

**Building the Community of Practice for Performance and Risk Assessment  
in Support of Risk-Informed Environmental Management Decisions - 14575**

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**ABSTRACT**

This paper discusses the current status of U.S. Department of Energy (DOE) Office of Environmental Management (EM)'s effort to build a Community of Practice for Performance and Risk Assessments in support of risk-informed environmental cleanup and waste management decisions.

Performance Assessments (PAs) provide a demonstration of compliance and important technical inputs to meet regulatory requirements for: 1) waste form development and implementation; 2) tank closure activities; 3) waste site closure activities (e.g., cribs and trenches); 4) in-situ decontamination and decommissioning; 5) soil and groundwater remediation; and 6) management of disposal facilities (e.g., land-fills or near surface disposal facilities). Risk Assessments (RAs) use outputs of PAs and other information to evaluate the impact of a proposed action on human health and the environment. The PAs and RAs or P&RAs become public documents upon completion. As such, DOE needs to ensure that P&RAs continue to be performed and documented consistently and to high standards. Robust risk assessments are critically needed for risk-informed, performance-based environmental management decisions. Continued improvements in the consistency of P&RAs and reductions in their underlying uncertainty will provide a sound foundation for future.

For these reasons, in 2009 DOE EM initiated and supported the development of the Performance Assessment Community of Practice (PA CoP), to understand the current state-of-practice, state of evolving science and opportunities to improve fidelity and reduce uncertainty in models used to estimate the performance of the engineered systems for environmental assessments. The PA CoP benefited from participation from DOE, U.S. Environmental Protection Agency, U.S. Nuclear Regulatory Commission, state regulators, national labs, contractors, and other stakeholders. Between 2009 and 2011, DOE EM organized 3 technical exchanges for the PA CoP.

More recently, the group has been renamed the P&RA CoP in recognition of the need to broaden its scope of work to include performance assessments, risk assessments, and decision analyses for both engineered and natural systems, in order to better support risk-informed decision makings in compliance with DOE Order 435.1, Comprehensive Environmental Response, Compensation, And Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and National Environmental Policy Act (NEPA) regulations. Technical exchanges including Webinars and teleconferences among steering committee and P&RA CoP participants have restarted since August 2013. In addition, an annual public meeting is being planned for 2014 to promote technical exchanges among P&RA CoP participants.

## **INTRODUCTION OF EM CLEANUP REGULATORY FRAMEWORK**

The mission of the U.S. Department of Energy Office of Environmental Management (DOE EM) is to complete the safe cleanup of the environmental legacy brought about from the nation's nuclear weapons development and production and nuclear energy research. Although the program has made significant progress in reducing the environmental footprint of the legacy waste since its inception in 1989, risks to the environment and public health still remain at a number of contaminated sites across the country. At the present, the Department's unfunded environmental remediation liability is estimated to be approximately \$300 billion.

Cleanup of the environmental legacy is executed under the regulatory framework that is governed by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and National Environmental Protection Act (NEPA) mandated by the U.S. Environmental Protection Agency (EPA), corresponding state environmental regulations, and DOE internal orders such as Order 435.1 for self-regulated operations and activities.

For example, throughout much of the history of plutonium production at the Hanford site, DOE regulated waste management and environmental protection under a set of orders implementing the Atomic Energy Act, including DOE Order 435.1, *Radioactive Waste Management* [1, Section 1.2.1]. RCRA enacted in 1976 gave other Federal agencies a major role in the regulation of hazardous waste. In 1986, State of Washington Department of Ecology was authorized by the EPA to administer its own hazardous waste program (through the state's Hazardous Waste Management Act) in lieu of the Federal RCRA program. CERCLA and its amendments established Federal agencies' responsibilities to investigate and remediate releases of hazardous substances, including radioactive contaminants, from their facilities. Beginning in 1986, Washington Department of Ecology and EPA began working with DOE to develop one compliance agreement that set milestones for cleaning up past disposal sites under CERCLA and bringing operating facilities into compliance with RCRA. The Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement (TPA), was signed by the three agencies in May 1989. Because the TPA, which addresses DOE's mixed waste that is subject to the RCRA storage prohibition, preceded the Federal Facility Compliance Act of 1992, the TPA also satisfies the act's requirement for a site treatment plan addressing mixed waste in storage at Hanford.

## **PERFORMANCE AND RISK ASSESSMENTS**

These site-specific regulatory frameworks often stipulate numerical performance objectives for protection of human health and the environment. Site-specific performance and risk assessments (sometimes also called safety assessments) are used to inform and support management decisions and to demonstrate compliance with the performance objectives. Performance Assessments (PAs) provide a demonstration of compliance and important technical inputs to meet regulatory requirements for: 1) waste form development and implementation; 2) tank closure activities; 3) waste site closure activities (e.g., cribs and trenches); 4) in-situ decontamination and decommissioning; 5) soil and groundwater remediation; and 6) management of disposal facilities (e.g., land-fills or near surface disposal facilities). Risk Assessments (RAs) use outputs of PAs

and other information to evaluate the impact of a proposed action on human health and the environment.

In practice, PAs and RAs are also used to identify critical data, facility design and information needs, and model development needs for: i) defensible and cost-effective licensing decisions and ii) developing and maintaining operating limits, such as, waste acceptance criteria. The modeling evaluations conducted typically include PAs of contaminant migration through environmental pathways (e.g., air, groundwater, and surface water) and potential human exposures to the contaminants in various exposure media (e.g., soil, drinking water, crops, and livestock), or RAs, for the purpose of: a) evaluating effectiveness of remedial alternatives, including monitored natural attenuation; b) assessing performance of the selected remedy for a given site/project (either during pre-construction design or performance confirmation/monitoring after implementation of the remedy); and c) decision analyses for planning and budgeting purposes (i.e., what-if scenario analyses).

These PA and RA modeling analyses provide useful input that support many decision-making points throughout the lifecycle of various waste management activities (e.g., siting, design decisions, operational limits, monitoring programs, closure options, remediation of contaminated areas, in-situ decommissioning). The analyses can support environmental cleanup decisions made with external oversight of, e.g., EPA and U.S. Nuclear Regulatory Commission (NRC) under CERCLA, National Environmental Policy Act (NEPA), and RCRA, as well as decisions made in association with DOE self regulated on-site disposal of LLW under DOE Order 435.1, in some cases satisfying overlapping requirements of both DOE 435.1 and CERCLA or RCRA. For example, at the Hanford Site, the Hanford Tank Closure and Waste Management Environmental Impact Statement conducted under CERCLA, NEPA, and RCRA [2] was used to evaluate options for managing and disposing of waste, selecting supplemental treatments, closing tanks, and closing the Fast Flux Test Facility (FFTF). In addition, efforts are underway to define the scope and approach for tank farm closure performance assessments under DOE Order 435.1, using the Waste Management Area (WMA) C performance assessment as a starting point [2, 3].

## **PERFORMANCE AND RISK ASSESSMENT COMMUNITY OF PRACTICE (P&RA CoP)**

The PAs and RAs or P&RAs become public documents upon completion. In practice, because the PAs and RAs are normally conducted by different groups of DOE contractors in consultation with different state and local regulators for specific site geologic and contamination conditions, different approaches and preferences to PAs and RAs are often used in conducting P&RAs even for similar waste sites or disposal systems. Some of these differences are often caused by different interpretations of regulatory requirements, varying familiarity of and/or preference for certain computer codes or platforms used to perform P&RAs, different educational background of P&RA practioners, and in some cases, by different stakeholder preferences (for simplicity, conservatism, cost savings, etc) to ensure outcomes from the P&RAs are understandable. As such, DOE needs to ensure that P&RAs continue to be performed and documented consistently and to high standards. Robust risk assessments are critically needed for risk-informed, performance-based environmental management decisions. Continued improvements in the consistency of P&RAs and reductions in their underlying uncertainty will provide a sound foundation for future.

To address these needs, the Low-Level Waste Disposal Facility Federal Review Group (LFRG) was chartered to provide reviews of the performance assessment completed to demonstrate compliance with DOE Order 435.1 requirements on DOE self-regulated radioactive waste disposal activities. In addition, the Performance Assessment Community of Practice (PA CoP) was established and envisioned as means to foster improved consistency at individual sites and across the DOE Complex. Specifically, PA CoP was envisioned to: a) provide means to address consistency early and throughout PA process; b) foster early and sustained communication among CERCLA, NEPA, RCRA, and DOE O 435.1 activities involving LLW, tank closure, and D&D; c) provide a forum to share information regarding state of the art and specific models, data and approaches; and d) serve as an enduring data and modeling resource to minimize duplication of effort across DOE and train future generation of PA professionals [4].

With DOE EM sponsorship, the PA CoP held its kickoff and first technical exchange meeting in July 2009 in Salt Lake City, Utah. The meeting focused on understanding models used for estimating performance of engineered systems.

In late 2013, the PA CoP has been reconstituted to emphasize the need for an integrated regulatory framework when cleanup work at a given site is subject to overlapping environmental regulations (CERCLA, RCRA, NEPA, and DOE Order 435.1) as well as the importance of risk assessments in non-DOE self-regulated cleanup activities. The reconstituted Performance and Risk Assessment Community of Practice (P&RA CoP) will cover performance assessments, risk assessments, and decision analyses for both engineered and natural systems. A near-term focus of the P&RA CoP is to inform and support risk-informed management decision of the changing EM work portfolio in response to recent fiscal constraints.

The P&RA CoP activities will be governed by a steering committee through a charter that was agreed to by representatives of participating organizations [5]. Otherwise, the P&RA CoP is self-directing. The steering committee uses the following guidelines to conduct its business:

1. The P&RA CoP should review documents from the existing literature from international, Departmental, and non-Departmental governmental agencies, which may benefit P&RA preparation methodologies. The use of lessons learned from these and other organizations is strongly encouraged; and
2. Guidance available from international, federal, and state agencies and stakeholders should be sought. Consideration should be given to how such agencies use completed, publically available, P&RAs.

P&RA CoP activities are administered by the steering committee. The following organizations are represented in the steering committee: DOE, NRC, EPA, State regulatory agencies from the Washington State and Kentucky, national laboratories, the Consortium for Risk Evaluation with Stakeholder Participation (CRESP), and leading engineering and environmental consulting firms. The steering committee is chaired by the DOE EM.

The P&RA CoP charter describes a three-tiered membership. The first tier shall be a Steering Committee, the second tier shall be Technical Advisors, and the third tier shall be Ad Hoc members.

- a. Steering Committee members are selected from the major DOE sites (Savannah River, Idaho, and Hanford), affected federal and state regulators, and other stakeholders.
- b. Technical Advisors are designated by the Steering Committee and shall be selected from CRESPI, national laboratories, site contractors, and other federal and state sources of expertise.
- c. Ad Hoc members are brought into the P&RA CoP to work on specific projects or for specific expertise to provide specialized advice, writing, and developing specific products. Ad Hoc members are recommended by a Member of the Steering Committee.

Other than steering committee meetings, all other technical exchange activities and information (Webinars, annual technical exchange, Website) of the P&RA CoP is open to all interested parties, including members of the general public. Open technical exchanges will be the key for developing best practices and lessons learned, and for promoting standardized practices that can help facilitate technical exchanges between EM practitioners and regulators, affected business, concerned citizens, and other stakeholders.

## **P&RA CoP OBJECTIVES**

Main objectives of the reconstituted P&RA CoP are envisioned to include the following:

1. Consolidate and expand the body of knowledge relating to the preparation and application of P&RAs that incorporates the concept of model and data reuse applicability and builds on lessons learned across the DOE complex;
2. Draft appropriate additional guidance, based upon this agreed-upon body of knowledge (and any desired improvements), in a clear and easy to understand manner with particular emphasis on continuing improvements to the consistency of approaches for P&RA implementation;
3. Provide support to DOE sites in the initial stages of developing and planning P&RA activities;
4. Formalize the conduct of technical exchanges, education, and training sessions as appropriate to accomplish the goals of the charter;
5. Develop a repository of P&RAs and risk-based modeling tools, data, and supporting technical information; and
6. Continue to develop the community of P&RA practitioners and technical expertise to support waste management and closure needs.

## **DOE EM SPONSORED TECHNICAL EXCHANGES**

Since 1988 DOE has promoted the PACoP for supporting environmental management decisions [5]. The following provides a summary of recent PA CoP activities that DOE EM has sponsored in the last few years.

On July 13-14, 2009, the PA CoP held its first technical exchange meeting in Salt Lake City. The meeting was aimed to understand the current state-of-practice, state of evolving science and opportunities to improve fidelity and reduce uncertainty in models used to estimate the performance of the engineered systems for environmental assessments. The engineered system is defined to include the waste form(s), engineered barriers to contaminant release such as vaults, tanks, caps, and the near field physical-chemical interactions of these systems with the immediate surroundings that impact contaminant release. The discussions focused on engineered systems at Yucca Mountain, the Waste Isolation Pilot Project, F Tank Farm at the Savannah River Site, and a low level waste disposal facility in Spain. Glass, ceramic, cementitious, and other waste forms were also discussed. For each topic, the presentations and discussions provided (i) state of practice, and (ii) state of science, with discussion focused on opportunities, near-term and longer-term directions. The meeting was organized with the technical assistance provided by CRESPP, which maintains the presentations on its website: <http://www.cresp.org/education/workshops/pacop/>.

On April 13-14, 2010, the PA CoP held another technical exchange at Richland, WA. The meeting showcased progress in the Advanced Simulation Capability for Environmental Management (ASCEM) [6, 7] and the Cementitious Barrier Partnership (CBP) [8] initiatives. Case studies from several EM sites across the complex were also presented. The meeting presentations can be found at: <http://srnl.doe.gov/copexchange/links.htm>.

The most recent PACoP technical exchange was held on May 25-26, 2011 in Atlanta, GA. The 2011 PA Technical Exchange was focused around the topic of the role of modeling in decision making and an additional topic of software quality assurance to address the recent report on DOE Office of Environmental Management (DOE-EM) modeling from the Government Accountability Office (GAO). The GAO recommendations have further reinforced the benefits of efforts to share information and lessons learned through the PA CoP. The meeting was organized with the assistance of SRNL, and was attended by some 50 participants. The presentations can be found at <http://srnl.doe.gov/copexchange/2011/links.htm>. A summary of the meeting can be found in [9].

## **PLANS FOR NEAR TERM ACTIVITIES**

A variety of stakeholder inputs have been collected from the P&RA CoP for the topics of interest for discussion. A list of topics of interest has been compiled from steering committee discussions and Technical Exchanges held between 2009 and 2011. Topics that appear to be of most interest include, in no particular order, e.g., the use of graded approach; features, events, and processes (FEPs) and their implementation in a performance assessment; impacts of regulatory updates (10 CFR Part 61 and DOE Order 435.1) on P&RAs; performance of engineered barriers including covers, liners, and cementitious and other waste forms; use of intruder scenario analysis in

regulatory compliance; confidence building and performance confirmation; and interpretation of (deterministic, probabilistic, etc) P&RA results for environmental management decision making.

The P&RA CoP will conduct periodic steering committee meetings to discuss approaches and priorities and set directions for public exchanges. The steering committee plans to organize quarterly Webinars and annual technical exchanges to discuss the topics of most interest to the community. Both the Webinars and annual technical exchange meetings are open to all interested parties. Information of the Webinar presentations and annual conferences will be posted on a public Website for information sharing and exchanges. Furthermore, working groups may be formed under the P&RA CoP to pursue the research of certain special topics of interest to the working group participants.

This P&RA CoP has a focus on supporting the completion of the mission of nuclear environmental legacy. It must be pointed out that this effort represents only a small part of the many undertakings by the scientific, engineering, and regulatory communities to broaden and deepen technical exchanges in this and related fields. In this regard, DOE EM is also supportive of the development of the iemHUB (<http://iemhub.org/>) through its involvement in the Federal Interagency Steering Committee on Multimedia Environmental Modeling (ISCMEM) (<http://iemhub.org/groups/iscmem>). The iemHUB is the online community resource for those involved in the development, evaluation, and application of environmental models, and is aimed to be a state-of-the-art, web-based CoP that serves an even larger community with more diverse interests for integrated environmental modelling than the P&RA CoP.

## REFERENCES

1. U.S. DEPARTMENT OF ENERGY (DOE), *Radioactive Waste Management*, DOE Order 435.1 (July 9, 1999).
2. DOE, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391 (2012).
3. DOE, *Record of Decision for Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, Washington, DC (2014).
4. LETOURNEAU, M.J., *DOE HQ Perspectives on Performance Assessments*, Presented at the *Performance Assessment Community of Practice Technical Exchange Meeting*, Salt Lake City, Utah (July 13, 2009).
5. DOE, *Interagency Performance and Risk Assessment Community of Practice (P&RA CoP) Charter*, Washington, DC (2013).
6. ZHU, M., J. MEZA, D. MOULTON, I. GORTON, M. FRESHLEY, P. DIXON, R. SEITZ, J. WENGLE, R. PATTERSON, and R. NELSON, *A New Initiative for Developing Advanced Simulation Capabilities for Environmental Management (ASCEM) – 10470*, Presented at WM2010 Conference, March 7-11, 2010, Phoenix, AZ (2010).
7. SEITZ, R., G. FLACH, S. HUBBARD, B. FAYBISHENKO, S. FINSTERLE, C. STEEFEL, P. DIXON, D. MOULTON, M. FRESHLEY, V. FREEDMAN, I. GORTON, and JUSTIN MARBLE, *Advanced Simulation Capability for Environmental Management – Current Status and Phase II Demonstration Results – 13161*, Presented at WM2013 Conference, February 24-28, 2013, Phoenix, AZ (2013).

8. LANGTON, C., G. FLACH, F. SMITH, H. VAN DER SLOOT, J. MEEUSSEN, ERIC SAMSON, H. BURNS, P. MALLICK, L. SUTTORA, D. ESH, M. FUHRMANN, J. PHILIP, K. BROWN, D. KOSSON, A. GARRABRANTS, and S. SARKAR, *The Cementitious Barriers Partnership (CBP) Software Toolbox Capabilities in Assessing the Degradation of Cementitious Barriers – 13487*, Presented at Presented at WM2013 Conference, February 24-28, 2013, Phoenix, AZ (2013).
9. SEITZ, R., M.J. LETOURNEAU, and L. SUTTORA, *2011 Performance Assessment Community of Practice Technical Exchange – Summary*, SRNL-STI-2011-00752, Savannah River National Laboratory, Aiken, SC (December 2011).

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