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Technical Session Th35

External Flood and Extreme Precipitation Hazard Analysis for Nuclear Plant Safety

Session Chair: **Thomas J. Nicholson***
Coordinator: **Joseph Kanney***

*U.S. NRC, Office of Nuclear Regulatory Research

Session Issues

- Flood Hazard Assessments for design specification of safety-related structures, systems and components (SSC) of nuclear power plants (NPP)
- Historical flooding due to abnormally high streamflow, floodway, lake or coastal water stages at or near a NPP site, as well as estimates of future flooding potential

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Session Issues

- Quantitative evaluation of extreme storm events involving intense precipitation; storm surges; seiches; as well as flooding caused by dam failures, landslides or effects of ice formation in water bodies
- Advances in assessment of intense local precipitation and external flooding, storm-surge modeling at coastal locations, combined effects, development of revised guidance, and recent operational experience

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Speakers & Panelists

Speakers:

Rajiv Prasad, Senior Hydrologist, Pacific Northwest National Laboratory
John England, Senior Hydraulic Engineer, U.S. Bureau of Reclamation
Donald Resio, Senior Research Scientist, U.S. Army Corps of Engineers
Eric de Fraguier, Vice President for Fleet Performance, Electricite de France

Panelists:

Richard Raione, Chief, Hydrologic Engineering, Office of New Reactors, NRC
Geoffrey Bonnin, Chief, Hydrologic Science and Modeling, Nat. Weather Serv.
Timothy Cohn, Senior Hydrologist, U.S. Geological Survey
E. Lewis Link, Senior Research Engineer, University of Maryland
Kit Ng, Assistant Chief Engineer, Bechtel Power Corporation

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Flood Types

Regional Flooding

1993 Mississippi River Flooding at Alton IL
Source: U.S. Geological Survey

Flash Flood

1976 Big Thompson flood
Source: Colorado State University Water Resources Archive

Dam Failure

1976 Teton Dam collapse
Source: U.S. Bureau of Reclamation

Ice Jam Flood

Ice Jam at Montpelier, VT
Source: USACE Cold Regions Research and Engineering Laboratory

Storm Surge

2003 Storm Surge Flooding from Hurricane Isabel St George Island, MD
Source: Maryland Geological Survey

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Significant U.S. Floods: 20th and 21st Centuries

Type	Date	Location	Deaths	Cost*	Remarks
Regional Flood	1913 Mar-Apr	Ohio	467	$143M	Regional Rainstorms
Regional Flood	1993 May-Sept	Miss. River Basin	48	$20B	Regional Rainstorms
Flash Flood	1972 June	Rapid City, SD	237	$160M	15 inch rainfall in 5 hours
Flash Flood	1977 July	Conemaugh River, PA	78	$300M	12 inch rainfall in 6-8 hours
Storm Surge	1900 Sept	Galveston, TX	6000+	Unknown	Hurricane
Storm Surge	2005 Aug	Gulf Coast (MS, LA)	> 1800	> $81B	Hurricane Katrina
Dam Failure	1972 Feb	Buffalo Creek, WV	125	$60M	Dam failure after excessive rainfall
Dam Failure	1976 June	Teton River, ID	11	$400M	Earthen dam breached

* uninflated costs

Sources: USGS Fact Sheet 024-00 (Perry, 2000); NOAA Technical Report 2005-01

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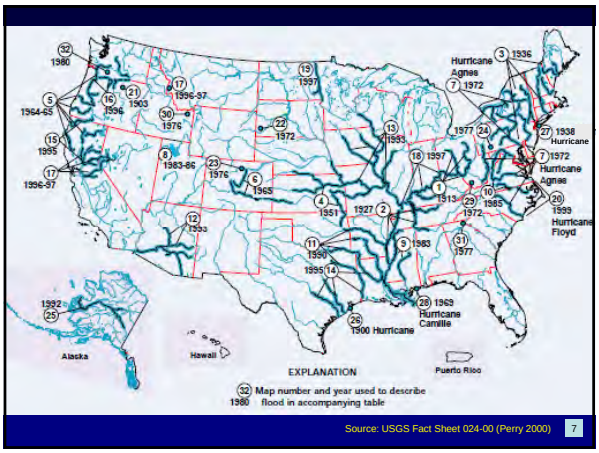

Source: USGS Fact Sheet 024-00 (Perry 2000)

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Probable Maximum Precipitation (PMP)

PMP is

- the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain of year (AMS 1959)
- the steps followed by meteorologists in arriving at answers supplied to engineers for hydrological design purposes (WMO, 1973)
- Due to considerable limited knowledge of complicated processes and interrelationships in storms, PMP values are identified as estimates

from Hydrometeorological Report (HMR) 51, Schreiner and Riedel, June 1978

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Current Generalized PMP HMRs*

from NOAA National Weather Service at http://mi.nws.noaa.gov/oh/hdsc/studies/pmp.html

* HydroMeteorological Report

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Research Recommendations*

- Update HMRs for the entire U.S. to include storm events since their last update or development
- Utilize, support (such as CoCoRaHS+), and where necessary develop data-collection surveys in combination with radar (especially for mountainous and desert regions) for extreme storm events
- Examine new extreme storm methods (e.g. mesoscale models; individual storms; transposition; and moisture maximization) to test PMP assumptions and to improve temporal-spatial PMP estimates

* Federal Advisory Committee on Water Information (ACWI), Subcommittee on Hydrology (SOH), Work Group on Extreme Storms, February 2010
+ Community Collaborative Rain, Hail & Snow Network

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Research Recommendations*

- Investigate effects of climate variability and potential impacts of accelerated climate change on extreme precipitation magnitude and frequency
- Develop a national database of extreme storm events related to flooding
- Assist the States in development of regional and local PMP estimates for use in Dam Safety and Flood Analysis studies

* Federal Advisory Committee on Water Information (ACWI), Subcommittee on Hydrology (SOH), Work Group on Extreme Storms, February 2010

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References

- Perry, C., ***Significant Floods in the United States During the 20th Century***, USGS Fact Sheet 024–00, U.S. Geological Survey, Reston, VA, March 2000 http://pubs.er.usgs.gov/usgspubs/fs/fs02400
- Graumann, A. and others, ***Hurricane Katrina: A Climatological Perspective***, NOAA Technical Report 2005-01, NOAA's National Climatic Data Center, Asheville, NC October 2005 (updated August 2006) http://www.ncdc.noaa.gov/oa/reports/tech-report-200501z.pdf
- Schreiner, L. and J. Riedel, ***HydroMeteorological Report No. 51, Probable Maximum Precipitation Estimates, United States, East of the 105th Meridan***, Hydrometeorological Branch, Office of Hydrology, National Weather Service, Washington, DC, June 1978 http://mi.nws.noaa.gov/oh/hdsc/PMP_documents/HMR51.pdf

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