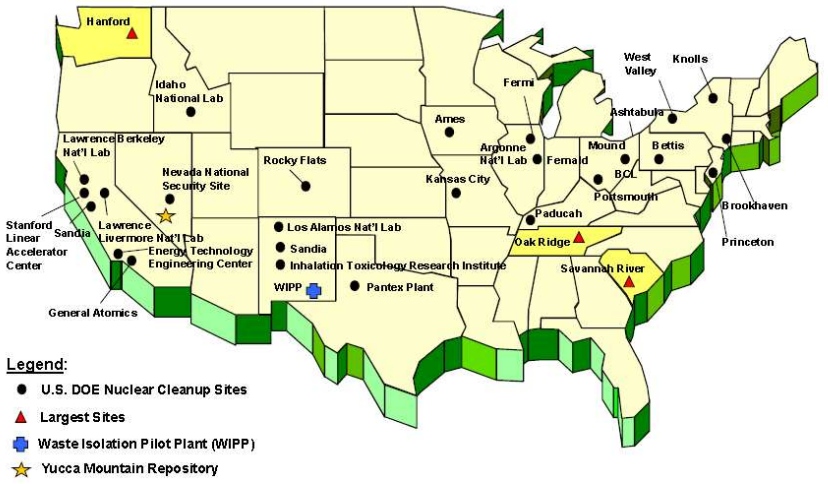
Introduction to CRESP

David S. Kosson, CRESP Principal Investigator
Cornelius Vanderbilt Professor of Engineering
Vanderbilt University

CRESP

Support safe, effective, publicly-credible, **risk-informed management of existing and future nuclear waste** from government and civilian sources through independent strategic analysis, review, applied research and education.

The U.S. Department of Energy's Cleanup Sites



www.CRESP.org

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Who is CRESP?

CRESP III Management Board (1/2)

Principal Investigator: **David S. Kosson**, Ph.D., Cornelius Vanderbilt Professor of Engineering, Vanderbilt University (david.kosson@vanderbilt.edu)

Craig Benson, Ph.D., P.E., N.A.E., Dean, School of Engineering and Applied Science, University of Virginia

Joanna Burger, Ph.D., Distinguished Professor of Biology, Rutgers – The State University of New Jersey

Kevin Brown, Ph.D., Associate Research Professor, Civil and Environmental Engineering, Vanderbilt University

Michael Greenberg, Ph.D., Distinguished Professor and former Dean, Bloustein School of Planning and Public Policy, Rutgers – The State University of New Jersey

Kathryn A. Higley, Ph.D., C.H.P., Professor, Nuclear Engineering & Radiation Health Physics, Oregon State University

The CRESP Management Board is comprised of technical, engineering, scientific and policy experts from eight university consortium member institutions

CRESP III Management Board (2/2)

Kimberly Jones, Ph.D., Professor and Chair of the Department of Civil and Environmental Engineering, Howard University

Steven Krahn, Ph.D., Professor of the Practice of Nuclear Environmental Engineering, Vanderbilt University

Martha Grover, Ph.D., Professor & Associate Chair, School of Chemical & Biomolecular Engineering, Georgia Institute of Technology

Jane B. Stewart, J.D., Director, International Environmental Legal Assistance Program, New York University

Additional CRESP Senior Researchers

Andrew Garrabrants, Ph.D., Research Associate Professor; **Jesus Gomez Velez**, Ph.D., Assistant Professor; **Florence Sanchez**, Ph.D., Associate Professor, Civil and Environmental Engineering, Vanderbilt University; **Tim Fields**, Sr. VP, Michael D. Baker, Inc. (environmental policy); **Michael Gochfeld**, M.D. (occupational medicine); **Hank Mayer,** Ph.D. (policy and economics); **Ronald W. Rousseau**, Ph.D., Professor, Georgia Tech., Chem. Eng.; **Richard B. Stewart**, LL.B., University Prof. and Director, NYU Center on Environmental and Land Use Law

CRESP
Consortium For Risk Evaluation with Stakeholder Participation

David S. Kosson

- Dr. Kosson is the Cornelius Vanderbilt Professor of Engineering and Professor of Civil and Environmental Engineering at Vanderbilt University. He is the principal investigator of the multi-university Consortium for Risk Evaluation with Stakeholder Participation (CRESP). Professor Kosson's research focuses on technical and policy for management of nuclear and chemical wastes, including process development and contaminant mass transfer applied to groundwater, soil, sediment and waste systems. His research also includes durability and performance assessment of cement and concrete systems in long-term environmental settings for nuclear and non-nuclear applications.
- His research in collaboration with the Energy Research Centre of The Netherlands on leaching of contaminants from wastes and construction materials and development of the leaching environmental assessment framework (LEAF) is currently providing the foundation for environmental regulation of these materials at USEPA, the Netherlands Ministry of Environment and the European Union's Directorate General for the Environment.
- Professor Kosson has served on and chaired committees of the National Academies focused on chemical weapons demilitarization for more than 20 years, including the Committee on Review and evaluation of the Army Chemical Stockpile Disposal Program. Professor Kosson has participated in or led many external technical reviews on nuclear waste processing for the Department of Energy including for tank wastes and a range of technology approaches at Hanford, Savannah River and Idaho sites, led major test and evaluation projects and served on DOE Secretary of Energy committees.

Kathryn A. Higley

- Professor, and previous Head of the School of Nuclear Science and Engineering in the College of Engineering at Oregon State University. She has managed OSU's Radiation Health Physics program, including developing its online graduate degree, into the largest in the country.
- Dr. Higley has been at Oregon State University since 1994 teaching undergraduate and graduate classes on radioecology, dosimetry, radiation protection, radiochemistry, and radiation biology.
- She is current Vice Chair of Committee 4 of (Implementation of the Commission's Recommendations) of the International Commission on Radiological Protection and past Chair of Committee 5 (Protection of the Environment); she is also a council member of the National Council on Radiation Protection and Measurements and serves on Council Committee 1 (radiation protection recommendations of the NCRP) and Committee 2 (where are the radiation professionals).
- She is a fellow of the Health Physics Society and a Certified Health Physicist. Dr. Higley and her students have done research in radiologically contaminated environments around the globe.

Michael R. Greenberg

- Distinguished professor of the Edward J. Bloustein School of Planning and Public Policy, Rutgers University. He studies environmental health and risk analysis and has written more than 35 books and more than 350 articles.
- Professor Greenberg was a member of National Research Council Committees that focus on the U.S. plutonium disposition; destruction of the U.S. chemical weapons stockpile; the degradation of the U.S. government physical infrastructure; and sustainability and the U.S. EPA.
- He served on the EPA Science Advisory Board environmental justice committee. He chaired a committee for the U.S. Senate and House Appropriations Committees examining the U.S. DOE's prioritization of human health and safety in its environmental management programs. Professor Greenberg served as area editor for social sciences and then editor-in-chief of Risk Analysis: An International Journal during the period 2002-2013 and was associate editor for environmental health for the American Journal of Public Health from 1997 through June 2020.
- Professor Greenberg was dean of the school or associate dean of the faculty of the Bloustein during the period July 1, 2000 through September 30, 2018.

Elements of Risk Communications

Why, What, How and Where?

Kathryn Higley
&
Michael Greenberg

DOE EM SSAB meeting
April 20, 2021

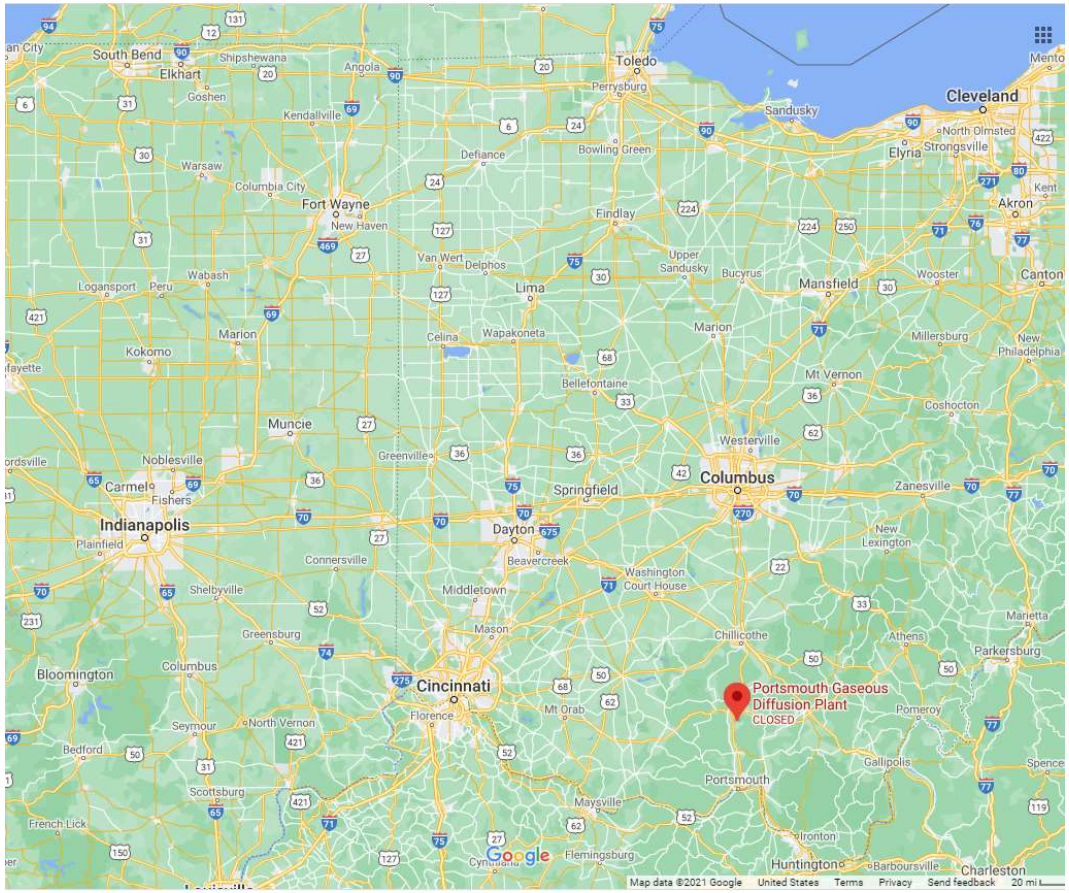
Risk Communications - Overview

- Why is it getting it right important?

Supplemental material

- What do you need to know for effective risk communication?
- Where can you go for more information?

THE IMPORTANCE OF GETTING RISK COMMUNICATION RIGHT



Example 1: Portsmouth

Portsmouth Site

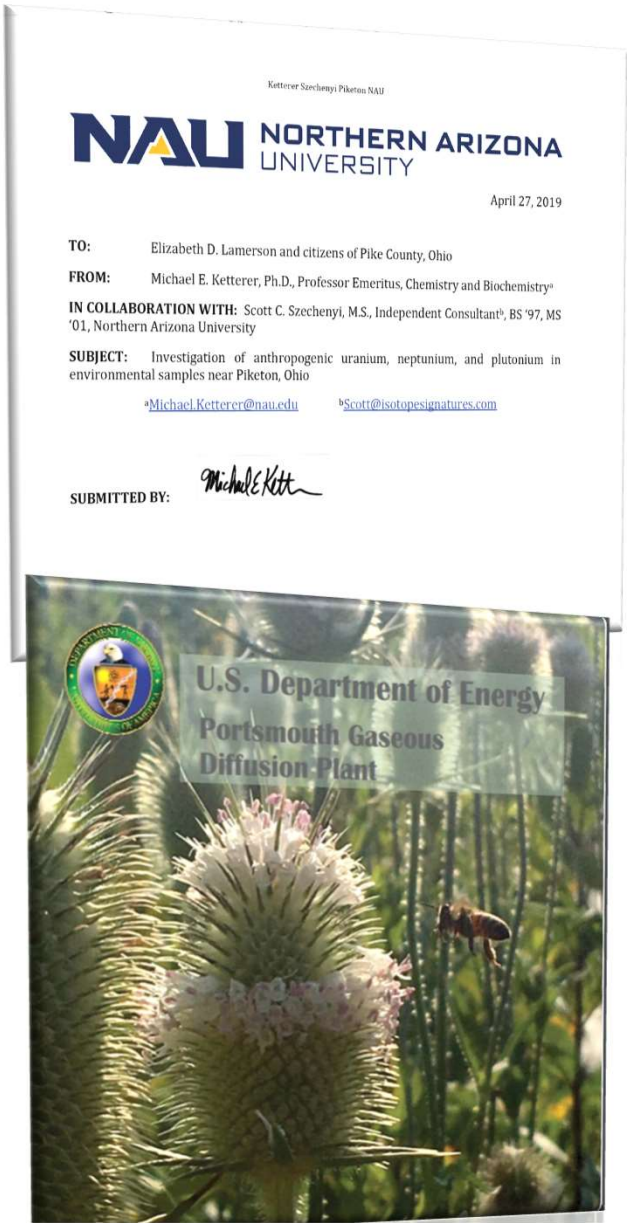
Timeline:

April 2019

- An independent researcher reported low levels of ***uranium, plutonium and neptunium*** in creeks in vicinity of Portsmouth Gaseous Diffusion Plant and inside Zahn's Corner Middle School in Piketon.
- Pike County Commissioners become involved
- ***Zahns Middle School Closed May 2019.***

FYI

- Traces of Neptunium-237, Plutonium 239/240 and Americium-241 were **routinely reported** in water and sediments in the Annual Site Environmental Monitoring Reports for the Portsmouth Ohio DOE facility.
- In 2018 offsite dose estimates were 0.1 mrem/yr from air pathways, 0.0017 mrem/year from waterborne, and 0.017 mrem/year from sediment[1]



[1]https://www.energy.gov/sites/default/files/2020/07/f77/2018%20Portsmouth%20ASER-4-env-radiological-programs_0.pdf

May 2019

Scioto Valley Local School District
1414 Piketon Road
P.O. Box 600
Piketon, Ohio 45661

Todd A. Burkitt, Superintendent
Telephone: (740) 289-4456

Megan Williams, Chief Financial Officer
Telephone: (740) 289-4089

May 13, 2019

An open letter to the students, parents, and staff of the Scioto Valley Local School District, and members of the community:

The top priority of the Scioto Valley Local School District Board of Education is to ensure the safety and health of our students and staff. The Scioto Valley Local School District was notified that enriched uranium was detected inside the Zahns Corner Middle School building and that Neptunium 237 was detected in a US Department of Energy air monitor located adjacent to the Zahns Corner Middle School. As a result of this information, the SVLSD Board of Education has made the decision to close the Zahns Corner Middle School until the source, extent, level of contamination, and potential impacts to public health and the environment can be determined.

It is the position of the Board that any level of contamination on or near our school is unacceptable. Enriched uranium and Neptunium are currently identified as contaminants of concern by the US Department of Energy on the Portsmouth Gaseous Diffusion Plant property. We agree with the Pike County Health Department that the US Department of Energy must take appropriate actions to ensure radiological contaminants are not being released from the site. The Scioto Valley Local School District is working closely with the Pike County Health Department to develop a path forward that will ensure our students, staff and community are safe. We believe that closing Zahns Corner Middle School for the remainder of this school year is in the best interest of our students and staff at this time.

Sincerely,

Brandon K. Wooldridge

Brandon Wooldridge
President, Scioto Valley Local Board of Education

Chillicothe Gazette

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LOCAL

Zahn's Corner Middle School closing due to contamination concerns

Chris Balusik Chillicothe Gazette

Published 5:27 p.m. ET May 13, 2019 | Updated 10:39 p.m. ET May 13, 2019

View Comments

PIKETON - In a letter to parents and the community, the Scioto Valley Local School District announced Monday that it is closing Zahn's Corner Middle School for the rest of the school year due to concerns over possible contamination from the former Portsmouth Gaseous Diffusion Plant nearby.

The former Portsmouth Gaseous Diffusion Plant in Piketon. *Submitted*

Portsmouth Site

May /June 2019

- DOE
  - Sent Savannah River National Laboratory team to sample site
  - Offered to pay for an independent 3rd party to validate the results.

May 2019

Cincinnati.com | The Enquirer

[Local News] Sports Politics Opinion For Subscribers NKY Obituaries E-Edition Legals 37°F

NEWS

Feds tested closed Pike County school for uranium, sparking criticism from health district

Max Londberg Cincinnati Enquirer

Published 2:07 p.m. ET May 30, 2019

View Comments

Portsmouth Site, cont'd

July 2019

- DOE assessment of radiological impact[1]
  - Levels largely consistent with environmental background including from natural sources and fallout
  - Statements supported by State DOH testing and analysis
- Pike County health district officials
  - Expressed concern with the sampling exercise and the lack of communication before, during and after the May sampling.
  - Felt lack of communication led to the use of different testing methods and techniques resulting in conflicting results between the health district and the other agencies.

[1]https://www.energy.gov/sites/prod/files/2019/07/f65/Sampling%20Analysis%20Report%20Zahns%20Corner%20Middle%20School.pdf

July 2019

Cincinnati.com | The Enquirer

NEWS

Uranium contamination: Local officials say retest shows radioactive material at Ohio school, DOE says school is safe

Sarah Brookbank Cincinnati Enquirer

Published 12:39 a.m. ET Jul. 26, 2019 | **Updated 2:28 p.m. ET Jul. 26, 2019**

View Comments

September 2020

The Columbus Dispatch

LOCAL

Pike County school district asks feds to move middle school away from radiation

Beth Burger bburger@dispatch.com

Published 10:07 a.m. ET Sep. 1, 2020

View Comments

A fence surrounds Zahn's Corner Middle School on Aug. 12 in Piketon. The school closed in May 2019 after traces of americium, a byproduct of the gaseous diffusion process of uranium enrichment, was detected by a U.S. Department of Energy detector near the school. The school is about two miles from the site of the former Portsmouth Gaseous Diffusion Plant. *Joshua A. Bickel/Dispatch*

Communication Challenges

The science

- DOE Labs, State Agencies:
  - Traces of transuranics found in the environment
  - Mainly fallout / background
  - Small contribution from PORTS
  - Doses ***very*** low
- NAU author
  - Attributes transuranics to PORTS
  - Challenges DOE sampling/analysis methodologies
  - But no comment on magnitude of dose or risks

Who is a trusted messenger regarding science & risk?

- NAU report author?
- DOE Annual Site Environmental Report(s)?
- Other outside agencies/individuals?

Communication Challenges

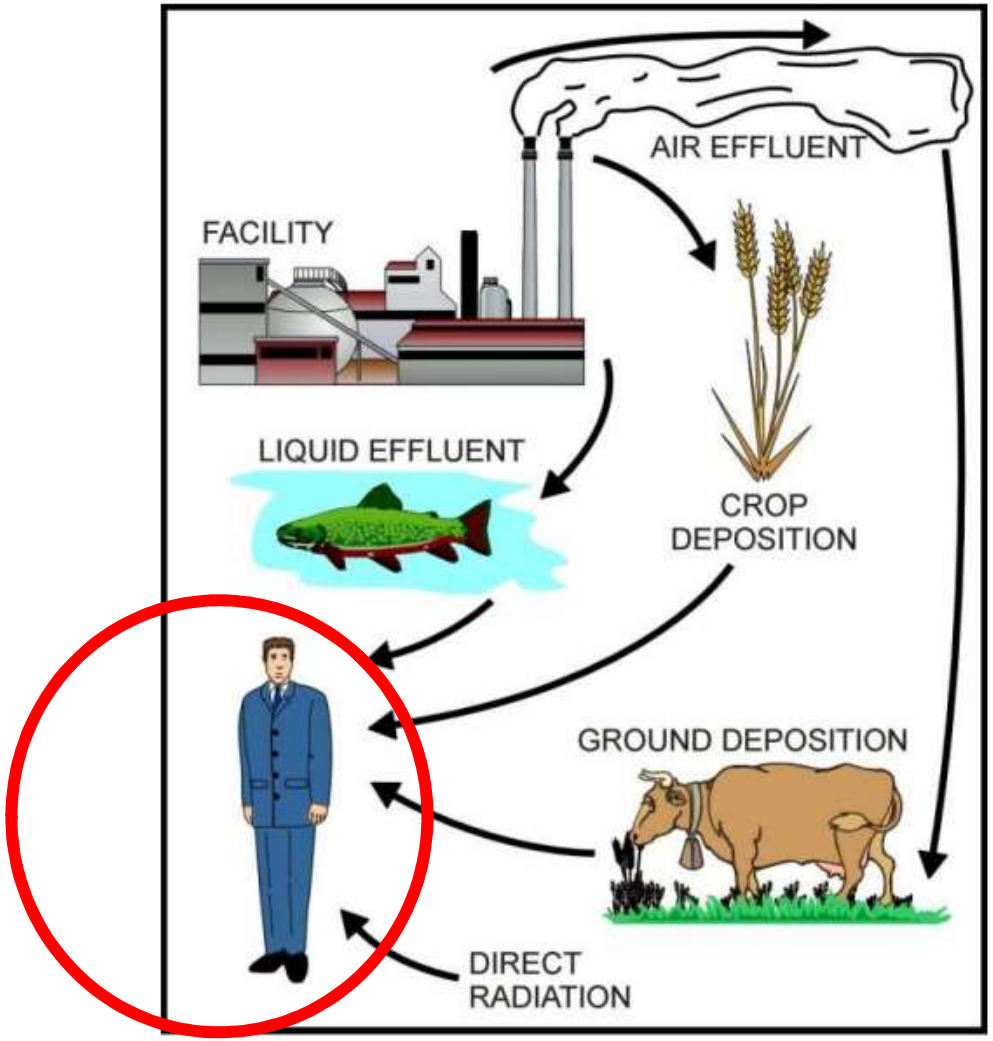
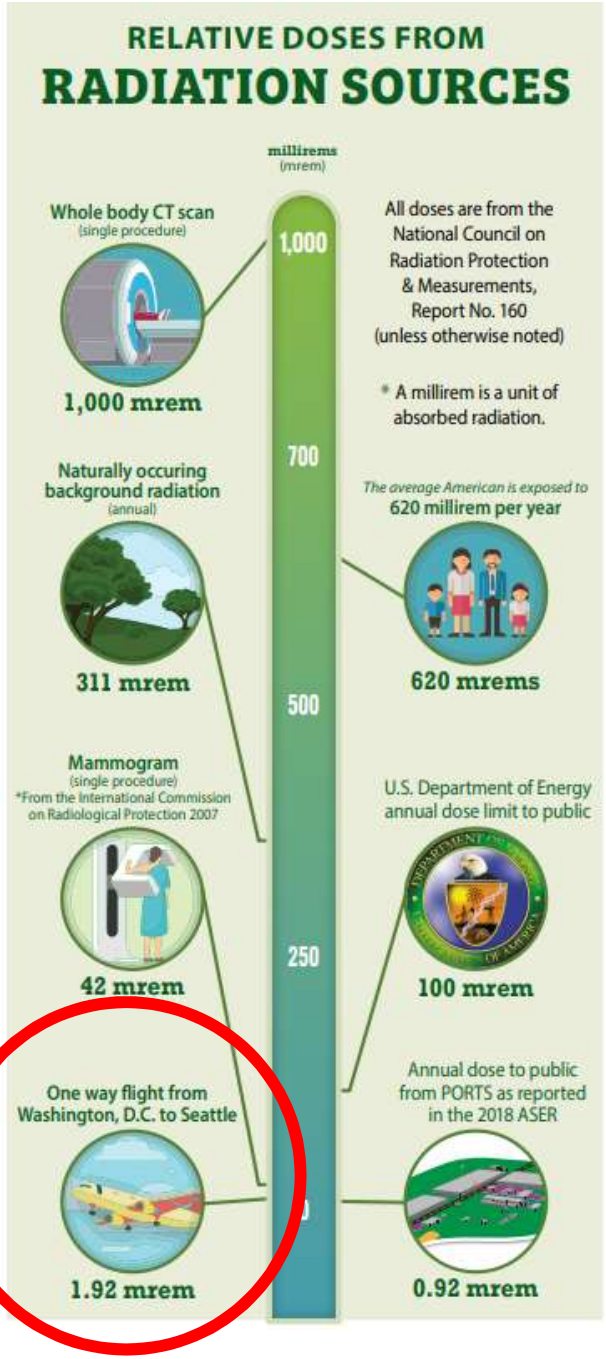


Figure R.3. Possible radiation pathways.



DOE/PPPO/03-0932&D1 FBP-ER-RCRA-WD-RPT-0320 Revision 3 June 2020

Complicating Issues

dispatch.com/news/20171105/piketon-fights-construction-of-radioactive-waste-dump

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The Columbus Dispatch

On-Site Waste Disposal Facility at PORTS[1]

Piketon fights construction of radioactive waste dump

BUY PHOTO HIDE CAPTION

A landfill is being built for the disposal of waste from the Portsmouth Gaseous Diffusion Plant, which enriched uranium for national defense from the late 1950s until 2001. [Eric Albrecht/Dispatch]

BUY PHOTO HIDE CAPTION

Piketon Village Council member Jennifer Chandler and Mayor Billy Spencer stand next to one of several signs in town that opposes the landfill under construction at the Portsmouth Gaseous Diffusion Plant. [Eric Albrecht/Dispatch]

[1]https://www.dispatch.com/news/20171105/piketon-fights-construction-of-radioactive-waste-dump

Take Away Message

- Obvious communication challenges
  - Are provided examples relevant?
  - Can other means of risk comparison be used?
  - Are spokespeople viewed as reliable?
- What other factors may contribute/complicate conversations?
  - Outside issues?

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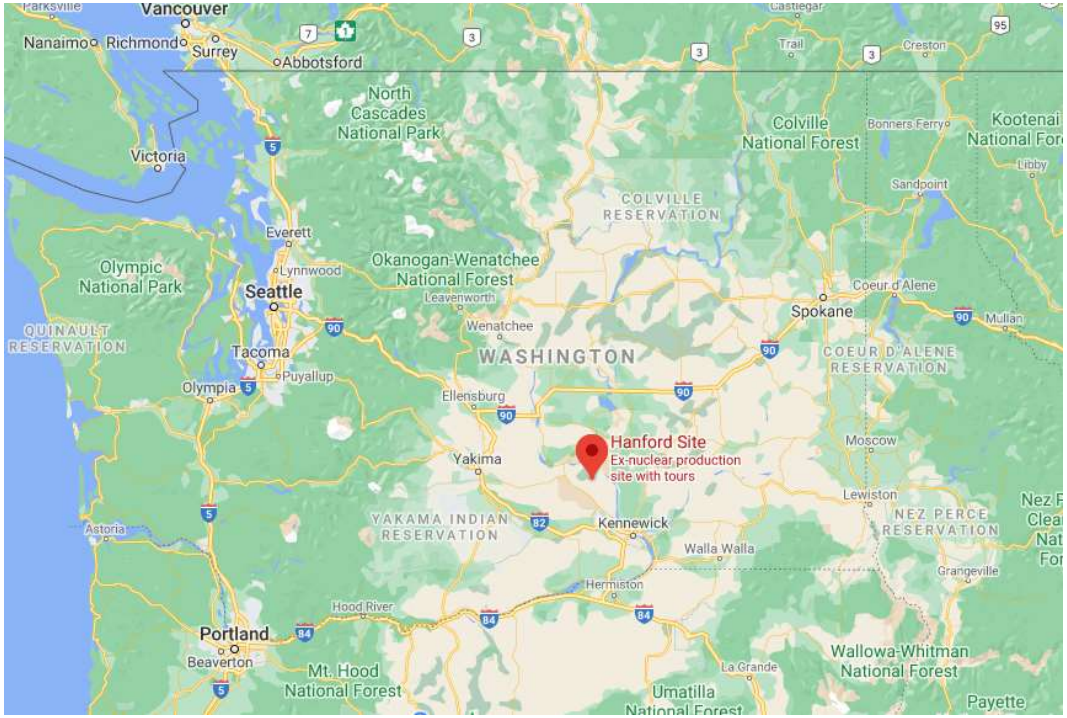

Example #2, Hanford Plutonium Finishing Plant

Plutonium Finishing Plant Decommissioning

- High hazard work completed
- Lower radiological risk building demolition underway

https://www.tri-cityherald.com/news/local/hanford/article239998058.html

https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Hanford-cleanup/Plutonium-Finishing-Plant

Plutonium Finishing Plant [1]

2016

- Open air demolition begins late 2016.

2017

- **June 8 —** Plutonium americium contamination first detected; 31 workers test positive for internal radiation.
- **June – Nov** -Causal analysis undertaken; corrective actions implemented[2]
- **Nov** – work resumed
- **Dec. 8-12 —** Workers' air samplers show elevated radiation levels. Elevated readings occurred Dec. 8, Dec. 9 and Dec. 12.
- Work resumes later on Dec. 14 after no further contamination is detected.
- **Dec. 15 —** Contamination found at air monitor outside established control area. Subsequent monitoring finds contamination on hood of vehicle, a concrete barrier, mobile office trailers and on a dumpster. Work continues.
- **Dec. 16** — Workers cover demolition debris with dirt and with glue-like fixative. New surveys find contamination on cars and around office trailers. A number of employees drive home, potentially tracking radioactive contamination off site and potentially into homes. Demolition continues. **Dec. 17** — Work stopped when contractor, CHPRC, is notified of the earlier contamination. Workers apply more fixatives to try to prevent more contamination spread.

[1]https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Hanford-cleanup/Plutonium-Finishing-Plant

[2]CHPRC-03689, Draft A , Plutonium Finishing Plant Work Resumption Plan

PFP Root Cause[1]

- 'Normalization of deviance' – small events, individually resolved, did not create a bigger picture of emerging problem.
- The spread of contamination on December 14 through December 18 demonstrated that the use of continuous air monitors (CAMs) as a near real-time process control did not effectively predict migration of non-respirable contamination.

[1]Discovery of Contamination Spread at the Plutonium Finishing Plant during Demolition Activities, EM-RL--CPRC-PFP-2017-0018 CR-2018-0022, ROOT CAUSE EVALUATION REPORT, 2018

Two Separate Issues

- Health and Safety:
  - Airborne release where none was expected
  - Extensive root cause analysis conducted
  - Issues identified
  - Work resumed (nearly year delay)
  - Worker dose very low

- Risk Communication
  - Unexpected release of radioactivity into public space
  - Dose to workers
  - Contributed to unflattering narrative of Hanford

Public Narrative

Los Angeles Times

WORLD & NATION

Contamination from a nuclear cleanup forced a shutdown. Investigators want to know who is responsible

The Energy Department project to tear down the Plutonium Finish Plant at the Hanford Site was halted in mid-December after radioactive dust was discovered far off the plant site. The hazardous work requires workers in protective gear. (Department of Energy)

By RALPH VARTABEDIAN

APRIL 16, 2018 4 AM PT

For the record:

6:15 PM, Apr. 16, 2018: *An earlier version of this article said that work was stopped five years ago on a $16.8-billion waste treatment plant. Work did stop on key parts of the plant, but there were portions that continued to operate.*

CORONAVIRUS, VACCINES AND PANDEMIC ›

California could actually reopen fully by June 15. Here's what has to happen

Far fewer California seniors are getting vaccinated in 'red' counties than urban areas

"The releases at the Department of Energy cleanup site spewed unknown amounts of plutonium dust into the environment, coated private automobiles with the toxic heavy metal and dispensed lifetime internal radioactive doses to 42 workers."[1]

[1]https://www.latimes.com/nation/la-na-hanford-plutonium-exposure-20180330-story.html

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42 Hanford workers contaminated with radiation

Originally published March 24, 2018 at 3:10 pm | *Updated March 27, 2018 at 9:33 pm*

Demolition work being carried out on the Plutonium Finishing Plant on the Hanford nuclear reservation near Richland last June. The work has been halted... (Nicholas K. Geranios/AP) More

The final results of worker tests after a December spread of contamination found that 11 Hanford workers had inhaled or ingested radioactive particles from demolition of the nuclear reservation's Plutonium Finishing Plant.

By Annette Cary
Tri-City Herald

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A total of 42 Hanford workers inhaled or ingested radioactive contamination from demolition of the nuclear reservation's Plutonium Finishing Plant.

The final results of worker tests after a December spread of contamination at the plant found 11 Hanford workers had inhaled or ingested radioactive

https://www.seattletimes.com/seattle-news/42-hanford-workers-contaminated-with-radiation/

As Reported by Other Agencies[1]

- **February** — Contamination detected by state air monitors **as far as 10 miles from the PFP demolition site**. WADOE continues to receive reports and news from other sources saying contamination has been found in air filters in worker's cars, both inside and outside expanding PFP demolition zone. Some toxic airborne contaminants from the buildings have been ingested by workers.
- **March 22** — After December spread of contamination, **281** Hanford workers tested for radiation doses. Tests show 42 inhaled or ingested contamination. **State experts consider the amounts found too small to pose health risk**
- **June** — With EPA, WA DOE approve resumption of lower-risk demolition activities. .

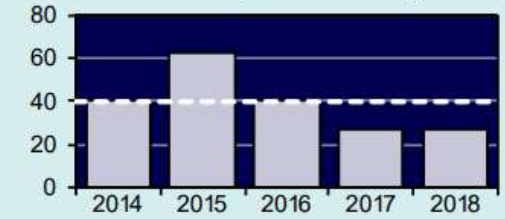
https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Hanford-cleanup/Plutonium-Finishing-Plant

DOE's Reporting

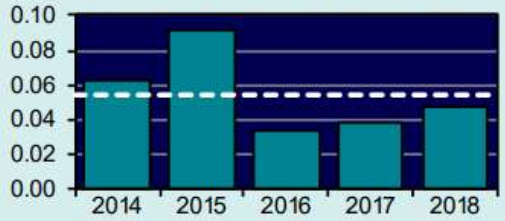
Hanford: Hanford Site

DOE's Hanford Site sits on 586 square miles in the desert of southeastern Washington State. The area is home to nine former nuclear reactors and their associated processing facilities that were built beginning in CY 1943. Hanford reactors produced plutonium from CY 1944 until 1987. Today, Hanford workers are involved in an environmental cleanup project and remediation of the site.

Collective TED (person-rem)



Average Measurable TED (rem)



Activities Involving Radiation Exposure

- Work activities at the plutonium finishing plant facility;
- Material handling and waste transfer; and
- Facility demolition and site remediation.

Changes in Dose

- The decrease in collective dose at the Plutonium Finishing Plant (PFP) facility was associated with a transition in work activities from source term removal to facility demolition; and
- Several Hanford projects continued to operate at minimal levels, resulting in a lower dose.

https://www.energy.gov/sites/default/files/2020/01/f70/2018_Occupational_Radiation_Exposure_Report_0.pdf

Take Away Message

- Health and safety failures were present
  - Radiological impact was small
- Substantial delay in demolition occurred

- Could better communication have helped?

Quick Tip: Do's and Don'ts

- Bring empathy for the audience with you
- Be an honest broker – be truthful
- Try to understand the audience by preparing for their issues and listening to what they have to say
- Address their needs and concerns as much as possible
- Don't show off your knowledge and power
- Be prepared to occupy the hot seat
- Avoid canned presentations
- Be flexible and not judgmental
- Avoid jargon and overly technical presentations
- Come with a risk communication plan – one central theme and 3-4 subthemes connected to the central one

Risk Communications: Supplemental material

- What do you need to know for effective risk communication?
- Where can you go for more information?

Risk communications: Three questions

1. What are key elements of planning for a risk communications event?
2. What should your information convey to the audience?
3. What needs to be explained about methods?

Planning a Risk Communications Event:

Key Elements

1.1 Determine reasons to communicate

- What is the starting point?
  - A risk-related crisis?
  - How do we know it's a crisis?
  - Is this engagement a defensive reaction?
  - Is this issue a chronic one?
- Is there time to for new investigations?
- Is there an unstated motive unrelated to the event?

1.2. Determine the audience(s)

- There can be multiple audiences to consider. These include:
  - host agency;
  - decision makers;
  - individuals and groups with a history of with the issue;
  - people that *might* suffer consequences;
  - people who *believe* that they will suffer consequences;
  - those likely to be distressed if not contacted;
  - individuals with a history of providing constructive comments; and
  - business interests.

1.3. Determine Information to include in communications

- Health-related information critical to the audience.
- Information needed by audiences in order to avoid confusion.
- Other information the audience has expressed interest in.

1.4. Find Sources of Ideas

- ***Consult the following to determine*** what is important to communicate:
  - host agency staff;
  - media clippings, radio and television;
  - local elected officials, health officers, medical personnel;
  - personnel from other agencies;
  - knowledgeable people that have expertise about the issue;
  - individuals who have called in, sent electronic or written messages;
  - local advisory committees with a record of providing useful feedback; and
  - focus groups and surveys, if time permits.

1.5. Consult Key groups

- Internal groups,
- Internal eyes and ears, implementers,
- Affiliated agencies, departments, elected officials, commissioners, health officers, and medical personnel,
- Unaffiliated science/engineering/social science community working in nearby colleges and companies that have expertise about the issue,
- Media gatekeepers, and
- Local advisory committees, for and not-for-profits, with a history of taking positions on environmental health issues and providing useful feedback.

1.6. Determine communication and listening methods and tools.

- Reserve time for listening and responding to questions and concerns.
- Where do people learn about local issues?
  - internet;
  - television/radio/newspaper;
  - appearances on local media;
  - schools, city council meetings, places of worship, etc.;
  - county fairs;
  - open web site or phone line; and
  - store fronts for conversations and to pick up written materials.
- The above list needs to be evaluated by people who know the local communities.

1.7. Determine who is responsible for what.

- Likely the most difficult part of the process.
  - Assign roles, and timelines to produce and distribute materials,
  - Avoid blindsiding other organizations and individuals.
  - Coordinate with local, county, state, and even federal agencies with responsibilities that overlap
  - Coordinate with local organizations that may have scheduled something at the same time.
- Having a plan is a good starting point for deciding what is more important and less important.
- The plan should include contingencies for dealing with insufficient time, resources and staffing, legal concerns, and inexperience with the local populations

1.8. Be prepared with a lessons learned feedback loop.

- Before implementing the plan, be prepared to evaluate if your efforts are succeeding.
- This could include:
  - checking news clips,
  - debriefing key individuals,
  - Handing out and reading evaluation forms and
  - polling/focus groups.

1.9. References

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2. What should your information convey to the audience?

2.1. Tuler's ideal metrics

- Easy to communicate to a wide audience.
- Relates to something that is important to many stakeholders.
- Credible.
- Relevant.
- Sensitive enough to capture the minimum meaningful level of change and it would have uncertainty bounds that are easy to communicate.

2.2 Sources of Information

- Full detailed reports;
- Newsletters;
- Presentations; and
- Website updates (which are often the vehicle for posting or distributing prepared materials).

2.3 Example: Communicating using coordinated and consistent metrics

- U.S. taxpayers have spent hundreds of billions of dollars to remediate large EM defense sites owned and/or operated by the U.S. Federal Government over the past 40+ years.
- Some stakeholders worry about the risks associated with what they perceive as a slow process of cleanup, as well as the positive and negative impacts of the cleanup activities themselves.
- If I lived near a site, and I did not have time to go to an SSAB meeting, but instead I searched DOE websites and other sources what I would I learn?

2.3a Two key questions

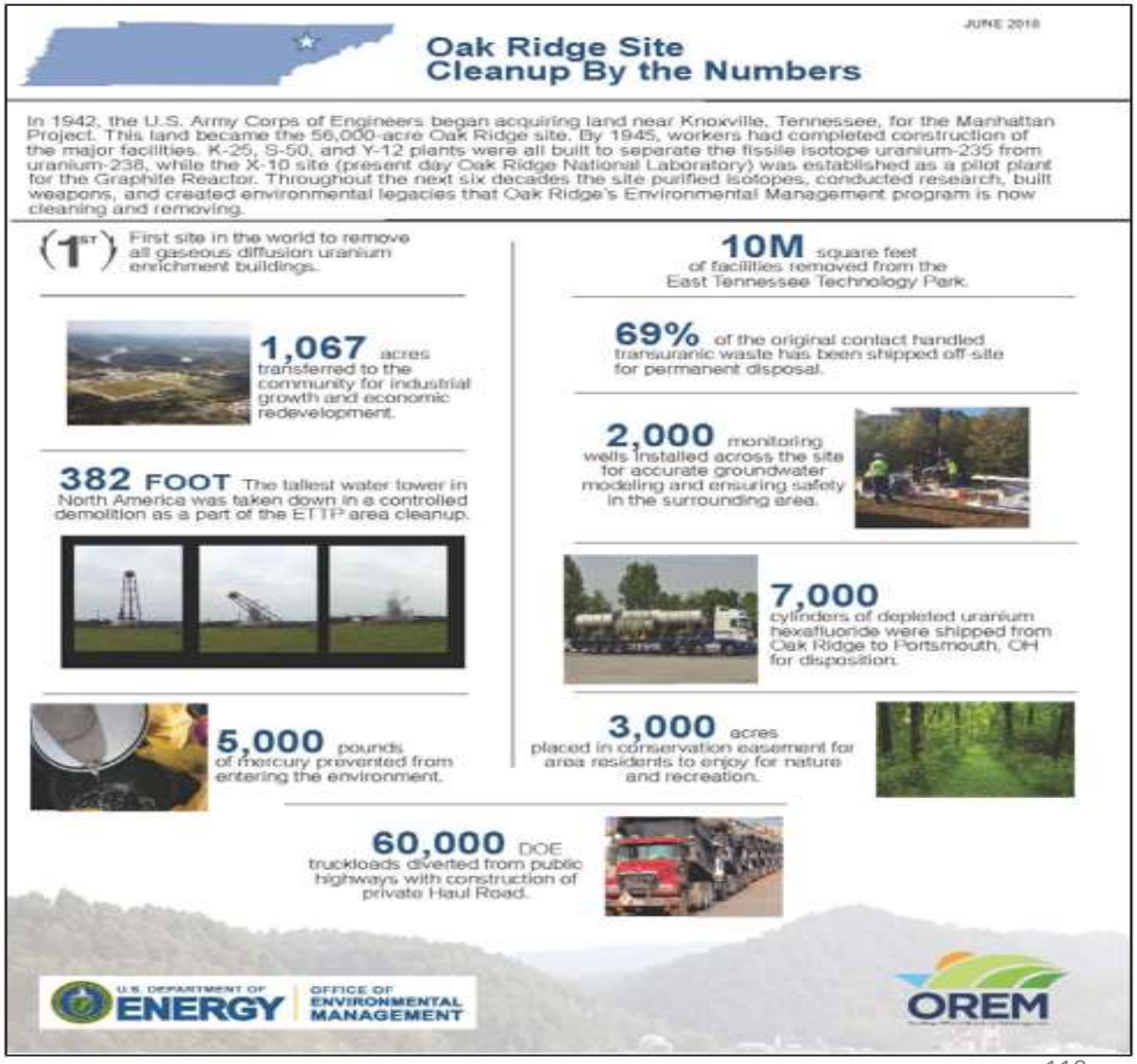
- How consistent are the metrics used to communicate site progress between the DOE Headquarters Environmental Management office and the three largest sites, and what are the implications for public understanding of how much progress is being made?
- How might lessons drawn from risk communication literature inform the development of more effective practices for using metrics for communicating cleanup progress at U.S. DOE sites to different audiences?

2.3b Oak Ridge, Hanford & Savannah River websites

- Different metrics at different sites
- Not comparable across sites or with DOE and State/EPA region information
- Reasonably attractive, but dated in many cases, and as a result inconsistent within same report.

Oak Ridge Site

What would I get from these numbers?



2.4 Recommendations

- Establish standards and expectations about metrics, and about the basis or goal of communication about metrics at the national level and the site levels.
- DOE, and other government owners and overseers of other large contaminated sites should work together to develop a set of metrics and delivery formats to most clearly and accurately communicate site cleanup status and progress, with a focus on risk and impacts to communities
- Every effort should be made to work with the EPA and the states to develop common metrics.
- Independent review of proposed metrics should be conducted by individuals with the requisite science and communication backgrounds.

2.5 References

- Karen Lowrie, Henry Mayer, and Michael Greenberg, Communicating about Contaminated Site Cleanup using Coordinated and Consistent Metrics: Opportunity and challenge for the DOE, Risk Analysis. *Risk Analysis*. Early view October 16, 2020.

3. What needs to be explained about methods?

3.1 Generic challenges for communicators

- Talking too much and not listening enough;
- Falling in love with the science and numbers;
- Admitting what we do not know and explaining how important missing information is going to be obtained; and
- Getting and sustaining an organizational commitment to communicate in different places and forms.
- Maintaining science, communications and value-related trust.

3.2 Example 1: Plutonium disposition challenge

- As part of the 1991 Strategic Arms Reduction Treaty (START), the United States and Russia agreed to greatly reduce the number of nuclear weapons held by each. This treaty increased need to safeguard plutonium to prevent theft. In 2000, the two sides agreed to each dispose of 34 metric tons of surplus plutonium. The original Plutonium Management and Disposition Agreement (PMDA) was amended in 2010, and in 2016 the Russians suspended the agreement. Nevertheless, the U.S. has continued to work to reduce its own surplus plutonium to lower the threat of nuclear proliferation. Two management options are as follows:
  - **Dilute plutonium with normal nuclear reactor uranium fuel and use it in a commercial nuclear reactor**. This mixed oxide fuel (MOX) option currently is no longer under consideration in the United States because of steep cost increases. The option was taken off the table by President Obama, with the decision being confirmed by President Trump. However, it might reappear in the future.
  - Add an adulterant(s) to plutonium, place it in protective packaging, and move it to the **Waste Isolation Pilot Plant (WIPP**) repository near Carlsbad, New Mexico. WIPP has been receiving transuranic wastes for 20 years. There is no certainty that this dilute and dispose option will be used.

3.2 Example 2: PRA 3 for MOX fuel and PA for WIPP

- **Major challenge to explain results of applying complex methods in reports and face-to-face public audiences, SSABs, and elected officials**
- With the goal of improving decision-maker and public understanding of risk-related options, we suggest the following five questions as priorities to communicate:
- What are major objectives for applying the tool?
- What knowledge has been gained by applying it in past cases?
- What gaps in our knowledge are accounted for by assumptions rather than being filled by reliable measurements?
- What level of transparency about and characterization of uncertainty in results, including both aleatory (random, stochastic) uncertainties and epistemic (due to incomplete knowledge and understanding) uncertainties, is communicable?
- How difficult is it to communicate results grounded in science due to their math and science content and legal/security restrictions on access?

Example 2 Continued PA for WIPP use

- Returning once more to the five types of information that we believe should be reported to stakeholders, here are some observations:
- *1. Major objectives for applying the tool:* The objective of a PA is to assure that a hazardous material can be contained, and this objective makes sense. What many people focus on is the 10,000-year containment period for WIPP. Even as knowledge expands, how comfortable can we be with changes that can occur during the next 10,000 years in this area? The objective does not feel credible to some because 10,000 years feels like forever. People want to know the origin of the number and some seem uncomfortable with it. Furthermore, there is concern expressed about transporting the plutonium to the site, which is not included in site PA process.

Example 2 continued PA for WIPP use

- *2. Knowledge gained by applying it in past cases*: With regard to PAs, the biggest challenge is that so few completed applications mean that there is little accumulated knowledge, except at those sites, and a good deal of the information is not publicly available. Computer codes are kept secret because of security concerns. Even individuals studying sites are not necessarily given access to all information. This reality does not build trust. Here again, however, special communities with local credibility and accessibility to all the information may be acceptable to some community members.

Example 2 continued PA for WIPP (3)

- *3. Gaps in our knowledge that are accounted for by assumptions rather than being filled by reliable measurements*: Congress mandated many of the requirements in PAs. More is being learned about the WIPP site and the models have become more sophisticated. Yet a PA represents a struggle for communicators, as so many variables, assumptions, and parameters must be included in studies and realistic risk assessment seems to be inherently complex.

Example 2 continued PA for WIPP (4)

- *4. Transparency about and characterization of uncertainty in results*, including both aleatory (random, stochastic) uncertainties and epistemic (due to incomplete knowledge and understanding) uncertainties: PA simulations at WIPP and Yucca require trying to display uncertainty in well over 1000 variables and parameters. Bayesian tools help, but the magnitude of complexity defies simple explanations of what the results mean.

Example 2 continued PA for WIPP (5)

- *5. Clarity* or obscurity of the tools due to their math and science content and legal/security restrictions on access: The science required to understand a WIPP PA is more than imposing, especially when information is not accessible due to security concerns. The New Mexico technical panel was an intermediary between the federal government and the State of New Mexico. It offered input to the DOE, and was considered credible by the state. Such intermediaries can bridge the gap between the experts and local elected officials, the media and publics.

3.3 References

- Greenberg M., and Cox, L.A., Jr. Plutonium Disposition: Using and Explaining Complex Risk-Related Methods. *Risk Analysis*. Accepted 2021.
- Cox, L.A., Jr. (2008). What's wrong with risk matrices? *Risk Analysis*. 28(2):497-512.
- Cox, L.A., Jr. (2012). Confronting deep uncertainties in risk analysis. *Risk Analysis*. 32(1), 1607-1629.