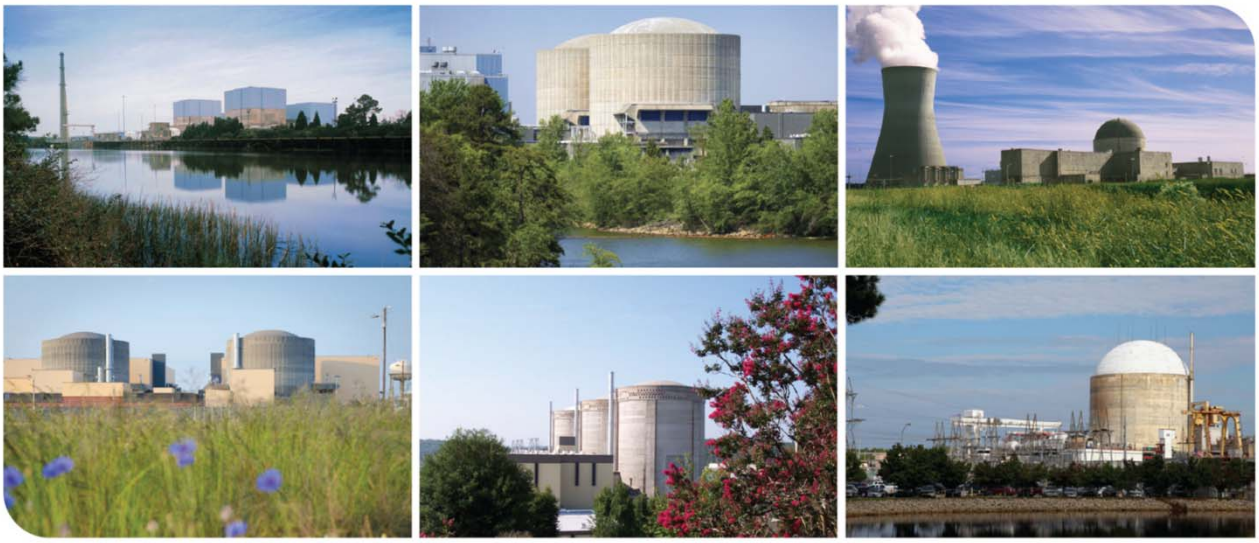

Application and Development of External Hazard Risk Models

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Topics

- Status of Duke Energy External Hazard PRA models
- Applications of External Hazard Risk Models
- Challenges in Development of External Hazards
- Going Forward

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Status of Duke Energy External Hazard Risk Models

- All six Duke Energy nuclear sites have developed risk models for one or more external hazards
  - Fire (all Duke Energy plants to meet NFPA 805 requirements)
  - Seismic (limited to those required to met Fukushima NTTF 2.1 order)
  - High Wind (all Duke Energy plants have or in development)
  - External Flooding (currently limited to coastal flooding only)
- All have been Peer Reviewed against ANS/ASME PRA Standard or associated Seismic Code Case
  - Some Peer Review Facts and Observations remain to be resolved

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Applications of External Hazard Risk Models

Fire hazard PRA

- Used most every risk informed application
  - NFPA 805 program requirements
  - Risk Informed License Amendment Requests
  - NRC and Licensee interactions
- Contains known conservatisms
  - Over states risk significance of fires
  - Newer information improves the fire risk realism
  - Model simplifications to limit cost and complexity
  - Fire Model technical methods are by nature conservative
- Use of the fire models identifies areas to reduce conservatism

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Applications of External Hazard Risk Models

Seismic hazard PRA

- Seismic hazard PRA current applications
  - Meet requirements of Fukushima Near Term Task Force 2.1 requirements
  - Provided insights into plant specific features where a known plant vulnerability was not fully understood (some due to significant improvement in computer capabilities) and resulting in potential plant modifications
- Seismic hazard PRA future applications planned
  - Support risk categorization under 50.69, Special Treatment
    - Allows additional SSC components to be low risk in 50.69 screening
  - Risk Informed Technical Specification Completion Time (TSTF 505)
    - The generic seismic risk penalty unnecessary large

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Applications of External Hazard Risk Models

High Wind PRA

- Identifies plant features not previously credited for protection in design analysis
- Use for 50.69 risk evaluation for those sites, where the High Wind hazard does not screen out per PRA Standard
- Significance Determination Process risk evaluation, especially Diesel Generators.
  - Can provide better risk insights than using generic data
- License Amendment requests to change the licensing basis
  - Supports increase in allowed Tech Spec Completion Time for some plant systems
  - Changes in specific design basis requirement
  - Supported Tornado Missile Risk Evaluation (TMRE) pilot process
- Supports either elimination of costly modifications or reduction in modification scope needed to provide adequate level of protection for some vulnerable plant design features

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Applications of External Hazard Risk Models

External Flooding PRA

- Allow risk informing inspection process of plant flooding prevention features
  - Penetrations
  - Doors
- Use for 50.69 risk evaluation for those sites, where the External Flooding hazard does not screen out per PRA Standard
- Requires the development of a return frequency and hazard curve for beyond design basis events
- Significance Determination Process risk evaluation,
  - Can provide better risk insights than using generic data
- Some sites with unique situations for external flooding, need a method to properly evaluate the risk contribution
  - PRA model provides an standard method
- Fukushima evaluation too extreme to provide meaningful risk insights
  - Does not determine frequency or occurrence or generate a hazard curve

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Lessons Learned

- External Hazard PRA models are expensive and may not pass a cost benefit without additional drivers
  - Regulatory or design issues
- Hazard curves are difficult to develop with large bias towards conservatism
  - The extreme end (200 mph straight line wind, Cat 4/5 Tornado, Seismic events 0.5g or greater)
- High Wind PRA refinement in the hazard interval need to have more bins at the lower winds speeds (<110 mph)
- Seismic PRA may benefit for more refinement in hazard interval at the lower accelerations
- External Flooding hazards look a lot like cliff edge hazard curve
  - No to little impact till water overcomes barriers
- HRAs for External Flooding needs to account for the significant time available to prepare for the water level
  - High confidence of preparation
  - Significant recovery time and oversight of preparations

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Going Forward

Fire PRAs

- Tracking the Aluminum in Electrical System issue for overly conservative assumptions on actual plant impact

Other Hazards

- ANS/ASME PRA Standard requirements drives cost of external hazard models
- Apply lessons learned and revise PRA standard to reduce complexity and costs of external hazard models.
- Improve the base of knowledge and skills needed to screen hazards appropriately

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Questions?

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