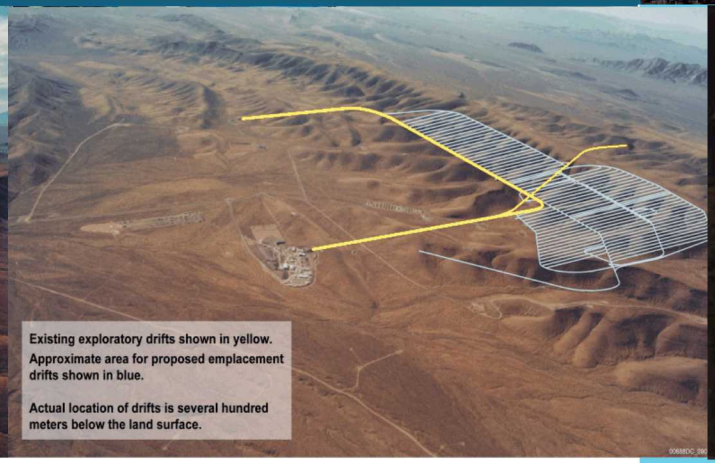
SAND2019-4279C

Knowledge Management and Preservation in Selected Long-Term Activities



PRESENTED BY

Kevin A. McMahon, Manager
Nuclear Waste Disposal Research and Analysis

DoD and Federal Knowledge Management Symposium
Defense Information Systems Agency

Baltimore, MD May 14-16, 2019

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SAND2019-XXXXX PE

Outline

- ✓ Knowledge Management and Preservation
- ✓ Case Studies:
  - Yucca Mountain Project Knowledge Preservation
  - Waste Isolation Pilot Plant Knowledge Preservation
  - Knowledge Management Strategy for the Nuclear Fuel Cycle Program
  - Knowledge Preservation for Nuclear Weapons
- ✓ Conclusions
- ✓ Historical References for Yucca Mountain Project and Waste Isolation Pilot Plant

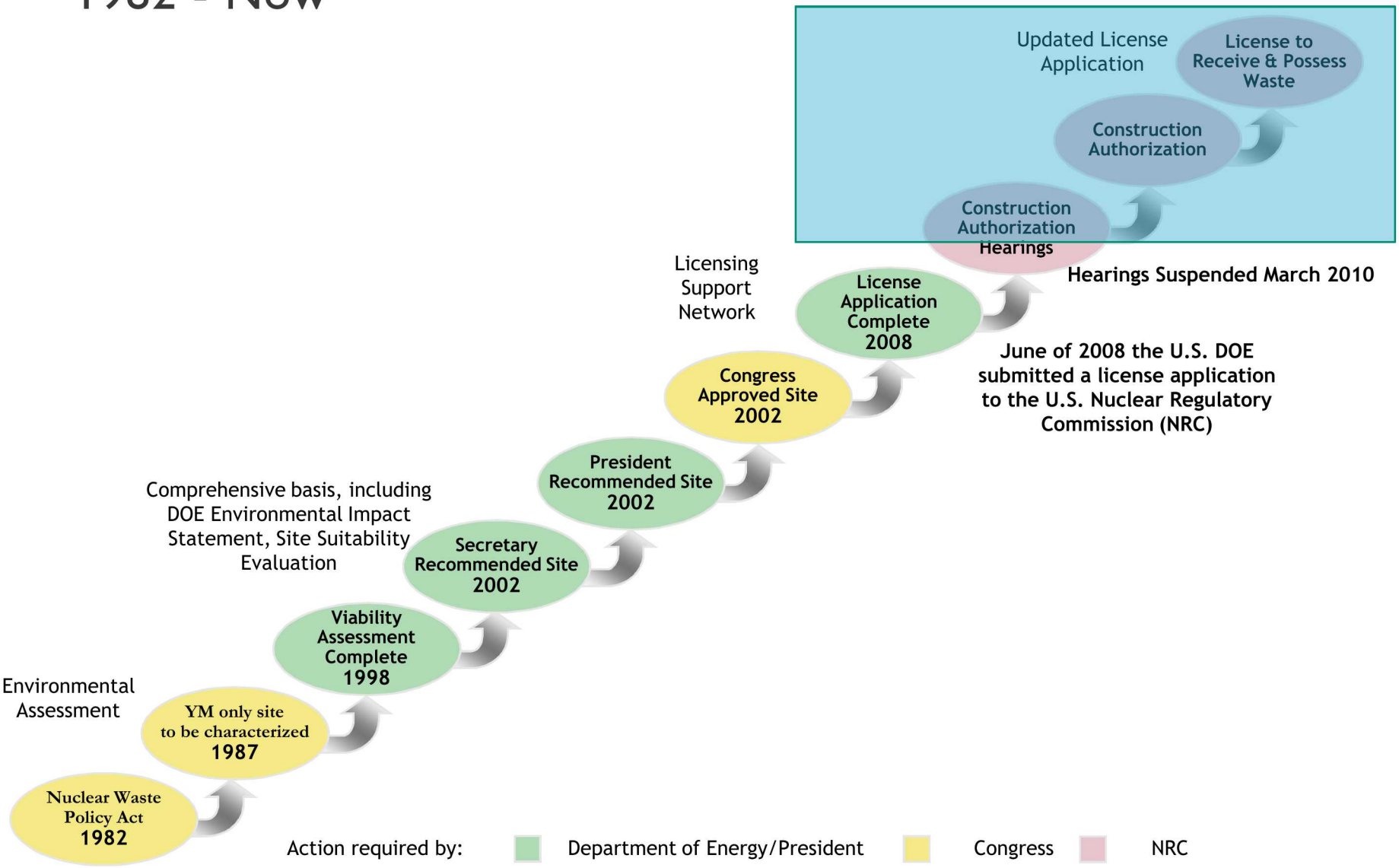
Knowledge Management and Preservation

MANAGEMENT: Encompasses efforts directed at compiling, organizing, and leveraging an organization's knowledge to support organizational goals, (continuity, profitability, efficiency, etc.)

PRESERVATION: Envelops both classic subdivisions of knowledge; *explicit* knowledge, and *tacit* knowledge

- ***Explicit*** knowledge includes information that is readily codified into a tangible form, i.e., documentary material (reports, analyses, memos, videos, email, databases, etc.) that may be retained in a wide variety of media (paper, film, electronic, etc.)
- ***Tacit*** knowledge is knowledge that we as individuals possess, but is not readily codified.
  - More difficult to codify, if possible at all
  - Examples include technical, societal, or cultural processes that pertain to substantial organized efforts (large engineering projects)

Yucca Mountain Project – Case Study
1982 - Now

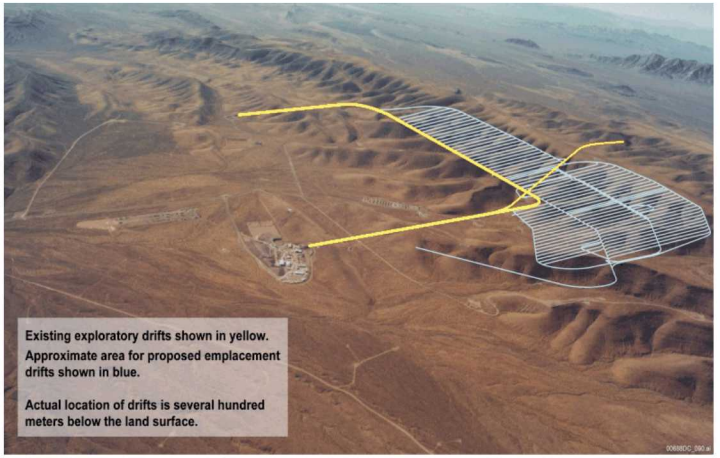


Yucca Mountain Project – Case Study
Explicit Knowledge Preservation

Knowledge Preservation Systems for the Yucca Mountain Project that preserve ***Explicit*** knowledge include:

- NRC ADAMS (Agency Document and Management System) Collection
- NRC ASLAB LSN (Licensing Support Network) Collection
- DOE Legacy Management Collection
- Sandia National Laboratories (Yucca Mountain Project Lead Laboratory)

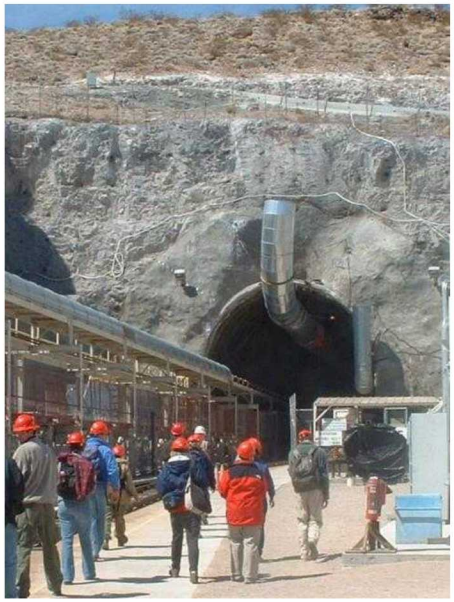
Yucca Mountain Project – Case Study
Tacit Knowledge Preservation



July 2009 focus group discussions with YM technical staff

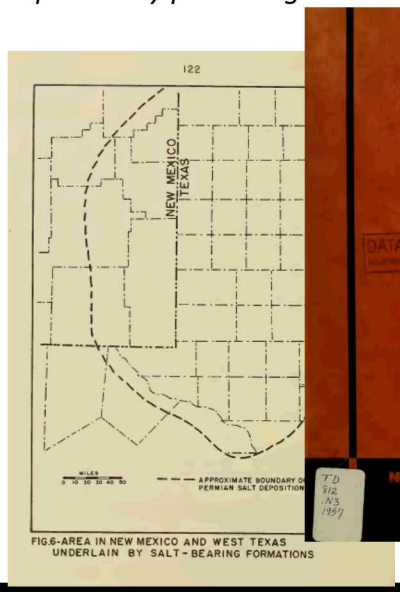
- Study to collect & preserve ***tacit*** YM knowledge
- Addressed the way policy and organizational changes affected perceptions of the:
  - Organizational environment,
  - Views of the role and nature of the technical work, and
  - Understandings of the norms and expectations for career scientific and technical professionals, over the nearly thirty year evolution of the project
- Concluded that one of the most significant concerns expressed by the YM workforce was the loss of RW management expertise, suggesting that a sustained institutional, organizational, and personnel effort to address the national radioactive waste problem was needed.

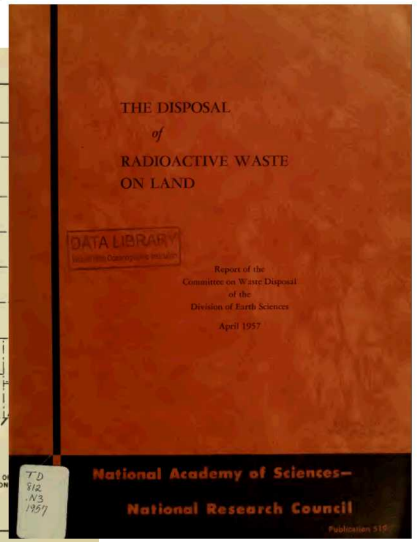
July 2010, all YM site-related technical studies were ended



Waste Isolation Pilot Plant – Case Study
Background

- 1940s Manhattan Project generates first significant volumes of spent nuclear fuel SNF and high-level radioactive waste (HLW)
  - Waste managed on-site
- 1957 National Academy of Sciences report *The Disposal of Radioactive Waste on Land*
  - *"Disposal in cavities mined in salt beds and salt domes is suggested as the possibility promising the most practical immediate solution of the problem." (NAS, 1957, page 1)*
- 1971 City of Carlsbad, NM approaches NM congressional delegation seeking a repository
- 1975 Sandia National Laboratories assumes lead science
  1976 Project is named Waste Isolation Pilot Plant
- 1979-1993 Site characterization
- 1996 DOE submits the WIPP Compliance Certification Application to the US EPA
- 1998 EPA certifies the WIPP for disposal operations
- 1999 First waste arrives at WIPP
  - 12,398 shipments as of April 3, 2019, all by truck
    http://www.wipp.energy.gov/shipments.htm

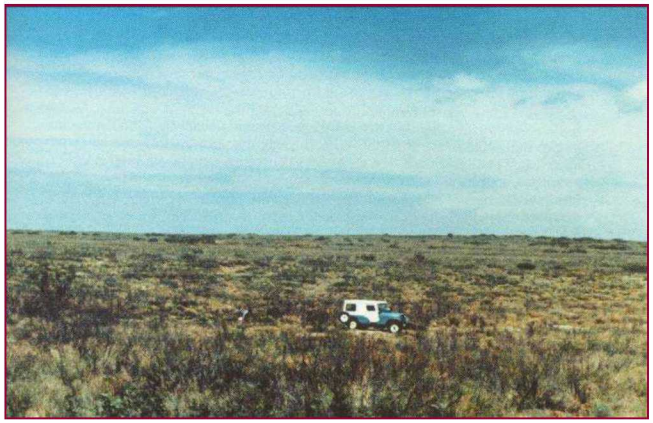




Waste Isolation Pilot Plant – Case Study
Knowledge Preservation

- Several layers of requirements prescribe what ***explicit*** records are to be kept for how long
- Hierarchy of messages is to be created, with the most detailed message level proposed to be stored at a number of U.S. state archives, the U.S. federal archives, and if possible in international archives[1]
- Archival quality paper and buffered inks are mandated by federal and other archiving institutions, but work is in progress to also, or perhaps instead, create electronic archives that are and will remain searchable and adaptable as hardware platforms and software technologies change
- Length of time over which archives (as well as markers on the site to inform the future) to be maintained is not specified. *As long as practicable* is assumed to be the timeframe, and not longer than 10,000 years

1975



TODAY

[1] Wagner, R.L. Beauheim, T.W. Pfeifle, A. Bethel, G. Sosa-Yates, C.V. Williams, M. Milligan and M. Fox. 2002. WIPP Case Study: Compliance Monitoring, Passive Institutional Controls, and Record Keeping, SAND 2002-2010, Albuquerque, NM, July 2002.

Waste Isolation Pilot Plant – Case Study
Ethics of Knowledge Preservation

Open issues remain concerning ethical and physical dimensions to warn the future through maintaining records

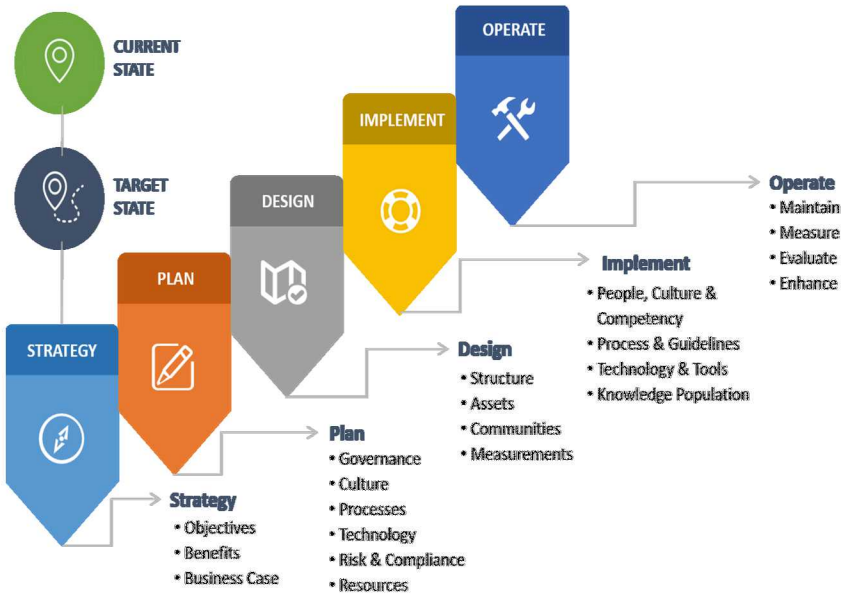
1. Balance must be struck between the investment pulled out of the resources available to current generations and the prevention of an unknown degree of harm to an unknown and hypothetical human in the far-future.
2. Assessment should be made of the quantity and nature of the information proposed to be archived:
   - Purpose for the archived materials is limited,
   - Trusting in archives and the national and international institutions that maintain them to exist for longer periods than a thousand years may be foolhardy and not contribute to future safety at all.

Images from http://www.wipp.energy.gov/Photo_Gallery_Images

Sandia's Knowledge Management Strategy
Nuclear Energy Fuel Cycle (NEFC) Program

- NEFC is in constant state of flux
  - Staff departures & hiring
  - Highly technical, majority MS, Ph.D.
- Projects complex requiring much time to become proficient
- Demographic change happening
  - Exodus of late-career
  - Influx of early-career
- Need for KM strategy is great
  - Initiated April, 2019

Sandia NEFC KM Plan Roadmap



Communication Tools for KM Program

Communication	Capture	Internalize	Organize
• Community Q & A Forums • Ask the Expert Forums • Instant Message • Blogs & Microblogs • Video conference, phone, email, meeting	• Digital Video and Audio • Lessons Learned Management System • Team Blogs • Wikis • Software (Microsoft Office Products such as Word and PowerPoint)	• Search engines and tools • E-learning • RSS • Community blogs and forums	• Wiki • Portals • SharePoint • Lessons Learned Management System • End Note

- Technology is enabler
  - Key tech platforms shown above
- Technologies chosen based on
  - KM objectives
  - Governance model
  - Culture
  - Rules and regulations

Sandia National Laboratories – Case Study
Nuclear Weapons Stewardship

- Sandia emerged from World War II's Manhattan project[2]
- Through the 1940's, nuclear stockpile was small, consisting of a few hand-crafted devices modeled on the Fat Man design used in World War II.
  - As cold war progressed from the 1950's through the end of the 20th century, the US developed a larger stockpile of nuclear weapons of multiple designs
  - Sandia's primary mission continues to be to provide the science and technology to maintain and certify the nuclear stockpile
- Ability to certify safety, security and operational capabilities of the stockpile are made even more difficult since the banning of nuclear weapon testing in 1996

2 Johnson, L. 1997, Sandia National Laboratories, A History of Exceptional Service in the National Interest, SAND97-1029.

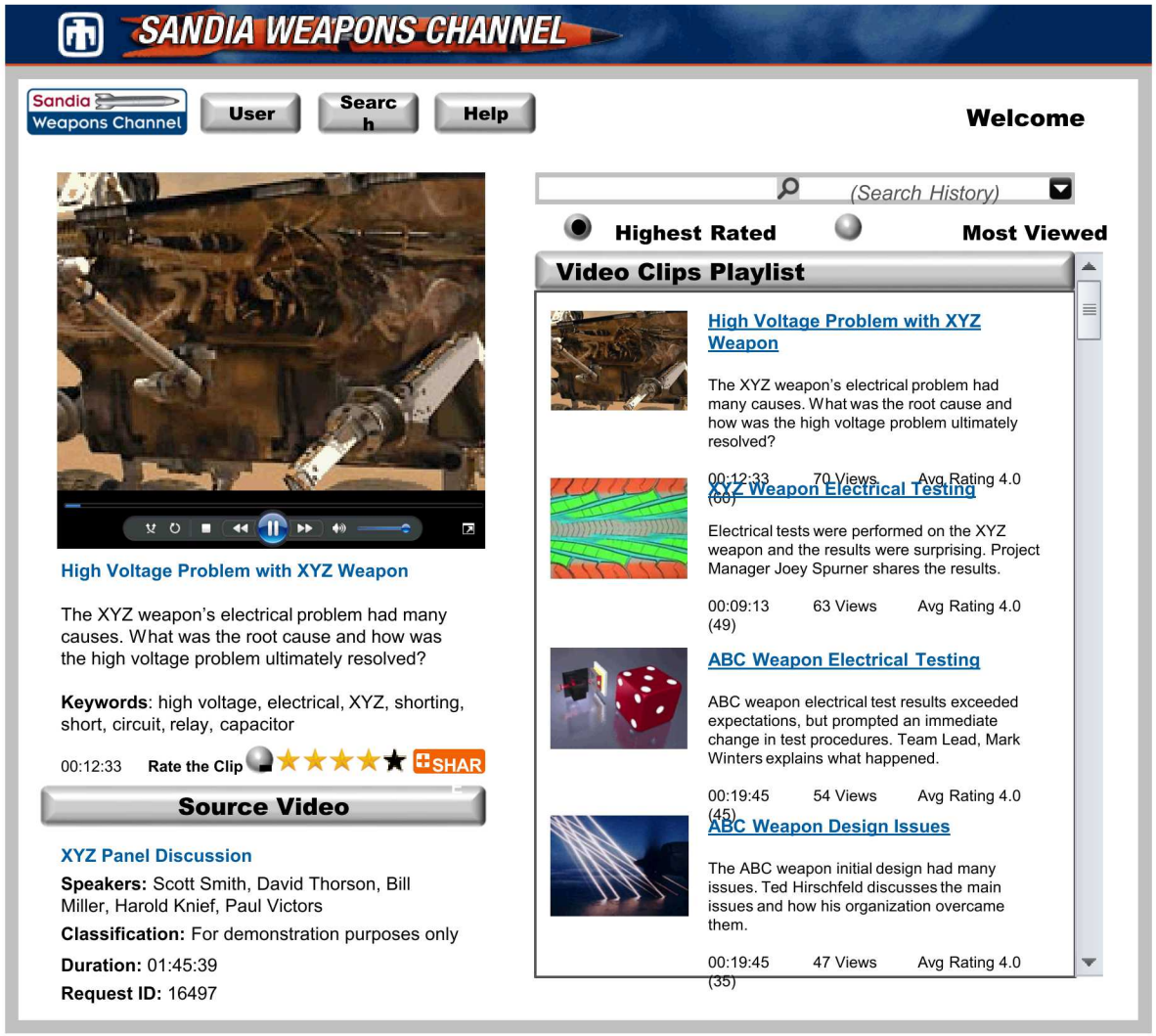
Sandia National Laboratories – Case Study
Nuclear Weapons Stewardship

- 1990's, Sandia recognized there were no new weapons designs on the horizon and designers of the weapons over the prior 40+ years were leaving Sandia and entering retirement [3]
  - Challenge to maintain expertise to sustain the nuclear stockpile and the capability to respond to changes in the threat environment
  - SNL and DOE require storage and maintenance of all design and test drawings and documents (***Explicit*** knowledge), but Sandia had no way of capturing and preserving ***Tacit*** knowledge of the weapons designers
  - In the 1990's and early 2000's, much of this ***Tacit*** knowledge of retiring weaponeers >1,500 hours of video was gathered and placed on the Sandia Classified Network
  - For over a decade, this captured ***Tacit*** knowledge resided on servers, available but unused

[3] Sandia Lab News, July 8, 1994.

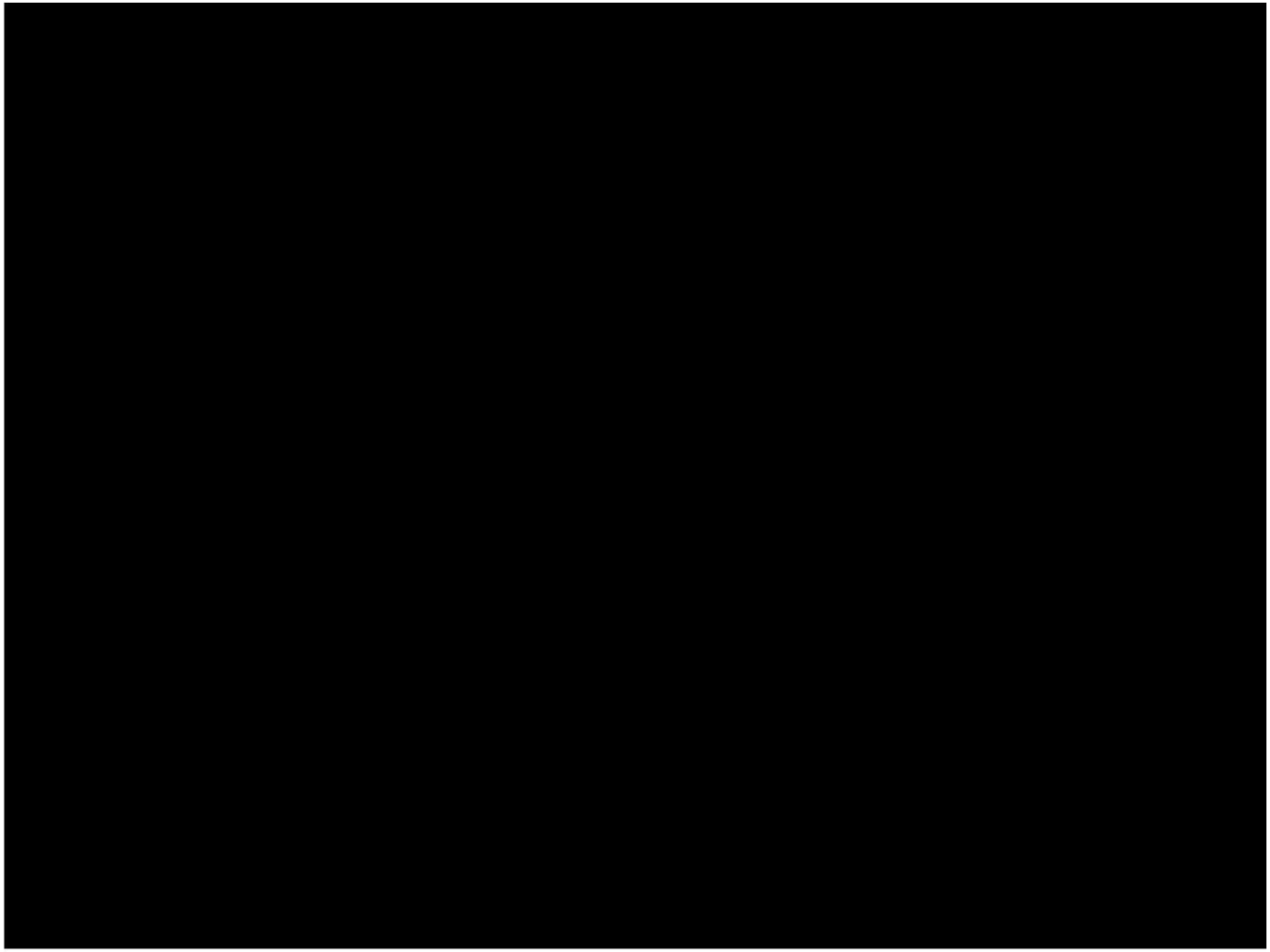
Sandia National Laboratories – Case Study
Nuclear Weapons Stewardship

- In 2012, retirees reviewed the lengthy tapes, identifying and categorizing short (5-10 minute) synopses (video clips) for inclusion into a web based "YouTube" like application
- Sandia Weapons Channel created



Sandia National Laboratories – Case Study
Nuclear Weapons Stewardship

Sandia Weapons Channel



Conclusions

- Knowledge Preservation related to an eventually successful long-term activity will be of inestimable value
- Long-term activities require historians or knowledge management entities that are explicitly responsible for Knowledge Management and Knowledge Preservation, as well as, a defined process for capturing not only ***Explicit***, but also ***Tacit*** knowledge from participants
- We should not leave future generations wondering: '*How did they move those enormous stones into place to build the pyramids*?'

Historical References for YM and WIPP

Yucca Mountain Project
Key Historical References

Luther Carter, 1987, *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste*, Resources for the Future, Inc. Baltimore, MD: John Hopkins University Press; 1987

J. Samuel Walker, 2009, *The Road to Yucca Mountain*. Berkeley, CA: University of California Press.

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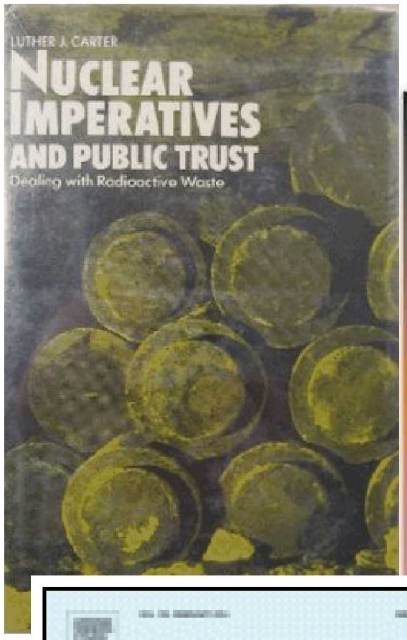

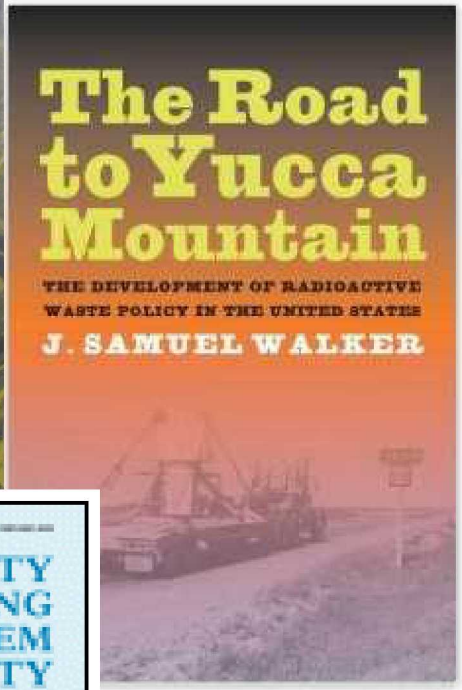

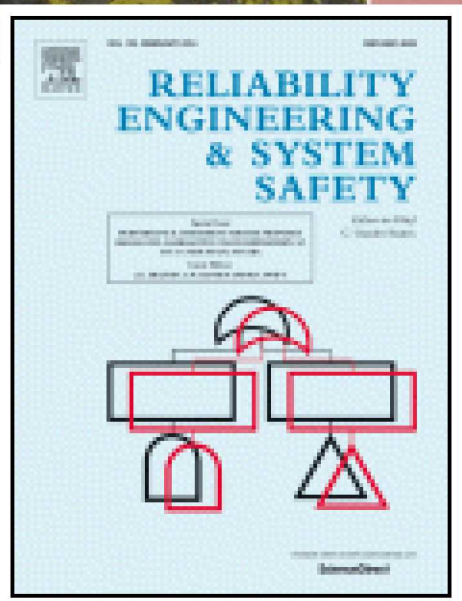

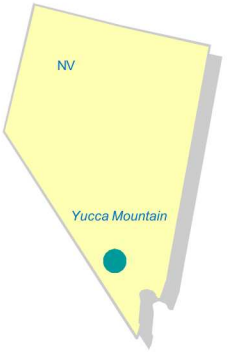

Waste Isolation Pilot Plant
Key Historical References

- Luther Carter, 1987, *Nuclear Imperatives and Public Trust: Dealing with Radioactive Waste*, Resources for the Future, Inc. Baltimore, MD: John Hopkins University Press
- Chuck McCutcheon, 2002, *Nuclear Reactions: The Politics of Opening a Radioactive Waste Disposal Site,* University of New Mexico Press.
- R.P. Rechard, 2000, "Historical Background on Performance Assessment for the Waste Isolation Pilot Plant,"
- *Reliability Engineering and System Safety* v. 69, p. 5-46 (See also other papers in this volume).