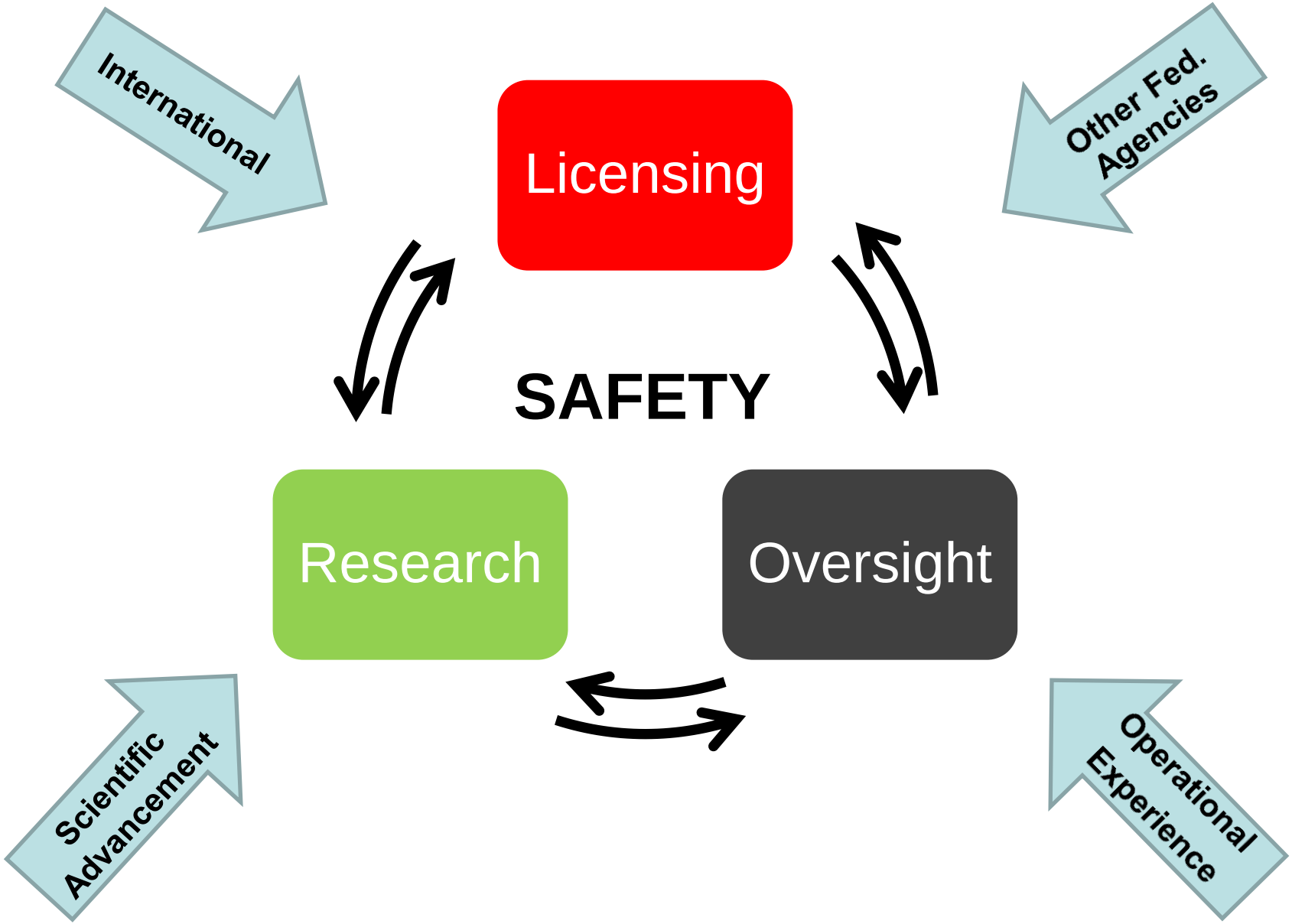
U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

FLOODING AND OTHER EXTREME WEATHER EVENTS

January 6, 2014


International
Other Fed. Agencies
Licensing
SAFETY
Research
Oversight
Scientific Advancement
Operational Experience

Flooding and Severe Storms Lessons Learned

George Wilson, Flooding Lead
Japan Lessons Learned Directorate
Office of Nuclear Reactor Regulation

Overview

- Reactor Oversight Process
- Impacts of Plant Findings and Events
  - Oconee
  - Fort Calhoun
  - Watts Bar
  - Oyster Creek
  - Fukushima

Reactor Oversight

- Specific inspection activities for adverse weather and flooding
- Inspectors have identified flooding and severe weather issues
- Feedback into regulatory process

Oconee

Inadequate maintenance procedure led to developing Generic Issue 204, “Upstream Dam Failures”

Fort Calhoun

Inadequate flood strategy provided insights for Near-Term Task Force (NTTF) Recommendation 2.3, “Flooding Walkdown,” guidance

Watts Bar

Inspection findings at other sites resulted in greater focus on reasonable simulations at Watts Bar Nuclear Plant

Oyster Creek

Effective contingency planning at Oyster Creek supported the site's response to when Superstorm Sandy exceeded forecasts

Fukushima

Importance of continued vigilance to ensure flood protection measures are adequate and maintained

Evolution of Flooding Hazards

Christopher Cook, Chief
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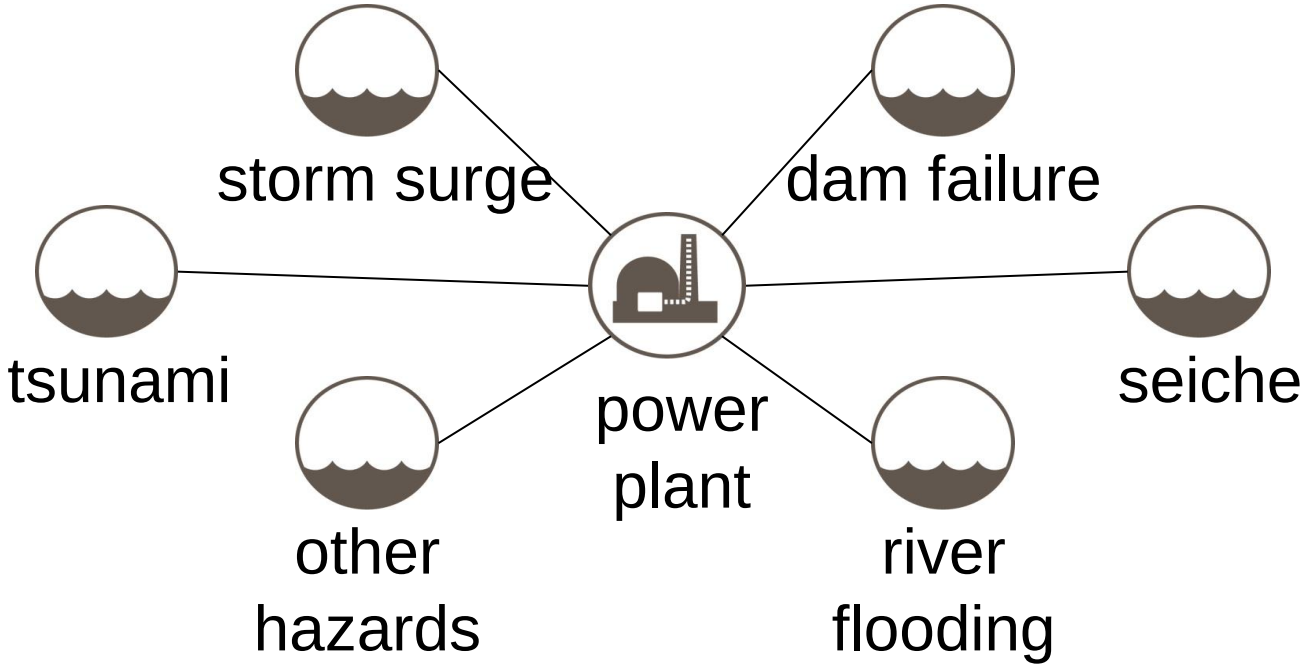
Overview

- Evolution of Design Basis Flooding Hazards
- Post-Licensing External Hazard Reevaluations
- Present-Day Methods
- Motivation for New Guidance
- Continuing Evolution

Evolution of Design Basis Flooding Hazards

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



Evolution of Design Basis Flooding Hazards (cont.)

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

Post-Licensing
External Hazard Reevaluations

- Past and present external hazard reevaluations:
  - Systematic Evaluation Program (1977)
  - Individual Plant Evaluation for External Events (1991)
  - NTTF Recommendation 2.1 (2012)

Present-Day Methods for Estimating Design Basis Flooding Hazards

- Based on the historical record for the site and region
- Includes changes to the baseline data (climate change, construction of dams, etc.)
- Predominantly deterministic
- Hybrid deterministic-probabilistic approaches have been submitted for some hazards

Motivation for New Guidance

- Flooding Hazards due to Dam Failure
  - Regulatory reviews demonstrated the need to update and supplement guidance
- Flooding from Tsunami, Storm Surge, or Seiche
  - Incorporate lessons-learned from new reactor reviews and NRC research programs
- Integrated Assessment for Flooding
  - Evaluate total plant response (protection and mitigation) to the reevaluated flooding hazard

Continuing Evolution

- Evolving understanding of flooding hazards
  - Increasing data records
  - Improving scientific knowledge and analytical tools
- Development of probabilistic methods
- Periodic updates of flood hazard evaluations
  - NTTF Recommendation 2.2

Research Activities

William Ott, Chief
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Office of Nuclear Regulatory Research

Overview

- Regulatory guidance and supporting technical bases
- Probabilistic flood hazard assessment (PFHA)
- Considering Climate Change
- Conclusion

Updating Regulatory Guidance

- Regulatory Guide 1.59 “Design Basis Floods for Nuclear Power Plants”
  - Issue: Substantial improvement in technology (storm data, computational resources, models)
  - Five published technical reports
  - Draft regulatory guide nearing release

Updating Regulatory Guidance (cont.)

- Regulatory Guide 1.102 “Flood Protection for Nuclear Power Plants”
  - Issue: Lessons learned from domestic and international experience
  - Technical basis project – final report under review
  - Draft revision to regulatory guide under development

Research to Improve Analyses

- Transition from deterministic to more risk-informed framework
  - Probabilistic evaluation of riverine flooding
  - Extension of Probable Maximum Precipitation studies to include transposition and orographic features
  - Use of paleoflood data to inform flooding risks at nuclear power plants
  - Evaluation of dam-breach scenarios
  - PFHA workshop – January 29-31, 2013

Probabilistic Flood Hazard Assessment Research Program Plan

- Outgrowth of (1) new reactor reviews, (2) reactor oversight program needs, (3) PFHA workshop
- Technical Advisory Group on Flooding
- Draft plan developed and under review
- Includes collaboration with domestic and international experts

Considering Climate Change

- Monitor scientific progress
- General guidance in the revision to Regulatory Guide 1.59
  - Site specific estimates based on federal projections from climate models
  - Projections for the life of the plant
- Changes in variability of Great Lakes water levels

Summary

- Substantial work has been completed to support state-of-the-art regulatory guidance
- New research is directed at providing critical information for probabilistic analyses
- A research program plan will guide future activities
- Advances in climate change science will be monitored and given appropriate consideration

Conclusion

- Safety is a continual process
- Our understanding and knowledge continues to evolve
- Lessons learned will be incorporated into the reactor oversight process