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Protecting People and the Environment

Perspectives on Regulation of Severe Accident Mitigation

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Outline of Presentation

- Motivation
- History
- Pertinent Issues
  - Responding to the unknown
  - Technical basis
  - Periodic exercise
  - Training needs
  - Regulatory footprint
- Summary

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Motivation

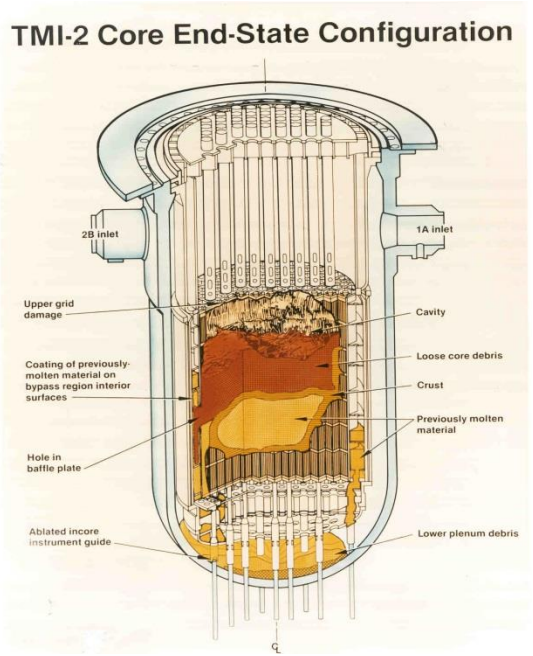
The impact of the tsunami was totally bigger than what we expected, trained, prepared for, or believed was possible—it was unimaginable. We must always be prepared for the possibility that something much bigger can happen.

Ikuo Izawa, Shift Manager Fukushima Dai-ichi Units 1 and 2

We need to be **prepared** for the **unexpected**. How do we do it?

Historical View

- 1979 Three Mile Island accident demonstrated the importance of operator actions in both contributing to accidents and also recovery
- Severe accident research programs and analytical tool development
- April 26, 1986 Chernobyl
- Symptom based SAMGs in 90's
- Attacks of September 11, 2001
  - New accident scenario
  - Use of portable equipment
- Fukushima on March 11, 2011
  - Emphasized the risk of external events
  - Highlighted the importance of site wide risk
  - Daiini actions prevented core damage

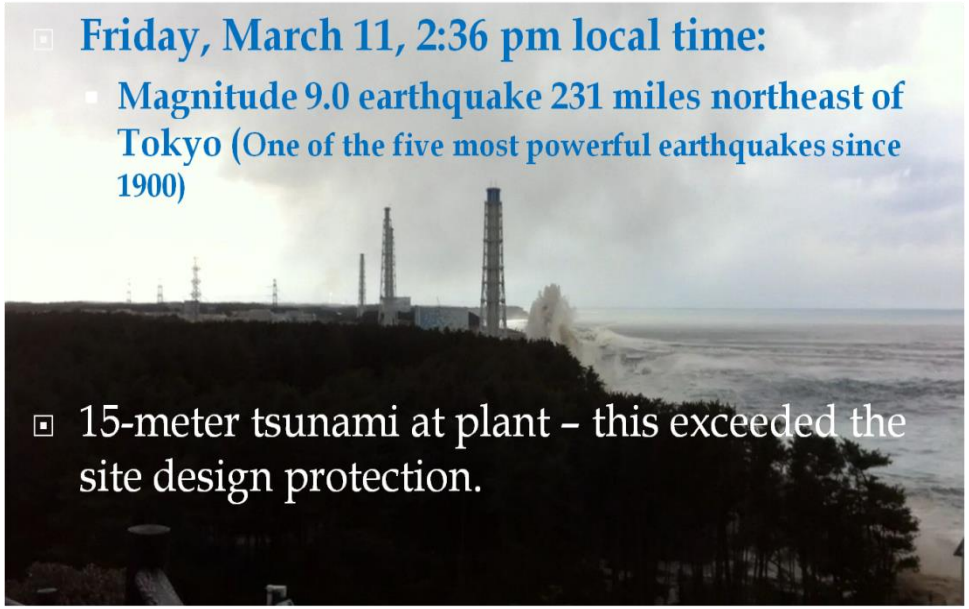


Responding to the Unknown

PRAs have mainly focused on internal events.

External events tend to dominate risk in part due to large uncertainties.

External events are highly site specific which limits the benefit of operating experience.



SAMGs should be symptom based and provide operators with the flexibility to respond to a wide variety of possible scenarios.

Plants should have readily deployable offsite assets.

Daini demonstrated the value of portable equipment and flexible strategies.

Training and Exercise

- Manual actions introduce failure modes that must be minimized by training and exercise.
- Implementation of SAMGs involves technical decision-making. Reliable communications are necessary.
- Operator actions need to consider the possible environmental factors, including radiation levels.
- Training and exercise should not be done at the expense of more probable events.

Plans are nothing. Planning is everything

President Eisenhower

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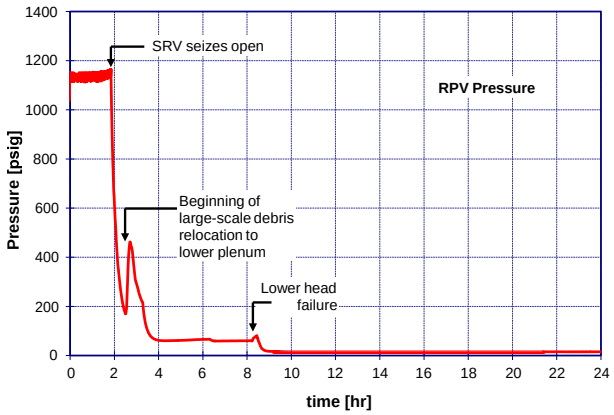
Technical Basis

Severe accident behavior is complex and validated analytical tools are of use in devising SAMGs.



Due to uncertainties in the tools as well as the plant conditions, symptom rather than scenario based SAMGs are preferred.

Best-estimate calculations can provide more accurate timelines which may allow more effective measures. There may be more time than older analyses would have indicated.
NUREG 1935, "State-of-the-Art Reactor Consequence Analysis."

SAMG decision-makers need strong technical and leadership skills.

Regulatory Footprint

- US Experience
  - SAMGs implemented by voluntary measures
  - Inspections showed inconsistent implementation
  - Currently pursuing rulemaking
- Several issues should be considered in any requirements
  - Technical Basis
  - Training and Exercise
  - Communications, staffing and roles and responsibilities
  - Availability of equipment
  - Multi-unit specific issues
- SAMGs require adequate communication, equipment, personnel and communication to be successful.

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Summary

- SAMGs can help us respond to the unexpected
- Uncertainties in external events will always be present
- SAMGs should be based on a firm technical basis using state-of-the-art analytical tools
- SAMGs should be flexible and not scenario based
- Offsite support can help address uncertainties
- Training and exercise is vital
- SAMGs should have a regulatory footprint