - **Caring for accident victims**
  - **Guarding the public welfare**
  - **Protecting the environment**
  - **Ensuring the safety of responders**

Sandia National Laboratories

Waste Handling

In this picture, the TRUPACT-II is in the WIPP Waste Handling Building TRU-dock to be unloaded. The Outer Containment Vessel (OCV) lid is being removed and will be placed on the round (grey) rack in the lower left corner of the picture. After the OCV lid is removed, the ICV will be removed in a similar fashion, allowing access to the waste packages within the ICV. The Inner Containment Vessel (ICV) lid can be seen as it remains on the TRUPACT-II container.

Sandia National Laboratories

Waste Emplacement

Contact Handled (CH) Waste is emplaced in rooms mined out of ancient saltbeds.

MgO is placed on waste stack to limit solubility of radionuclides

Emplacement of remote-handled (RM) waste in the wall of a WIPP panel

As of October, 2011, more than 77,000 m^3 of waste have been emplaced in the repository

Sandia National Laboratories

Key Components of WIPP Success

- Clear and direct leadership, decision-making and simple organization
- Well documented technical program
- Unbiased and open site selection process
- Effective interactions with the regulators
- Obtain public acceptance
- Overarching themes: Safety and Transparency

Organization and Leadership

- A repository project is inherently complex
  - Multiple government agencies (i.e., state, local, federal)
  - Multiple regulators
  - Diverse public opinions
- Because of the inherent complexity; keep organization structure simple and well defined
  - Separate program into operations and scientific support
  - Compliance-based approach - avoid analysis paralysis
  - Priortize R&D activities based on compliance and performance assessment impacts
  - Compliance focused QA program
- Strong leadership and commitment is essential

Well-Documented Technical Program

- **Even the BEST technical program is of little use if the program outputs are not well documented and of sufficient quality**
  - Data management system (e.g., records)
  - Modeling system version control
  - Reproducibility (e.g., experiments, modeling results)
  - Traceability (e.g., experimental data)
  - Credible and Defensible
- **Utilize credible independent technical review**
  - Independent Peer Panels
  - Corroborate technical approaches
  - Settle technical disputes
  - Enhances public and stakeholder confidence
- **Implement an effective Quality Assurance Program**
  - Cradle to Grave approach

Site Selection Process

- Investigate several sites in the initial selection and screening phase
- Select a site on its technical merits
- Don't oversell your site to stakeholders
  - Be prepared to abandon a given site for technical reasons
  - Unexpected events or information may cause a site to be eliminated from consideration

    "…It's never too late to do the right thing."
  - Further site studies will find issues; be prepared to deal with technical and perceptual issues based on technical grounds
- Don't settle for a marginal site - it must be robust enough to survive challenges

Sandia National Laboratories

WIPP Regulatory Framework

U.S. Department of Energy (DOE)

National Environmental Policy Act (environmental impact statements), nuclear safety

U.S. Environmental Protection Agency (EPA)

10,000 year Repository certification, radionuclide regulation, PCBs

New Mexico Environment Department (NMED)

RCRA hazardous constituents, water discharge, groundwater, air

U.S. Nuclear Regulatory Commission (NRC)

Transportation Type B packages for nuclear materials

U.S. Department of Transportation (DOT)

Highway transportation, Type 7A containers

Effective Interactions with the Regulators

- Engage regulator early in process
  - Use opportunity to establish working relationships
- Initially use informal and frequent dialog
  - Technical meetings (with public present)
  - Develop and nurture a collegial relationship
  - After a formal regulatory submittal is made, a more formal and rigid communication protocol may be required to allow regulator to avoid conflicts of interest and maintain independence

Gaining Public Acceptance

- Involve public at every juncture
  - A well-informed public is your ally
- DOE had a well-organized public outreach/educational program that started locally, and expanded outward
  - Educate affected local, state, and tribal governments
  - Educate affected local, state, and tribal members of public
  - Provide training/equipment to emergency response personnel along shipment corridor(s)
- Involving public helps to demonstrate transparency and openness; builds confidence
- WIPP regulatory compliance determinations employed an iterative public involvement process (also aids in transparency)

Summary

- Safety and Transparency at every phase of the project is of utmost importance
  - Site selection, construction and operation
  - Site characterization/data collection
  - Performance assessments
  - Compliance demonstrations and license decisions
- Assemble the strongest technical team possible, effectively use expert panels, and focus on documentation, QA and safety
- Develop a relationship of "mutual respect" with the regulator, ensuring appropriately resourced dialogue and face-to-face meetings with regulators
  - Independent regulatory standards and criteria
  - Recognize regulators will represent applicants to public

Sandia National Laboratories

Summary (continued)

- Early involvement of stakeholders and independent oversight group(s)
- Involve, educate, and sincerely address public concerns
- Recognize opponents probably will not be convinced; expect legal challenges
- Balance desire to increase public confidence, achieve transparent processes, with resources to meet regulatory requirements
  - Committed and focused project management
  - Recognize the time to go from R&D to compliance (certification/licensing)
- Success directly related to strong local and political support

Sandia National Laboratories