



Insights from NRC's Post-Fukushima Flood-Hazard Reviews

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Agenda

- Overall Status of Hazard Reviews
- Evolution of Evaluating Flooding Hazards for Nuclear Power Plants
- Context and Insights from Longer Data Periods
- Dam Failure Analysis Challenges
- Summary

Overall Status

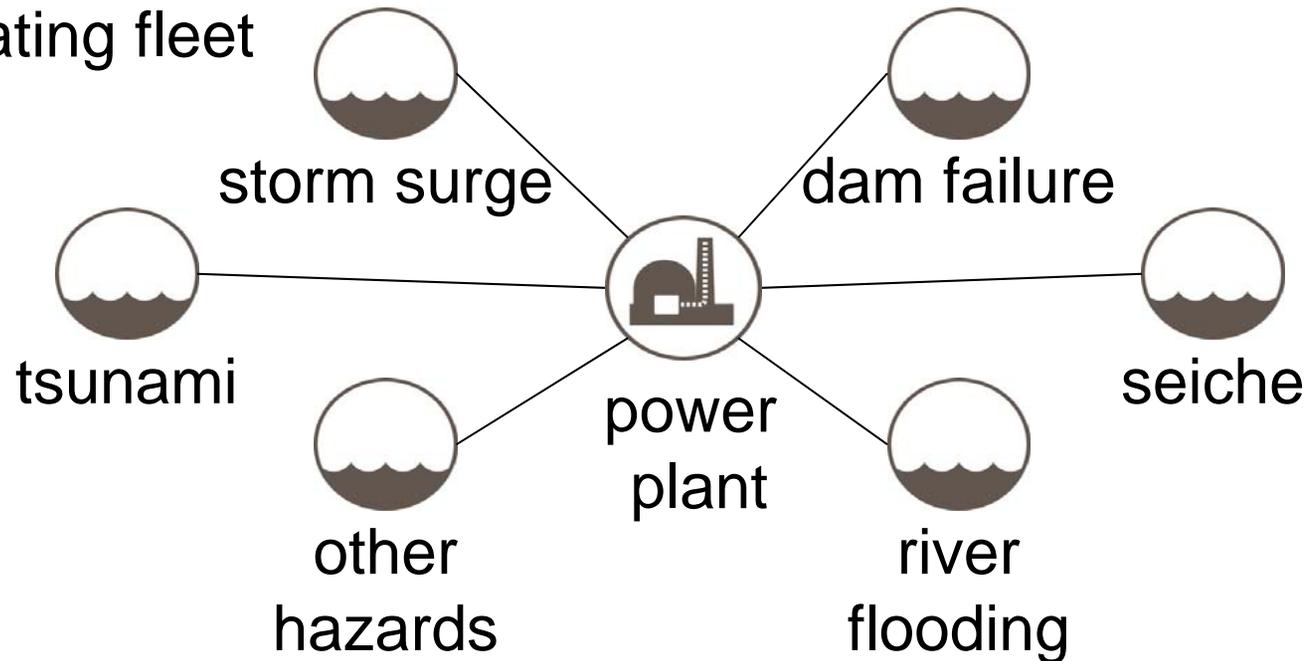
- 32 Flood Hazard Reevaluation Reports (FHRRs) submitted to date by licensees
- Category 1 sites (most submitted March 2013)
 - 18 FHRRs submitted to NRC
 - 11 sites completed the technical review stage
 - 5 reviews in the RAI stage
 - 1 review deferred; plant ceasing operations
 - 1 review extended; associated with USACE review
- Category 2 sites (submitted March 2014)
 - 14 FHRRs submitted to NRC
 - All reviews in the RAI stage

Overall Status

- **Category 2 sites not submitted**
 - 9 extended; licensee requested USACE assistance evaluating potential flooding due to upstream dam failure(s)
- **Category 3 & Remaining Extended sites**
 - 20 original sites (ML12097A509) due March 2015
 - 2 requested extension from Category 1 to March 2015
 - 2 requested extension from Category 2 to March 2015

Evolution of Design Basis Flooding Hazards

- Hazard mechanisms considered today have not changed from those considered when licensing the operating fleet



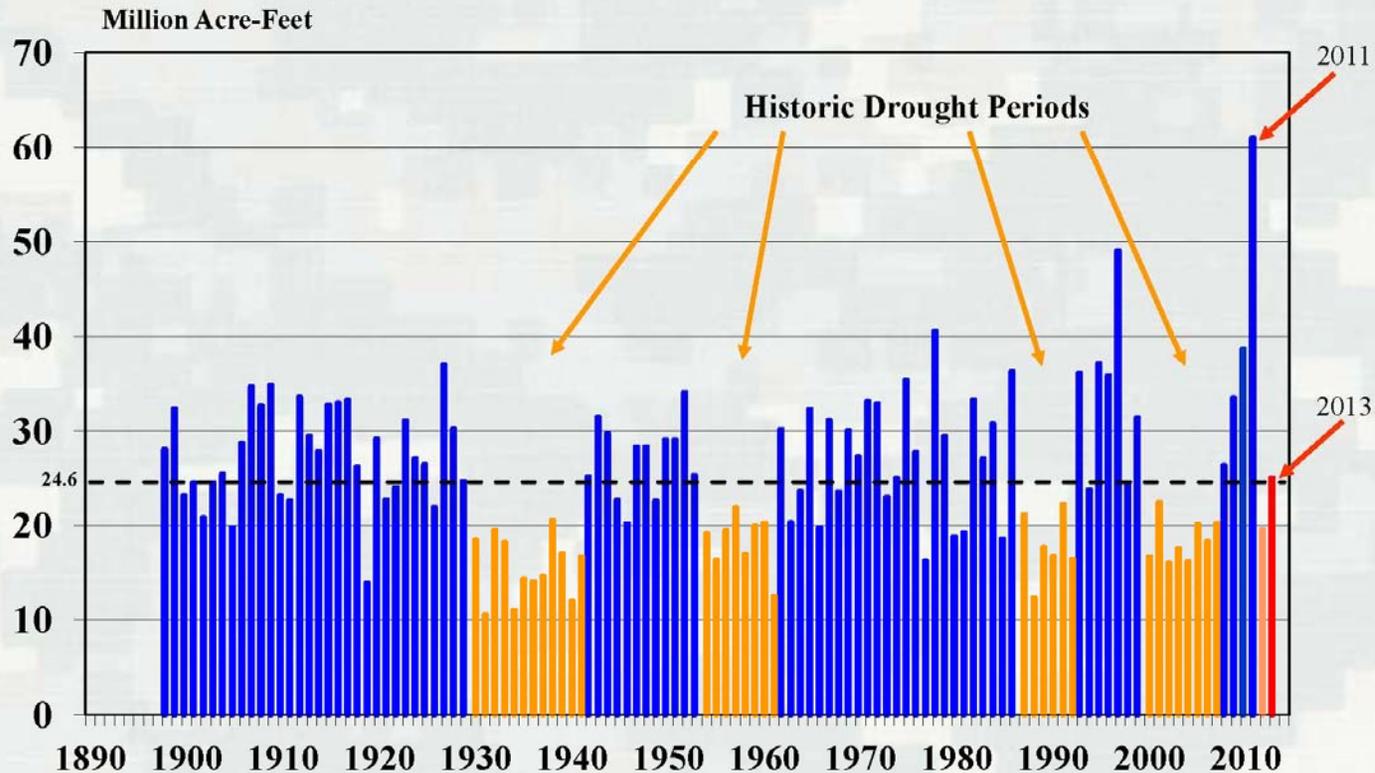
- Regulations and guidance have not significantly changed in flooding area for decades

Evolution of Design Basis Flooding Hazards (cont.)

- What has changed?
 - Increased data record
 - Understanding of flooding hazards
 - Advancements in scientific knowledge and analytical tools

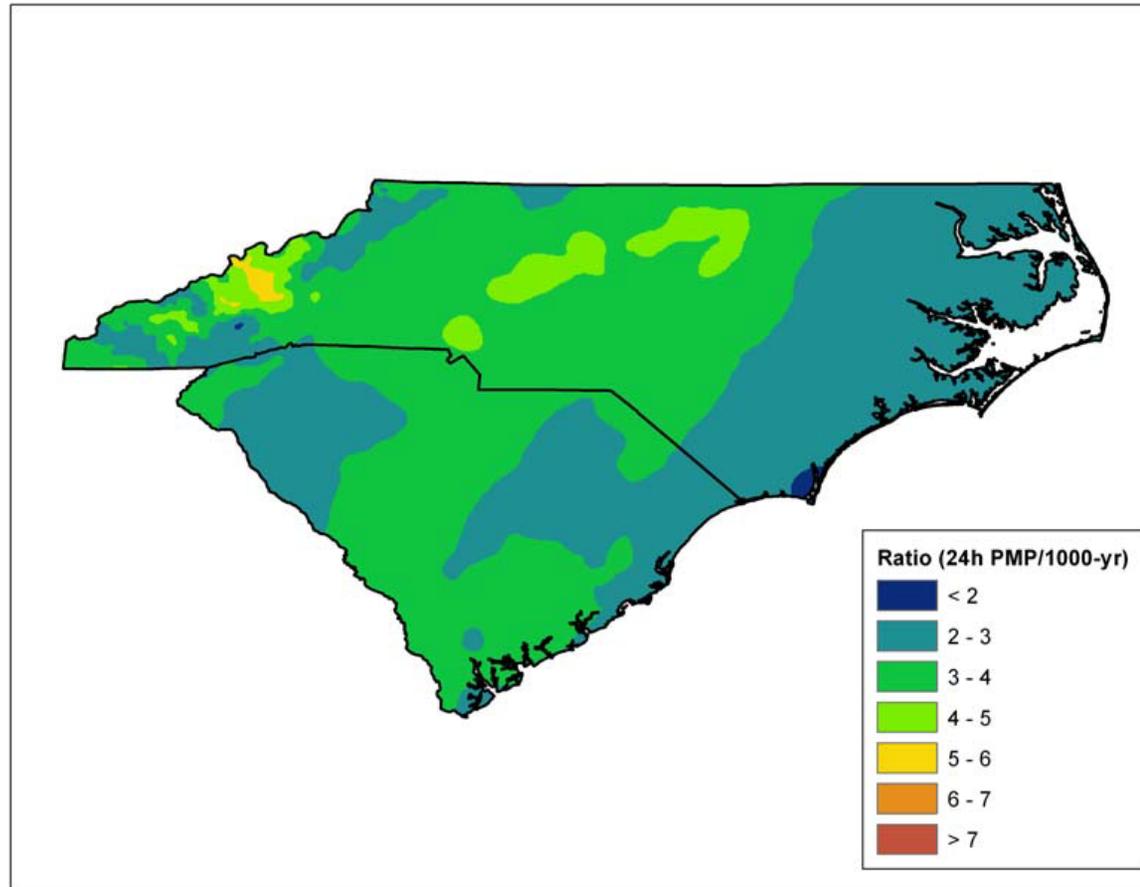
Increased Data Record

Missouri River Mainstem System Annual Runoff above Sioux City, IA



Increased Context of “Rare Events”

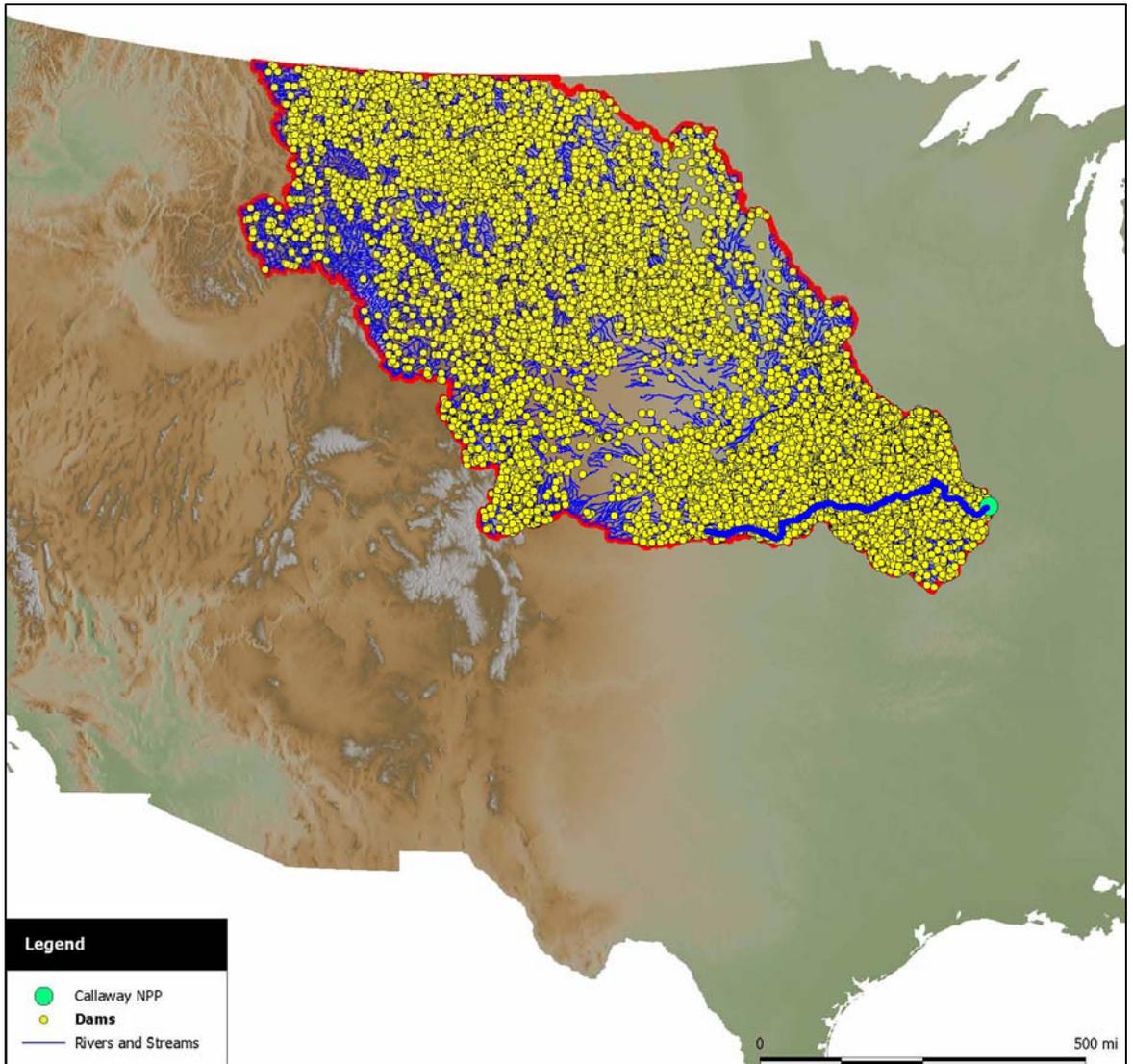
**Ratios of the 24-hour, 10 mi² PMP from HMR-51 and
NOAA-14, 24-hour, 1000-yr precipitation**



Source: US Bureau of Reclamation, December 2011, “Synthesis of Extreme Storm Rainfall and Probable Maximum Precipitation in the Southeastern U.S. Pilot Region”

Example Challenges Associated with Dam Analysis

- Screening of small or distant dams (see figure)
- Potential failure mode analysis (PFMA) of dams.
- Licensee access to detailed data on dam construction and maintenance.
- Coordination of reviews with other federal agencies.



Summary

- NRC's systematic review of all flooding hazards provides a unique fleet-wide context
- Site flooding reviews developed in the 1960's and 1970's are being reevaluated using present-day methodologies:
 - 1960/1970s: slide rule, distant dam failure routing impossible, HMR-33
 - 2010s: HMR-51/52, computer models (some 2-d at site), addt'l data
- Future review challenges exist, including:
 - Review of site-specific PMPs
 - Use of multiple 'industry standard' numerical models
 - Use of probabilistic techniques for NPPs
 - Inability to compare analysis 'conservatism' from site to site
- Hazard Reviews will continue into 2016
- Following completion of post-Fukushima activities, NRC will develop summary documents comparing the outcomes and lessons-learned.

Disclaimer

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