“Use of Seismic PRAs to Resolve the Post-Fukushima Safety Issues”

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Introduction

- **After Fukushima, what motivated the world-wide reevaluation of the seismic adequacy of the NPPs ?**

Fundamentally,
(i) the public was worried,
(ii) the regulatory agencies were worried,
and (iii) the plant owners were worried.

Worried about what?

- **Worried that a large earthquake could cause a major NPP accident.**
- **Worried more generally about other external hazards too.**
- **Worried about the spent-fuel pools too.**

What was the world-wide response?

- **U.S. -- a major reevaluation program**
- **E.U. – the “stress test” evaluations**
- **Japan – plants were shut down, and an extensive evaluation began**
- **Other countries – mostly followed the U.S. or the E.U. lead**

But the response has differed technically !

- **U.S. – a major reevaluation and upgrade program**
  - **extensive seismic hazard work, walkdowns, full seismic PRAs for only some plants**
  - **the FLEX program (loss of offsite power, ultimate heat-sink)**
- **E.U. – the "stress test" evaluations**
  - **extensive evaluation of seismic "margins," not PRA-based**
- **Japan – plants were shut down, and an extensive seismic evaluation has begun**
  - **extensive reviews of seismic hazard, seismic design basis, not PRA-based**
  - **planning seismic PRAs soon**

Use of Seismic PRAs

Worldwide: Recognition of the value of seismic PRAs *among some decision-makers*

- **Probabilistic seismic hazard:**
  how frequently? how "big"?
- **Emphasis on specific accident sequences**
- **Special roles of offsite power and ultimate heat-sink**
- **Roles of individual SSCs (structures and equipment)**
- **Role of an intact containment**
- **Role of offsite emergency response**

Major benefit is the use of SPRAs by decision-makers (managers, regulators, the public).

A major benefit is the use of SPRAs by decision-makers. Why?

- **Decision-makers can understand the use of quantified decision criteria**:
  - **CDF $\leq$ 10^{-5}/year (for example)**
  - **LERF $\leq$ 10^{-6}/year**
  - **PRA results point to where improvements are feasible, and how much benefit can be gained.**

- **So why do decision-makers balk?**
  - **(i) Seismic PRAs are expensive.**
  - **(ii) In most countries, earthquakes are very rare.**
  - **(iii) The uncertainties are inevitably large, and coping with large uncertainties is complicated.**

European Stress Tests

- **The E.U. seismic reviews explicitly did not require seismic PRAs.**
- **Instead, NPPs were asked to identify something like a "seismic margin" above the design basis**
- **It turns out that the best way to identify these "margins" uses PRA-type concepts, such as**
  - **individual accident sequences**
  - **HCLPF capacities**
  - **roles of individual SSCs.**
- **Most E.U. NPPs do not now have full seismic PRAs.**

"Use of Seismic PRAs to Resolve the Post-Fukushima Safety Issues"

- **The above is the TITLE of this talk.**

- **Are Seismic PRAs being used?**
  - **Yes and No!**
  - **U.S.: Yes (in part)**
  - **E.U.: Only in a supporting role**
  - **Japan: Not yet**
  - **Other countries: Some yes, some no**

- **Is their use coming soon?**
  - **Yes and No!**
  - **U.S.: Perhaps more widespread (in a few years)**
  - **E.U.: Use of SPRA being urged in the 10-year periodic reviews**
  - **Japan: They say that SPRAs will be performed everywhere soon.**