

# Public Meeting Summary

## ***Workshop on Probabilistic Flood Hazard Assessment (PFHA)***

The U.S. Nuclear Regulatory Commission's (NRC's) Offices of Nuclear Regulatory Research, Nuclear Reactor Regulation, and New Reactors — in cooperation with Federal agency partners U.S. Department of Energy (DOE), Federal Energy Regulatory Commission, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and U.S. Geological Survey — organized and conducted a ***Workshop on Probabilistic Flood Hazard Assessment*** at the NRC headquarters auditorium, Rockville, Maryland, on January 29–31, 2013. This research workshop provided a venue for the sharing of information on probabilistic flood hazard assessments of extreme natural and human-related events (i.e., annual exceedance probabilities much less than 2.0 E-3 per year) among the Federal community. Technical staff from the National Oceanic and Atmospheric Agency (NOAA) and the Federal Emergency Management Agency (FEMA) also participated in the workshop.

The workshop organizing committee chose the session topics, presenters, and panelists. The committee members were: Thomas Nicholson, Richard Raione and Christopher Cook, NRC, Co-Chairs; John England and Tony Wahl, BoR; Mark Blackburn, DOE; Tony Cheesebrough and Joel Piper, DHS; Siamak Esfandiary, FEMA; Sam Lin and David Lord, FERC; Chandra Pathak, David Margo and Ty Wamsley, USACE; Timothy Cohn and Eric Geist, USGS; Donald Resio, University of North Florida; Joost Beckers, Deltares; Fernando Ferrante, Joe Kanney, Sunil Weerakkody, Jeff Mitman, Nathan Siu and Wendy Reed, NRC.

The workshop objectives were to:

- Assess, discuss, and inform participants on the state-of-the-practice for extreme flood assessments within a risk context with the following objectives.
- Facilitate the sharing of information between both Federal agencies and other interested parties to bridge the current state-of-knowledge between extreme flood assessments and risk assessments of critical infrastructures.
- Seek ideas and insights on possible ways to develop a probabilistic flood hazard assessment (PFHA) for use in probabilistic risk assessment (PRA). Flood assessments include combinations of flood-causing mechanisms associated with riverine flooding, dam and levee safety, extreme storm precipitation, hurricane and storm surges, and tsunamis.
- Identify potential components of flood-causing mechanisms that lend themselves to probabilistic analysis and warrant further study (i.e., computer-generated storm events).
- Establish realistic plans for coordination of PFHA research studies as the follow-up to the workshop observations and insights.
- Develop plans for a cooperative research strategy on PFHA for the workshop partners.

The technical focus was to:

- Understand flood assessment needs of the participating Federal agencies with respect to the evaluation of critical industry infrastructure.
- Leverage the flood hazard risk assessment studies performed to date to assess the applicability and practicality of using probabilistic approaches for extreme flood hazard assessments within a risk framework.
- Discuss research or other activities needed to address identified gaps or challenges in the use of PFHA for extreme flood assessments within PRA.
- Determine how these PFHA approaches and methods can be best used in conjunction with more traditional deterministic approaches.

The workshop was structured around eight topic sessions and a final summary session:

- Panel 1: Federal Agencies' Interests and Needs in PFHA.
- Panel 2: State-of-the-Practice in Identifying and Quantifying Extreme Flood Hazards.
- Panel 3: Extreme Precipitation Events.
- Panel 4: Flood-Induced Dam and Levee Failures.
- Panel 5: Tsunamis Flooding.
- Panel 6: Riverine Flooding.
- Panel 7: Extreme Storm Surge for Coastal Areas.
- Panel 8: Combined Events Flooding.
- Panel 9: Summary of Significant Observations, Insights, and Identified Opportunities for Collaboration on PFHA.

Commissioner George Apostolakis provided the Keynote Address on the "Importance of Risk-Informed, Performance-Based Regulations." A series of technical presentations followed according to the topics listed above for each panel session. At the end of each session, there was a lengthy panel discussion by the presenters and panelists. They responded to a series of specially-prepared questions printed in the Workshop Program, as well as questions from the workshop participants.

The workshop agenda; presentation titles, presenters, abstracts, and biographies of the workshop participants are provided in the final ***Program of the Federal Workshop on Probabilistic Flood Hazard Assessment*** (in ADAMS as document ML13024A242).

Over 256 registrants from Federal agencies (USACE, BoR, USGS, FERC, DOE, FEMA, NOAA, TVA); NRC staff and licensees and their contractors; DOE national laboratories, Nuclear Energy Institute (NEI), Electric Power Research Institute (EPRI) and private industry consultants from the U.S. and foreign countries attended the workshop to share information on flood hazard assessments and to discuss the current state-of-knowledge on extreme flood assessments and risk assessments. Specific observations and insights from those presentations and panel discussions include:

- Risk-informed approaches are being used and are incorporated in safety assessments and decision-making by Federal agencies and international groups.

- It is not a question of deterministic vs. risk assessment because they are complementary processes. PFHA requires probabilities of initiating events.
- An expert elicitation strategy similar to the Senior Seismic Hazard Analysis Committee (SSHAC) approach would help address:
  - paucity of data for characterizing extreme events,
  - formulation of scenarios in hydrometeorologic model simulations, and
  - systematically access uncertainties both epistemic and aleatory.
- Many of the technical challenges to implement PFHA are being met by researchers; however, impediments to applying PFHA include willingness to try, availability of experts, communication, and education.
- PFHA strategies need multidisciplinary teams to:
  - assess complex meteorologic, hydrologic, and geologic data;
  - simulate hydrologic conditions and scenarios; and
  - incorporate risk analyses throughout the assessments.
- Universities and Federal training programs need to focus on courses in statistics, risk, and uncertainty assessments to develop the next generation of hydrologists and risk analysts.

Preliminary recommendations by the NRC staff to the workshop observations and insights include:

- Establish understanding of commonality and differences in risk-informed approaches and decision criteria among the Federal agencies.
- Develop collaborative and coordinated efforts with other Federal agencies, industry, standard bodies, and other stakeholders.
- Consider implementation of Senior Seismic Hazard Analysis Committee type of approaches for selected hazards.
- Provide technical staff support to Advisory Committee on Water Information/Advisory Committee on Water Information/Subcommittee on Hydrology work groups on the PFHA issues.

A workshop proceeding is being developed and will be issued as a NUREG/CP report. The proceedings will provide summaries of the presentations, panel discussions, and major observations and insights.

A public Web page is in development that will contain:

- Final Program of the Federal Workshop on Probabilistic Flood Hazard Assessment (PFHA) (ML13024A242).
- Presentations in pdf format for Panels 1–9.

- Webstreaming archives for all three days of the workshop at: <http://video.nrc.gov/>).

Follow-up activities include organizing and convening a technical session, T9 on “Probabilistic Flood Hazard Assessments for Nuclear Facilities” at the 2013 Regulatory Information Conference (RIC). Information, insights and observations from the PFHA Workshop will be discussed at the RIC T9 session. This session is scheduled for Tuesday, March 12, 2013 at 3:30 p.m. in Salons A-C at the Montgomery County Conference Center adjacent to the White Flint METRO station on Marinelli Road.