# The Consortium for Risk Evaluation with Stakeholder Participation (CRESP)

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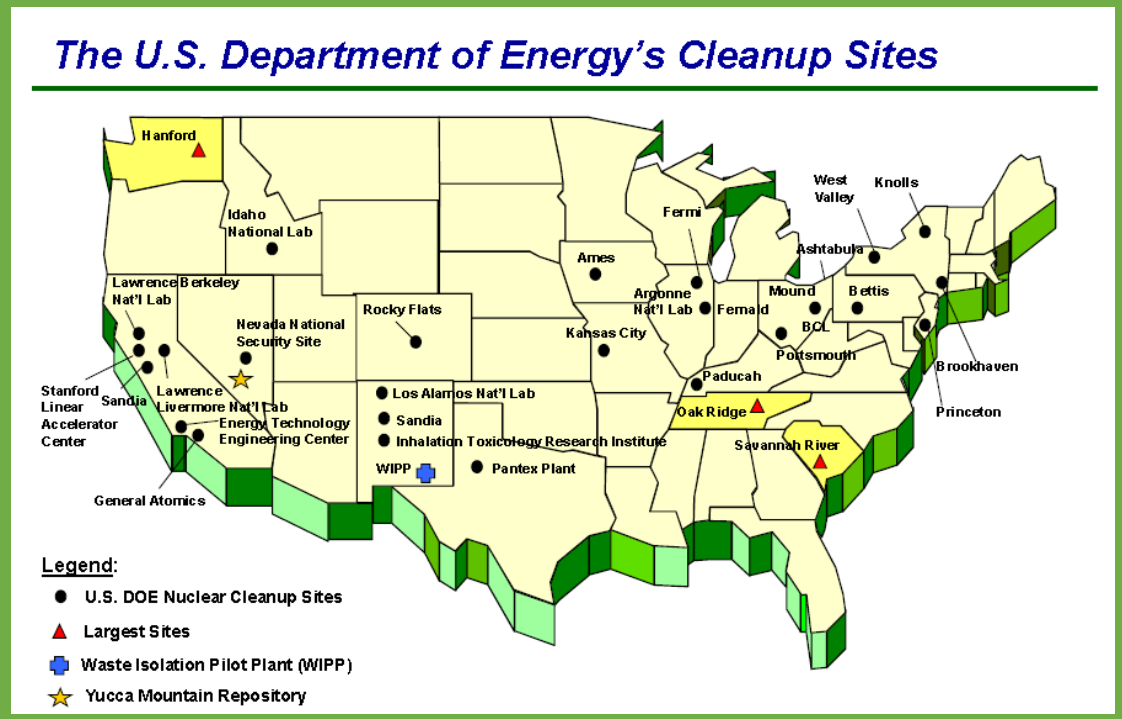
CRESP

Mission: 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.

Established in 1995 in response to recommendation of the National Academies of Science, Engineering and Medicine

- Targets > $1 trillion in US liability
- CRESP is celebrating 30 years in 2025; >$100 billion in impact
- CRESP cooperative agreement renewed for 5 years (2025-2029)

Expertise:

- *Education & Workforce Development*
- *Risk Communication & Stakeholder Engagement*
- *Nuclear-Chemical Safety & Health Physics*
- *Waste Processing, Waste Disposal Systems & Waste Form Performance*
- *Environmental & Ecological Assessments*
- *Fuel Cycle Evaluation*
- *Nuclear-Environmental Law and Regulation*
- *Independent Review*

# Stakeholders

# United States Partnerships & Collaborations

## Universities

**Texas Tech**
- PFAS leaching, fate & transport

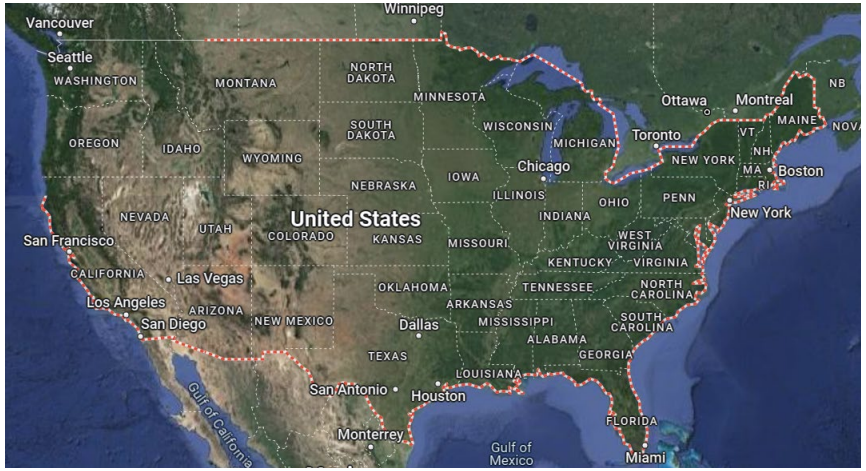
**Rutgers**
- Risk communications
- Ecological assessment

**Massachusetts Institute of Technology**
- Soils and groundwater monitoring and treatment
- Nuclear-Environmental Engineering and Science Education

**NYU School of Law**
- Nuclear waste law and policy
- Soil and groundwater remediation law and policy

**Oregon State University**
- Health physics
- Nuclear engineering
- Environmental fate of radionuclides

**University of Wisconsin - Madison**
- Hydrology, geotechnical engineering
- Near-surface disposal system performance (caps, liners)




**Howard University**
- Nuclear-Environmental Engineering and Science Education
- Membrane separations

**Georgia Institute of Technology**
- Real-time process monitoring
- Early career professional development

**University of Central Florida**
- Local-scale, high-resolution hydrology

**Clemson University**
- Nuclear-Environmental Engineering and Science Education

**Washington State University**
- Materials science (glass, cement)

## National Laboratories

Argonne National Laboratory (ANL)

Los Alamos National Laboratory (LANL)

Lawrence Livermore National Laboratory (LLNL)

Pacific Northwest National Laboratory (PNNL)

Sandia National Laboratories (SNL)

Savannah River National Laboratory (SRNL)

## Federal Agencies & Entities

Department of Energy

Defense Nuclear Facilities Safety Board

Environmental Protection Agency

Government Accountability Office

National Research Council of the National Academies

Smithsonian Institution

# International Partnerships & Collaborations

- **Australia** (University of Adelaide, CSIRO)
  - PFAS leaching, fate & transport
- **France** (Ecole des Mines de Paris, Institute for Radiation Protection and Nuclear Safety)
  - Contaminated soils treatment
  - Ancient cements
- **Israel** (The Technion, Geological Survey of Israel, Nuclear Research Center of the Negev, Tel Aviv University, Israel Antiquities Authority)
  - Leaching Environmental Assessment Framework (LEAF)
  - Mineral waste treatment for reuse
  - Nuclear waste management
  - Chemo-mechanical evolution at cement-carbonate rock interfaces
  - Use of ancient analogues for evaluating long-term performance treated nuclear waste (cement grouts, glass)

**Great Britain** (Sheffield University, Environment Agency)

- Nuclear waste management
- Leaching assessment of glass waste forms

**South Korea** (Pohang University of Science and Technology)

- Nuclear waste form performance

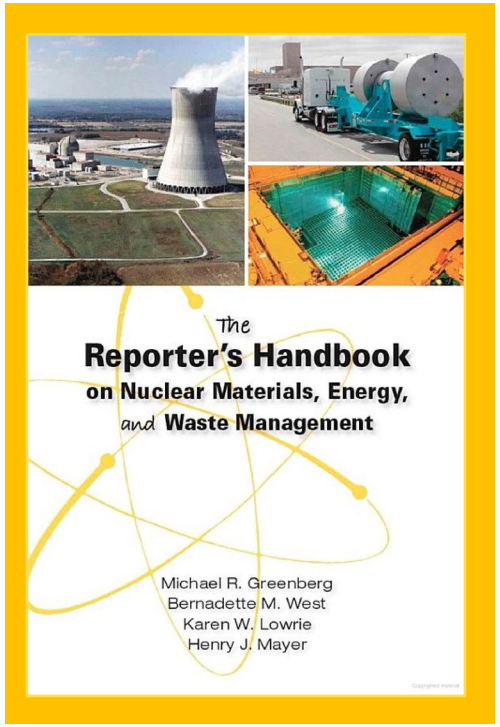
**The Netherlands** (Energy Research Centre of The Netherlands/NRG; Hans van der Sloot Consultancy; Delft University; Wageningen University)

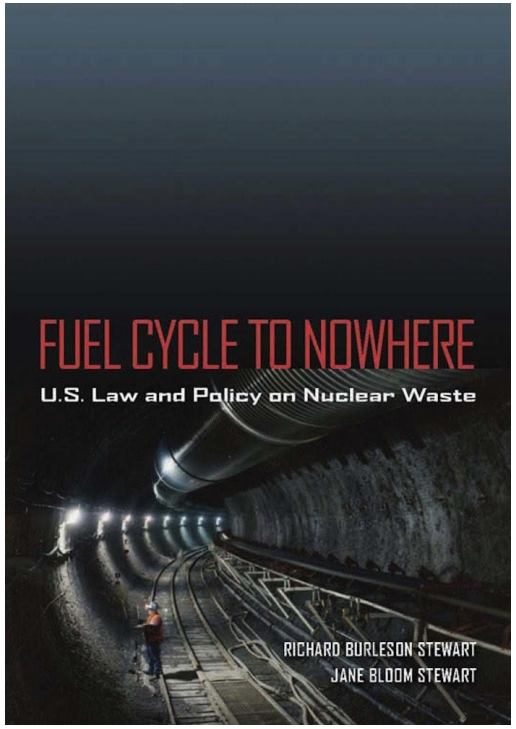
- Leaching assessment, nuclear waste management

**South Africa** (University of Pretoria)

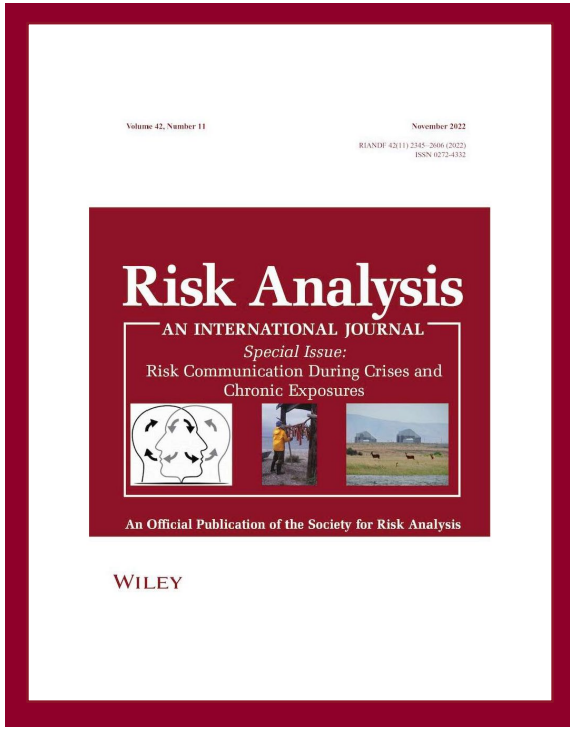
- Mine reclamation
- Use of secondary materials in agriculture

# Example CRESP Contributions

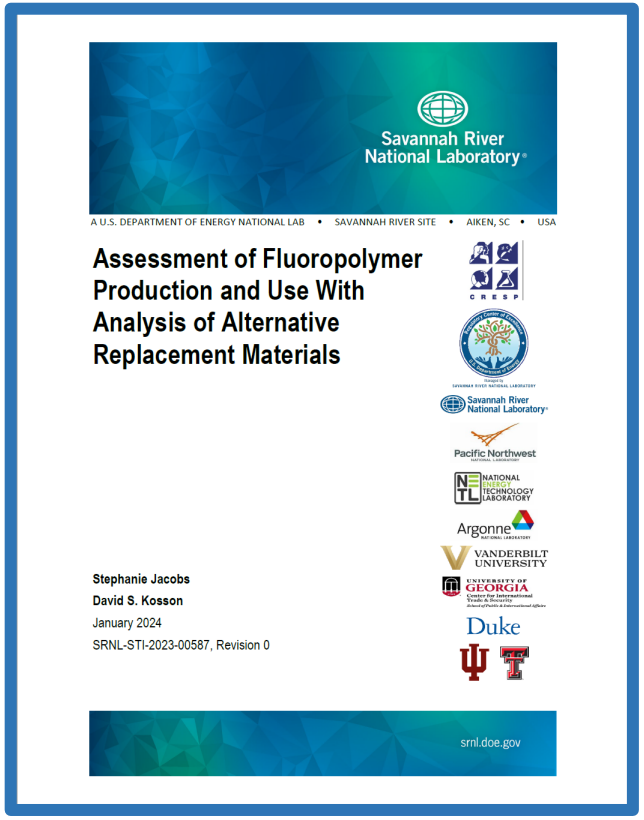






# Example CRESP Contributions




CRESP co-led with SRNL the development of 2 reports requested by Congress to review fluoropolymer production, use, lifecycle and potential replacement materials for targeted industry sectors (aerospace, automotive, battery, building construction, chemical processing, infrastructure, electronics, solar and wind energy)


CRESP provided an evaluation of treatment alternatives for Supplemental LAW Processing that was the foundation for the 2022 report provided to the National Academies of Sciences, Engineering, and Medicine (NASEM) from the Federally Funded Research and Development Center (FFRDC) team.

# Example CRESP Contributions

**Detection of Neptunium-237 (Np-237) in Zahn's Middle School near the Portsmouth Gaseous Diffusion Plant (PGDP or PORTS)** – Detection of trace amounts of Np-237 was attributed to the PGDP by individuals outside the Piketon community. CRESP provided technical assistance, with regard to the radiological risk, to DOE and the community.

**Development and Verification of Long-term Performance Models for Grout and Glass Waste Forms –** Use of waste form characterization techniques and geochemical reactive transport modeling for predicting waste form performance over > 1,000 years; verification of the models based on aging of ancient materials (slags and cements up to 4,500 years old; in collaboration with Tel Aviv U., Geological Survey of Israel, Isreal Antiquities Authority and Pacific Northwest National Laboratory).

**Risk-Informed Decision-Making (RIDM) for Safety** – Enhance the guidance available to DOE-Environmental Management (EM) and its contractors for the use of quantitative and risk-informed decision making (RIDM) in safety-related applications at EM's nuclear facilities and perform targeted case studies on DOE-EM facilities

**Review of Safety Practices –** CRESP has performed several safety reviews, such as evaluation of the safety of radiological and mining operations at the Waste Isolation Pilot Plan (WIPP) Site; review of the implementation of criticality safety implementation, for the Portsmouth and Paducah sites; and evaluation of changes to DOE-STD-1027 on the hazard categorization of nuclear facilities on the Oak Ridge Reservation.

**Amchitka Island, Alaska –** At the request of the State of Alaska and DOE, CRESP fielded a multi-disciplinary team that, working in conjunction with the local communities, developed and carried out a science plan to determine the impacts of radionuclides from underground nuclear testing on commercial and subsistence fishing in the northern Pacific. CRESP then designed a biomonitoring plan that remains in effect.

# CRESP Early Career Program

**Investigator(s): M. Grover (Lead), J. Chen (Co-Lead)**

CRESP funds approximately 20 early career researchers, which we define as PhD students and postdocs. In addition, there are MS and undergraduate students, and other affiliated PhD students and postdocs who participate in the community.

Project Objectives:

- Foster a community of graduate students and postdocs, linking the disparate geographic sites
- Create professional development opportunities for our early career researchers through networking and internships
- Connect all CRESP researchers with EM practitioners to enhance our research impact

Activities:

- Annual Field Trip: Each fall, CRESP will organize a field trip to a DOE site, spending approximately three days touring a site to give the early career researchers a better context for their research.
- Mentors: Early career researchers can apply for a mentor.
- Internships at DOE sites provide valuable professional development opportunities for PhD students and postdocs. They also can inform the ongoing research of the intern, provide context for their research, and aid in building collaborations between the groups.
- Awards: Each year, CRESP will give out a monetary award for the best paper authored by an early career researcher. Papers will be nominated, including a nomination letter from the CRESP advisor, and will be reviewed by a selection committee.

- Early career organizing committee: A committee of approximately five PhD students and postdocs will advise on all activities of the CRESP Early Career program. The group will select a president and vice-president, as well as officers, for the various activities. One key responsibility for the group will be to organize the seminar series.
- Seminar series: To solidify the early career community, a seminar series (virtual) will be organized by the early career committee. Seminars will be held biweekly, with one seminar per month by an early career researcher and one seminar per month by a member of DOE-EM or related practitioners (e.g. contractors). The early career committee will select the speakers based on their interest, in consultation with the CRESP faculty who can also help facilitate the invitations.
- Social media: A LinkedIn group has been created to connect the academic members of CRESP with researchers and practitioners at the Department of Energy Environmental Management Division, for networking and for sharing of our latest results and news.

# Nuclear-Environmental Engineering and Science Education Workshop

The objective of this year's workshop is to ***"educate the educators"*** in science and engineering disciplines at 2- and 4-year universities within the Tennessee Valley Region who are looking to expand their curricula offerings in or learn more about the burgeoning nuclear industry by

- increasing awareness of nuclear workforce opportunities,
- providing foundational information regarding nuclear missions, and
- introducing teaching resources available to support educational initiatives. In other words, we are looking to connect with educators who may not have a nuclear background but are interested in expanding their curricula offerings into this area.

**Previous Workshops:**

- Summer 2024 (Vanderbilt) - Workforce development and curriculum needs.
- Summer 2023 (Clemson) – Developing teaching resources for educational purposes.
- Summer 2022 (MIT) - Improving nuclear waste education.

## Mark Your Calendars

Nuclear Educators and Workforce Development Workshop

July 24th and July 25th, 2025

### Please join us ...

**What:** Nuclear Educators and Workforce Development Workshop

**Where:** Knoxville, TN

**When:** July 24 -25, 2025

**Who:**

This workshop is for engineering and science educators (primarily at vocational, 2-year, and 4-year institutions) in the Tennessee Valley Region (TN, GA, KY, SC, AL, NC, AR) who are looking to expand their curricula offerings or learn more about the burgeoning nuclear industry within the U.S. today.

**Purpose:**

This two-day workshop is intended to increase awareness of nuclear workforce opportunities, provide foundational information regarding nuclear missions, and introduce teaching resources available to support educational initiatives. Join us to learn about the history and future of nuclear power generation in the U.S., state-of-the-art education & training initiatives, a tour of a commercial nuclear facility, and much more.

*Workshop organized by:*

CRESP

CLEMSON

Massachusetts Institute of Technology

VANDERBILT UNIVERSITY

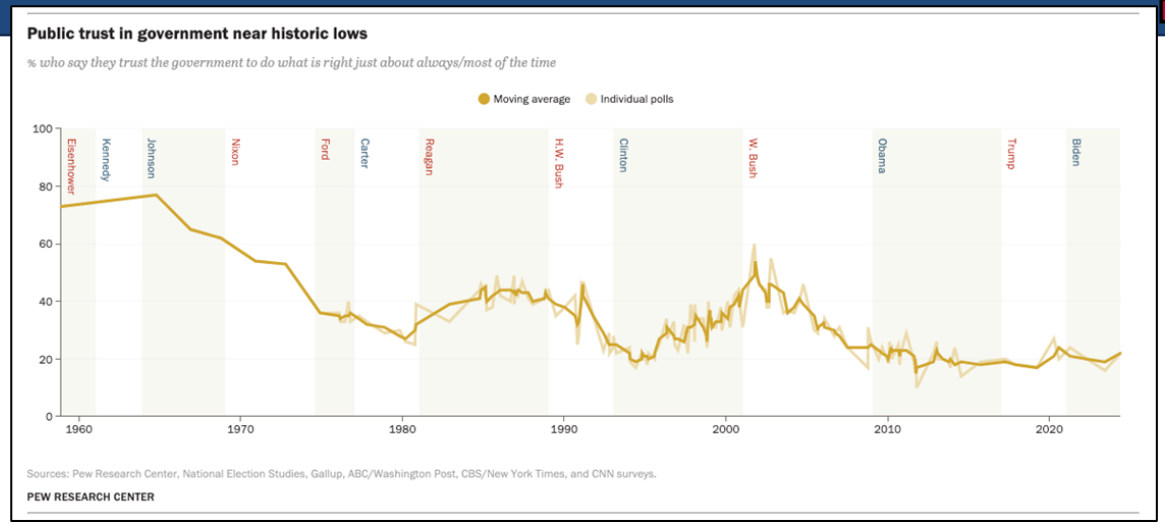
# Developing an Overarching Strategy to Promote Trusted Information on Radioactive Waste

**Investigators**: Matthew Weber (Rutgers), Mike Greenberg (Rutgers), Joanna Burger (Rutgers), Kathryn Higley (Oregon State), David Kosson (Vanderbilt)

**DOE Applicable Sites**: EM HQ and all sites

**Primary Objective(s):**

- Engage with stakeholders, including community members, regulatory bodies, and scientific experts, to gather diverse perspectives on the issue of identifying and communicating authentic and trustworthy information and to understand the current landscape of public perception
- Develop tailored strategic engagement guidelines that complement existing efforts and specifically outline strategies for effectively establishing authority and trust in the context of the modern media environment
- Establish an iterative approach to the evaluation of the effectiveness of stakeholder engagement, especially regarding trust in engagement. This will include the development of guidelines regarding effective strategic communication of complex scientific information regarding radioactive waste and nuclear energy more broadly.




**In a 2024 Pew Center Survey: only 22% of U.S. adults said they trust the federal government to do the right thing just about always or most of the time.**

**Relevance and Impact to DOE**:

This study focuses on communities surrounding key DOE-EM cleanup sites to examine the motivations that drive trust on the part of community stakeholders.

- Aide EM in crafting strategic communication that helps to establish, sustain, and grow trust with community members.
- Identify key channels trusted by community members to understand existing pathways for obtaining information.
- Drive community trust in EM information sources when seeking knowledge about cleanup activities.

# Understanding the Narrowing Scope of Federal Agency Regulatory Authority Under New Supreme Court Decisions and the Implications for DOE Decision-Making

**Investigators**: J. Stewart, K. Wyman (New York University), D. Kosson (Vanderbilt)

**DOE Applicable Sites**: DOE-EM Headquarters

**Project Objectives**:

- Assist DOE in understanding the origins, legal basis for, and history of federal agency regulatory authority and discretion, including the key role of the long-standing Chevron Doctrine in affording judicial deference to federal agencies' reasonable interpretations of their statutory authority where the authorizing statute is unclear, ambiguous, or silent.
- Similarly, to address additional recent and pending Supreme Court rulings that will have major impacts on environmental and nuclear regulations (e.g., major question doctrine, statute of limitations, trial by jury, non-delegation doctrine).
- Provide DOE with an independent regulatory analysis of the Supreme Court's decisions and the implications of those decisions for federal agency decision-making and judicial review of agency actions going forward.
- To the extent possible within the timeframe of the project, provide DOE with a preliminary assessment of how lower federal courts are implementing the new Court decisions.

**Project Milestones/Deliverables**:

- In-progress briefings: TBD based on discussion with DOE
- Milestone 1: Preliminary Analysis and overview of Court Decisions (2025-Q2)
- Milestone 2: Memorandum of Analysis of Court Decision on Chevron (2025-Q4)
- Milestones 3+: Memorandum of Analysis of other key Court decisions (TBD based on DOE and CRESP prioritization)


**Public Benefit:**

- Independent reviews of specific Supreme Court decisions and subsequent actions by lower courts will have far-reaching implications for environmental and nuclear regulation that impacts well beyond DOE missions.
- Results will be available to the public and be useful as educational materials (legal and non-legal classes).

**Benefit to DOE:**

This Project will help DOE understand the scope and implications of these highly significant new Supreme Court initiatives and develop forward-looking strategies for coping with them.

# Tank Waste Uncertainty Impacts on WTP Process Capability and Support

**Investigators**: Kevin G. Brown (Lead) & David S. Kosson (Vanderbilt Univ.)

**DOE Applicable Sites**: DOE-ORP for Hanford Site

**Project Objectives**:

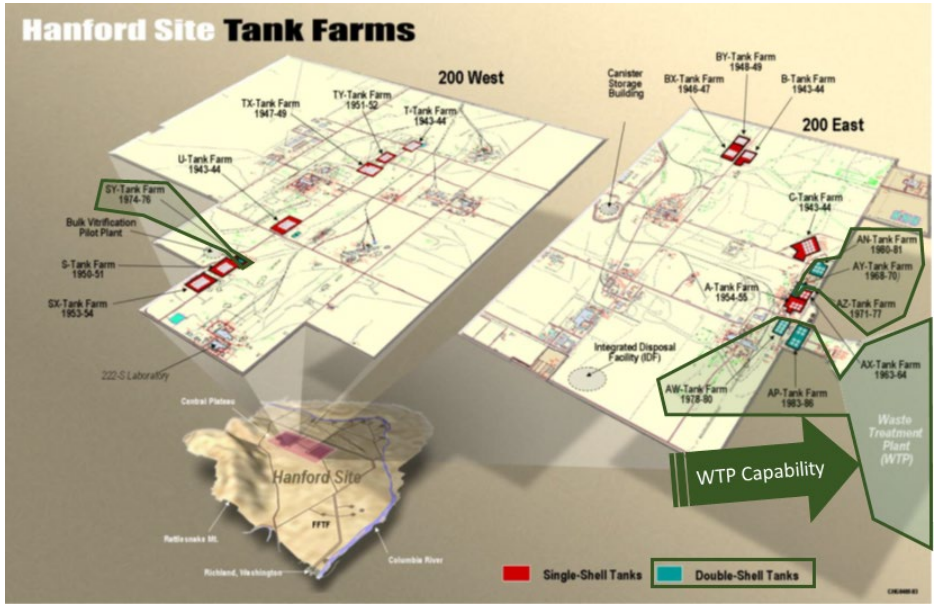
- Update Goldsim Monte Carlo models evaluating inventory uncertainties in the 177 Hanford Site tanks, including 158 tanks requiring retrieval.
- Update Best-Basis Inventory (BBI) & Single-Shell Tank (SST) retrieval plan.
- Evaluate inventory uncertainties for planning, sampling/characterization, retrievals, tank residuals, processing rates, waste form volumes, and risk/dose estimates.

**Public Benefit:**

- Provides general methodology to evaluate uncertainties for missing and sparse data that can be applied to other types of data.
- Provides support for treating and disposing wastes safely focusing on waste characteristics (risk) and not strictly waste origin.

**Relevance and Impact to DOE**:

- Inventory uncertainties as they propagate through blended compositions to be treated in WTP may require changes in waste acceptance criteria or indicate challenges to process capability (e.g., ease of making glass).
- Potential focus areas include characterization sampling, DFLAW, DFHLW, and off-site management of grouted waste.




**Project Milestones/Deliverables (New Project)**:

- Revise Goldsim Monte Carlo models to approximate WTP feed vectors (e.g., Direct Feed HLW).
- Verify revised Goldsim deterministic results versus TOPSim and other relevant model / sampling results.
- Revise Goldsim models based on verification results and input from DOE-ORP on required results.
- Document probabilistic feed vector results in a white paper for DOE review and comment.

# Develop On-Line Methods for Monitoring Tank Waste Processing

**Investigators**: Martha Grover (Lead), Ronald Rousseau, Steven Crouse, Rupanjali Prasad (Georgia Tech)

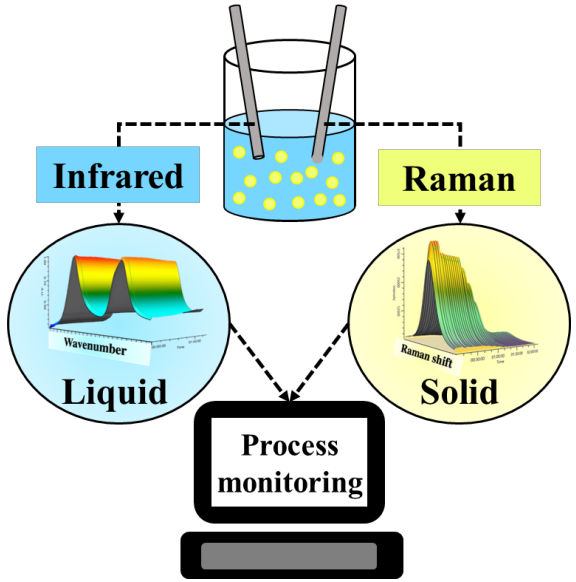
**DOE Applicable Sites**: DOE-ORP for Hanford Site, Savannah River Site

**Project Objectives:**

- Combine existing knowledge of on-line monitoring with proposed mass-balance modeling and offline sampling to produce fault detection methodologies that include uncertainty quantification
- Investigate the solution chemistry of the slurries inside the melter feed preparation vessel (MFPV).
- Understand the partitioning of sodium in solid and aqueous phases when waste is mixed with the glass forming chemicals (GFCs).

**Relevance and Impact to DOE**:

- In-line monitoring of nuclear waste slurries provides safer and faster alternatives for acquiring compositional information on nuclear waste slurries as compared to offline analytical labs.
- Compositional measurements of nuclear waste slurries enable measurements of high-level waste streams and streams containing glass-forming chemicals.




Using online monitoring tools, specifically attenuated total reflectance - Fourier transform infrared (ATR-FTIR) spectroscopy, and Raman spectroscopy to quantify both solution and solid phases in simulated nuclear waste slurries.

**Project Milestones/Deliverables related to these objectives**:

- Perform characterization of a new high-level waste simulant provided by Savannah River.
- Generate a designed data set to probe key solution and solution-phase species.
- Characterize the impact of particle size on inline measurements.

Our work has been recently published as Crouse et al. (2024): https://doi.org/10.1016/j.compchemeng.2024.108785

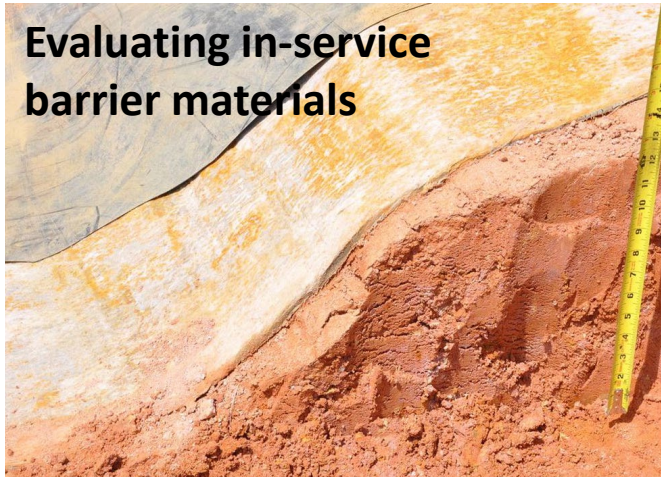
# CRESP Landfill Partnership

**Investigators:**
Craig H. Benson, J. Nicholas Chen, D. Kosson, K. Brown

**DOE Applicable Sites:**
All DOE sites with on-site disposal facilities including Oak Ridge, Savannah River, Portsmouth, Paducah, Hanford, Idaho, Los Alamos, Sandia.

**Project Objectives and Background:**
The CRESP Landfill Partnership (LP) provides applied research and technology transfer to address site-specific and complex-wide issues related to on-site disposal facilities. The objective is to develop more effective and cost-efficient on-site disposal facilities based on research and lessons learned, providing significant public benefit.

The LP was initiated in 2009 based on outcomes of a complex-wide review of on-site disposal operations under the directive of then Asst. Secretary J. Rispoli. ***The LP has become a definitive source of authoritative technical information for design, performance assessment (PA), and operation of on-site disposal facilities.*** These outcomes are achieved through a combination of field experiments and monitoring systems at DOE facilities, laboratory experiments, and computer modeling exercises.


**Examples of Achievements:**

1. Demonstrated service life of geomembranes in excess of 1000 yr in LLW environment, enabling use and accounting in PAs at Oak Ridge, Portsmouth, Paducah, and Idaho.
2. Demonstrated field performance of engineering barriers for radon control, including extensive field measurements at DOE sites demonstrating sustained compliance with Rn control requirements after decades of service.
3. Most extensive database on in-service hydraulic properties of engineered barriers used in final covers, providing authoritative information for use in PAs throughout the complex.
4. Most extensive information on service life of bentonite-polymer composite barriers, enabling their use for sites with stronger leachates.

# Model Development and Verification for Long-term Wasteform Performance

**Investigators**: Florence Sanchez (Lead), Lesa Brown, Kevin Brown, Chen Gruber, David Kosson (Vanderbilt Univ.)

**DOE Applicable Sites**: Hanford, Savannah River, Idaho, Oak Ridge

**Project Objectives**:

- Develop machine learning approaches for determining reaction sets and thermodynamic constants for geochemical speciation modeling
- Characterize ancient cement samples that have been exposed to relevant climate conditions and geologic interfaces to improve confidence in long-term performance modeling

**Public Benefit:**

- Improved prediction leads to more informed decision-making and policy development for environmental protection; model development & validation applicable to non-DOE industries

**Relevance and Impact to DOE**:

- Geochemical speciation modeling: Automation and machine learning to select mineral assemblages can improve alignment between predictions and experimental data
- Ancient cements: Long-term data (>1000 years) for grout and concrete, validated by ancient cement studies, is critical for DOE performance assessments

**Project Milestones/Deliverables**:

- Geochemical speciation modeling: (1) Select relevant material families for DOE grouted waste forms; (2) Evaluate and select ML algorithms for model improvement and uncertainty quantification; (3) Implement and train ML algorithms on cement materials; (4) Conduct gap and uncertainty evaluations; (5) Design and test waste forms using ML-based models; (6) Characterize improved waste forms
- Ancient cements: (1) Sample collection; (2) Natural analogues and ancient cement samples characterization; (3) Natural analogues and ancient cement aging model; (4) Document characterization results for ancient cements as a white paper

# Tank and Vault Integrity and Performance under Closure

**Investigators**: Kevin G. Brown (Lead), Chen Gruber, David S. Kosson (VU)

**DOE Applicable Sites**: Hanford Site

**Project Objectives**:

- Perform integrated experimental and modeling studies in support of waste tank and vault closure at the Hanford Site.
- Perform "inverse PA modeling" to evaluate
  - relationship among residual waste in tanks, conditions in and around tanks, and releases to the environment
  - maximum allowable tank residuals to meet performance objectives.

**Public Benefit:**

- Models developed here will be used to understand cement and concrete performance of buried structures for a range of non-DOE applications.
- Provides a centralized property database curated for general use in future Machine Learning applied to cement and grout formulation.

**Relevance and Impact to DOE**:

- Studies support risk-informed waste retrieval by improving evaluation basis for the performance of concrete barriers.
- ***Leverages*** detailed hydrological modeling (see *Modeling Post-closure Hydrological Conditions of Hanford Waste Tanks)*.
- ***Synergistic*** with PNNL-led NNLEMS Project: *Developing a Hanford Grout Modeling Framework and Property Database for PAs*.

**Achievements to date:**

- Completed review of PNNL test plan for concrete sidewall cores from the 241-A-106 tank.
- Conceptual and reactive transport model developed to describe representative Hanford Site waste tanks (241-B).
- Reactive transport model applied to 241-C-107 tank where dome core previously tested for carbonation (after 65 yrs).

**Milestone(s) / Deliverable(s)**:

- Complete verification and validation studies for important laboratory models to support performance studies.
- Complete "inverse PA" study, including "maximum" tank waste residuals – documented in white paper.

# Artificial Intelligence Technologies for Long-term Groundwater Model Validation and Data Assimilation Strategies

**Investigators**: Haruko Wainwright (MIT) and Kevin Brown (Vanderbilt)

**DOE Applicable Sites**: All DOE sites

**Project Objectives**: Develop a blueprint of archiving/managing/synthesizing groundwater and performance assessment models across multiple sites, improving groundwater model developments in the future

- Objective 1: Create AI-ready database of past models/data (e.g., parameters/assumptions, CRESP data), and perform cross-site analyses
- Objective 2: Identify best modeling practices and key challenges
- Objective 3: Develop a framework to automatically detect the deviation of observational data from model predictions, and to evaluate model performance

**Public Benefit:**

- Improved predictability of groundwater systems will provide assurance to the public about the performance of waste disposal cells, the stability of residual contaminants and others

**Relevance and Impact to DOE**:

- Contribute to DOE's knowledge management and next generation workforce development for modeling and assessments
- Improved predictability will provide the better estimate of cost and closure timeline


**Project Milestones/Deliverables**:

- Deliverable 1: AI-ready database of groundwater assessments
- Deliverable 2: Best practices and key factors associated with the success and failures of modeling results.
- Deliverable 3: Bayesian model-data assimilation framework and associated AI technologies to
  - Automatically ingest datasets collected the sites
  - Detect model deviation/discrepancy from data

# DOE-Office of Nuclear Energy Projects

## Member of the DOE-NE Consent-Based Siting Consortia

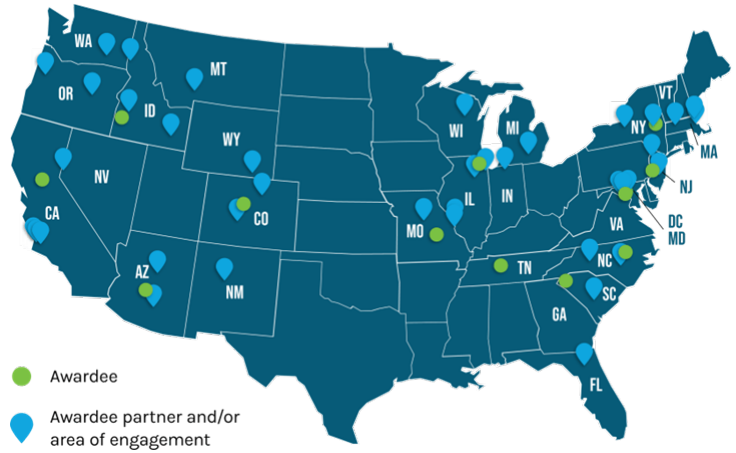
- DE-NE0009342, Moving Toward Consent-Based Siting of a Federal CISF: Improving Strategies for Community-Informed Decision-Making during Stakeholder and Tribal Engagements

## 4 Nuclear Energy University Program Consolidated Innovative Nuclear Research Awards

- DE-NE0000735, Development of Fuel Cycle Data Packages for Thorium Fuel Cycle Options
- DE-NE0008905, Fuel Salt Sampling and Enriching System Technology Development
- DE-NE0009387, Validation of Geochemical Reactive Transport Long-Term Predictions Using Natural Cements and Ancient Cements Analogues
- JUST ANNOUNCED: Informing Consent-Based Siting of a Consolidated Interim Storage Facility (CISF): Examining Public Engagement Through History and Evaluation of Prior & Current Outreach Results

## Members of 2 DOE-NE Advanced Reactor Demonstration Program (ARDP) teams

- Advanced Reactor Concepts-20 (ARC-20) Program: Fast Modular Reactor Conceptual Design (lead: General Atomics)
- Risk Reduction Program: Molten Chloride Reactor Experiment (lead: Southern Company Services, Inc.)




**DOE-NE's Consent-Based Siting Consortia**

Assists DOE-NE with research regarding its pursuit of one or more federal consolidated interim storage facilities (CISFs) using a multi-stage consent-based approach that puts communities' interests at the forefront

# CRESP By the Numbers

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|---|---|---|---|
| **14**<br>DOE Sites Served | **>24**<br>Major Reports & Reviews aiding DOE's Management Decision Making/Issue Resolution | **24**<br>Universities represented by Faculty & Students since 1995 | **18**<br>Current Faculty |
| **127**<br>Post Doctoral, Graduate & Undergraduate Students | **44**<br>Multidisciplinary Research Areas – Engineering, Sciences, Social Sciences & Law | **50**<br>Peer Reviewed Papers Published/Year | **30**<br>Years of Collaboration |

Vanderbilt University · Rutgers · Howard University · NYU · Wisconsin · Oregon State University · University of Central Florida · Washington State University · Massachusetts Institute of Technology · Georgia Tech · Texas Tech

CRESP