

# Nuclear Safety Workshop Summary

September 19-20, 2012





## **Nuclear Safety Workshop Summary**

On September 19-20, 2012, the U.S. Department of Energy (DOE) held a second Nuclear Safety Workshop covering the results of the Department's actions to improve its posture for analyzing and responding to severe accidents in light of lessons learned from the March 2011 nuclear accident in Japan. Sponsored by DOE and championed by Deputy Secretary of Energy Daniel Poneman, the two-day workshop discussed the lessons learned in a national and international context. The workshop's theme was *Post Fukushima Initiatives and Results*, and included technical breakout sessions focused on beyond design basis events (BDBEs) analysis and response, safety culture, and risk assessment and management.

Over 200 high-ranking officials and technical experts participated in the workshop at the Bethesda North Marriott Hotel and Conference Center in Bethesda, Maryland. Representatives attended from DOE, the International Atomic Energy Agency (IAEA), Nuclear Regulatory Commission (NRC), Defense Nuclear Facilities Safety Board (DNFSB), Environmental Protection Agency, U.S. Chemical Safety Board, Institute of Nuclear Power Operations (INPO), Federal Aviation Administration (FAA), and National Aeronautics and Space Administration (NASA). Members of the academic community also participated in the workshop, including breakout session moderators from the University of Maryland and Vanderbilt University. In addition, 60 nuclear safety experts—many from around the world—signed up to view the workshop over the Internet via WebEx. The international remote participants included a Scientific Attaché to the European Union; representatives from Bulgaria, China, Nigeria, Slovakia, and the Czech Republic; and a member of the IAEA board reviewing post-Fukushima “stress tests” of European nuclear power plants.

Workshop technical reference materials and speaker presentations can be found at <http://www.hss.doe.gov/nuclearsafety/nsworkshop2012/>.

This summary provides an overview of presentations, discussions, and outcomes from workshop participants. DOE will evaluate the information provided and recommendations made by the distinguished group of participants to determine where DOE can make improvements to its nuclear safety regulatory infrastructure and its implementation.

### **Opening Plenary Session**

The keynote speakers for the workshop included:

- DOE Deputy Secretary of Energy, Daniel B. Poneman
- DOE Chief Health, Safety and Security Officer, Glenn S. Podonsky
- NRC Commissioner, William C. Ostendorff
- DNFSB Chairman, Dr. Peter S. Winokur
- IAEA Head of Operational Safety, Miroslav Lipar
- Tokyo Electric Power Company General Manager, Akira Kawano
- Human Performance Analysis Corporation President, Dr. Sonja B. Haber.

### **Technical Breakout Sessions**

After the opening plenary keynote speeches, the participants broke into three concurrent technical sessions that included very energetic and insightful discussions aimed at identifying potential nuclear safety improvements. DOE senior managers led each breakout session in conjunction with subject matter experts from DOE sites and academia.

### *BDBEs Analysis and Response Breakout Session*

The BDBEs Analysis and Response breakout session was designed to ensure participants understood current DOE BDBE and emergency management expectations, learned about developing post-Fukushima requirements and guidance, and shared perspectives on the need for changes in BDBE analysis and response.

The moderators included:

- Robert J. Budnitz, Research Scientist, Lawrence Berkeley National Laboratory
- James Fairbent, Director, National Nuclear Security Administration (NNSA) Office of Emergency Management
- Dr. James O'Brien, Director, DOE Office of Nuclear Safety
- Garrett Smith, Director, DOE Office of Nuclear Safety Basis and Facility Design.

The breakout session began Wednesday afternoon by outlining DOE's BDBE and emergency management concepts, actions taken in response to the Fukushima-Daiichi accident, and the NRC's approach toward BDBE analysis and response. DOE, NNSA, and NRC speakers gave the following presentations:

- Dr. James O'Brien, DOE, *Development of Guidance for Analysis of BDBEs*
- David Freshwater, Emergency Management Specialist, NNSA Office of Emergency Management, *Emergency Management Concepts, Existing Guidance, and Changes*
- Mike Hillman, Program Manager, DOE Office of Health, Safety and Security, *Results from BDBE Pilots*
- David Freshwater, NNSA, *Summary of Emergency Management Results from Pilot Evaluations*
- Bill Reckley, Chief, Policy and Support Branch, Japan Lessons-Learned Project Directorate, NRC Office of Nuclear Reactor Regulation, *NRC Handling of BDBEs for Nuclear Power Reactors*.

After the presentations, the moderators led a discussion with participants regarding defining BDBEs, identifying BDBEs deserving additional analysis, and using updated BDBE information.

The breakout session continued on Thursday morning with three additional speakers:

- Jim Maddox, Director, INPO Emergency Response Development, *INPO BDBEs Analysis and Response Perspectives*
- Ron Crone, Director, Research Reactors Division, UT-Battelle, LLC, Oak Ridge National Laboratory, *DOE Management and Operating Contractor Perspectives on BDBE Analysis and Response*
- John Schwenker, Nuclear Safety Manager for Liquid Operations, Savannah River Remediation, LLC, Savannah River Site, *Perspective on BDBE Analysis and Response*.

After the presentations, the moderators led a discussion to solicit participant reaction to changes in requirements and guidance under consideration. The discussion focused on:

- What constitutes a BDBE?
- What scope of BDBEs should be evaluated?
- What controls should be established to address BDBEs?
- Where should those controls be documented?

The moderated discussions resulted in general agreement among the participants on the following:

- The responsibility to mitigate the effects of a BDBE on the facility and its operations resides with the facility operations organization.
- The responsibility for protecting co-located workers and the public from the consequences of BDBEs resides with the emergency response organization.
- Operations, security, and emergency management planning for BDBEs must address the coordination and prioritization of facility, site, and community response actions to ensure human safety, stabilize the situation, and protect the environment.
- The evaluation of BDBEs should include an assessment of the residual risk and cost/benefit of mitigation.
- BDBE evaluations should include an identification of the facility safety functions needed to cope with BDBEs, the equipment necessary to perform those functions, and the means to sustain those functions in case equipment fails.
- BDBE evaluations should include an evaluation of whether any equipment necessary to maintain safety functions is realistically accessible by the facility staff during and immediately after a BDBE.
- Emergency management evaluations should ensure facility supervisors can communicate with offsite organizations in case of BDBE-initiated failures of primary communications systems, such as providing multiple means of communication (e.g., cell phones, Voice-over Internet Protocol (VOIP) phones, radios, and satellite phones).
- Emergency management procedures should clearly establish who has the authority to make difficult decisions for the protection of human, facility, and/or environmental safety when communications with senior facility management is excessively delayed or unavailable.

Over the course of the two days, the BDBE Analysis and Response breakout session participants identified the following recent actions taken, lessons learned, additional actions needed, and recommended path forward.

#### Actions to Date

- Issued [DOE Safety Bulletin 2011-01](#), *Events Beyond Design Safety Basis Analysis*.
- Conducted Nuclear Safety Workshop in [2011](#).
- Developed report to the DOE Secretary, [Review of Requirements and Capabilities for Analyzing and Responding to BDBEs](#), with recommendations for additional post-Fukushima actions.
- Drafted and solicited comments on two post-Fukushima, emergency management approach documents.
- Conducted four pilot BDBE evaluation studies in 2012.
- Updated the safety basis guidance based on the pilot evaluations.

#### Lessons Learned

- The bounding BDBE is usually a seismic event; however, it is beneficial to evaluate other events.
- The existing hazard survey/emergency planning hazards assessment process is sound.
- Important information for focusing equipment margin analysis and emergency planning efforts can be identified through BDBE analysis that includes an evaluation of cliff-edge effects.
- Facility BDBE evaluations with multi-discipline teams, including safety analysis, operations, and emergency management, are an effective approach.

### Additional Actions Needed/Path Forward

- Determine criteria for selecting which facilities and sites need to perform BDBE evaluations.
- Further investigate numeric and/or non-numeric criteria for evaluating what constitutes BDBEs.
- Establish guidance for prioritizing responses to co-located, sitewide, and offsite BDBE challenges.
- Define where BDBE analysis results and mitigation strategy should be documented.
- Update safety analysis and emergency management guidance documents.
- Determine need to learn from NRC approach and criteria for screening specific accidents from further BDBE evaluation.
- Determine appropriate role for cost-benefit analysis.
- Evaluate need to develop an Operating Experience Report that documents lessons learned from facility evaluations.
- Distribute the enhanced BDBE evaluation guidance to all DOE facilities for comment and to facilitate self-assessments.

### Safety Culture Breakout Session

The Safety Culture breakout session was designed to provide an overview and perspectives on the topic of safety culture, including methods to understand, evaluate, and improve safety culture across various organizations and DOE.

The moderators included:

- Dr. Sonja B. Haber, Human Performance Analysis Corporation
- James Hutton, Acting Associate Deputy Assistant Secretary for Safety, Security, and Quality Programs and Chief Nuclear Safety Advisor, DOE Office of Environmental Management
- Dr. Steven Krahn, Professor of the Practice of Nuclear Environmental Engineering, Vanderbilt University Department of Civil and Environmental Engineering.

The breakout session began Wednesday afternoon with a group exercise, which asked audience members to rate the importance of various predefined actions on a safety scale from least to most important. The moderator informally collected the results by a show of hands and used the results as an introduction to the afternoon speakers:

- Monica Haage, IAEA Safety Culture Specialist, *What Is Safety Culture and Why Is It Important?*
- Undine Shoop, Chief, Health Physics and Human Performance Branch, NRC Office of Nuclear Reactor Regulation, *Safety Culture in the NRC's Reactor Oversight Process.*
- Honorable Mark A. Griffon, Board Member, U.S. Chemical Safety Board, *Chemical Safety Board Investigations and Safety Culture.*

These presentations provided national and international perspectives on safety culture from outside the DOE complex.

The breakout session continued on Thursday morning with four DOE speakers:

- Dr. Suzanne Helfinstine, Staff Engineer, High Reliability Operations, B&W Pantex, Pantex Plant, *What Does Self-Assessment of Safety Culture Look Like?*
- Ward Sproat, Principal Vice President and Deputy Project Director for Design and Operations, Waste Treatment Plant Project, Bechtel National, Inc., *External Assessment of Nuclear Safety Culture: The Why and How.*
- James Hutton, DOE, *What Has DOE Been Doing in the Area of Safety Culture?*
- Chip Lagdon, Chief of Nuclear Safety, DOE Office of the Under Secretary for National Security, *Differing Professional Opinion Summary – Erosion.*

After the presentations, the moderators led a roundtable discussion with interactive questions and answers between the audience and the presenters.

Over the course of the two days, the Safety Culture breakout session participants identified the following actions taken, lessons learned, additional actions needed, and recommended path forward.

#### Actions to Date

- Formed joint DOE/Energy Facility Contractors Group working group in 2007 followed by development work in 2008-2010.
- Issued *Integrated Safety Management Policy* ([DOE Policy 450.4A](#)) and *DOE Nuclear Safety Policy* ([DOE Policy 420.1](#)) in 2011.
- Issued *Integrated Safety Management System Guide* ([DOE Guide 450.4-1C](#)) in September 2011.



- Published the DOE Secretary's and Deputy Secretary's nuclear safety (including safety culture) [expectations](#) in December 2011.
- Initiated DOE Office of Health, Safety and Security independent assessments of safety culture in January 2012.
- Held safety-conscious work environment training for DOE, NNSA, and contractor senior leaders in July 2012.
- Issued safety-conscious work environment self-assessment guidance in July 2012.

## Lessons Learned

### Leadership

- Leaders play a significant role in establishing and maintaining safety culture.
- Building a healthy safety culture is a continuous journey, not an end point.
- Building a healthy safety culture takes a significant commitment.
- Management teams generally think things are going better in the workforce than the workforce believes.
- Management teams generally think that people from the outside do not “get” their unique challenges.
- Technically-oriented management teams generally do not understand or pay attention to safety culture.
- Management is responsible for creating an environment that supports raising concerns and fulfills the expectation that they will be resolved.

### Communications

- The DOE Implementation Plan addressing DNFSB Recommendation 2011-1, [Safety Culture at the Waste Treatment and Immobilization Plant](#), is not well advertised or understood.
- The Differing Professional Opinions and Employee Concerns processes described in [DOE Order 442.2](#) and [DOE Order 442.1A](#) are not always well communicated, trusted by workers, and effectively implemented by contractor and Federal staffs.
- The available resources for safety culture assistance are not widely understood.

### Sustainability

- DOE's safety culture initiatives need to incorporate the roles and responsibilities of contractors and subcontractors.
- Management often overemphasizes and places too much confidence in personnel safety metrics (e.g., lost time hours) without due consideration for process-related information.
- Serious events tend to fade from memory over time.

## Additional Action/Path Forward

- Establish feedback process for self-assessment guidance.
- Strengthen self-assessment guidance with respect to social science expertise.
- Clearly explain the role of the differing professional opinion and employee concerns programs in DOE's implementation of safety culture.
- Establish a plan for sustainability of performance over the long term.
- Expand DOE efforts to fully educate its personnel on safety culture.
- Schedule workshops on a regular basis to continue to improve implementation.
- Consider the interface between nuclear safety culture and other programs (e.g., security).



- Consider creating advocacy roles for safety culture at DOE and contractor organizations.
- Ensure DOE's safety culture implementation process is part of the briefing package for new senior leadership.

### Risk Assessment and Management Breakout Session

The Risk Assessment and Management breakout session focused on current practices and initiatives related to risk analysis, probabilistic risk assessment (PRA), and risk management.

The moderators included:

- Dr. Robert Bari, Senior Advisor and Senior Physicist, Brookhaven National Laboratory
- Chip Lagdon, Chief of Nuclear Safety, DOE Office of the Under Secretary for National Security
- Dr. Mohammad Modarres, Professor and Director of Reliability Engineering, University of Maryland Department of Mechanical Engineering
- Carl Sykes, Technical Director, NNSA Office of Nuclear Safety.

The breakout session began Wednesday afternoon with presentations on different approaches to risk analysis:

- Bentley Harwood, Advanced Test Reactor Nuclear Safety Engineer, Battelle Energy Alliance, Idaho National Laboratory, *Idaho National Laboratory Advanced Test Reactor PRA*
- Jeffrey Kimball, DNFSB Technical Specialist (Seismologist), *Assessing Beyond Design Basis Seismic Events and Implications on Seismic Risks*
- Dr. Kamiar Jamali, NNSA Senior Technical Advisor to the Chief of Defense Nuclear Safety, *A Proposed Cost-Benefit Analysis Approach for Evaluating DOE Nuclear Facility Design Options.*

After the presentations, the moderators led a discussion with participants regarding how DOE could benefit from the information presented.

The breakout session continued on Thursday morning with five additional speakers:

- Cindy Caldwell, Senior Technical Advisor, Environment, Safety, and Health Directorate, Pacific Northwest National Laboratory, *Prioritizing and Managing Risk Across the Organization*
- Mark DeNicuolo, Manager, Performance and Analyses, Safety and Technical Training, FAA Air Traffic Organization, *FAA Air Traffic Organization Safety Management*
- Dr. Homayoon Dezfuli, NASA Technical Fellow for System Safety, NASA Office of Safety and Mission Assurance, *Evolution of Risk Management at NASA in the Context of Achieving Adequate Safety*
- Dr. James O'Brien, Director, DOE Office of Nuclear Safety, *DOE's Approach to Nuclear Facility Safety Analysis and Management*
- NRC Commissioner George Apostolakis, *Application of Risk Assessment and Management to Nuclear Safety.*

Over the course of the two days, the Risk Assessment and Management breakout session participants identified the following key points, best practices, additional actions needed, and recommended path forward.

#### Key Points Discussed

- The optimal way to employ PRA is as a comparative analysis tool to support more traditional deterministic methods.
- Do not use PRA exclusively to make safety basis decisions.

- Consider PRA development in the safety design strategy during the Critical Decision-1 phase of a capital project.
- Consider building collapse in a risk assessment, because seismic collapse may be the controlling factor for seismic risk.

#### Best Practices

- The FAA's use of the top five risk areas, which allows organizational focus and alignment on the critical risk areas of greatest importance to the agency.
- NRC's recent efforts to develop an integrated framework for addressing safety risk for all NRC-regulated activities.

#### Additional Actions Needed/Recommended Path Forward

- Establish a central organization to be responsible for risk policy, guidance, and review.
- Consistently address uncertainty values in PRA applications.
- Develop PRAs for DOE Category 2 nuclear facilities.
- Consider developing PRA training programs to disseminate PRA methods and uses.
- Conduct pilots of the PRA process.
- Issue the draft DOE standard on PRA.
- Perform a peer review by the DOE Chief of Nuclear Safety Seismic Panel of the building collapse analysis.
- Develop more in-house capability related to risk analysis to provide the infrastructure to use risk analysis to support nuclear safety improvements.
- Continue research into understanding the relationship between safety goals and adequate protection.

#### **Closing Plenary Presentation**

A panel discussion summarized and discussed the outcomes of the breakout sessions, and DOE Associate Deputy Secretary Mel Williams then closed the workshop by sharing his insights on the importance of leadership and working together as a team.

The Department will continue to partner with its colleagues in the nuclear safety community on ways to strengthen its infrastructure. The workshop outcomes will assist DOE in developing further actions for implementing safety improvements.