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Protecting People and the Environment

RIC 2011
RISK AND DEFENSE-IN-DEPTH FOR
EVALUATING CONTAINMENT ACCIDENT
PRESSURE FOR NET POSITIVE SUCTION HEAD

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Presentation Topics

- Defense-in-Depth Philosophy
- Use of Risk in Licensing Actions
  - Operating Reactors
  - New Reactors
- Relationship to Containment
  Accident Pressure (CAP)

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Defense-in-Depth Philosophy

Defense-in-depth – a design and operational philosophy with regard to nuclear facilities that calls for multiple layers of protection to prevent and mitigate accidents. It includes the use of controls, multiple physical barriers to prevent release of radiation, redundant and diverse key safety functions, and emergency response measures.

Source: NRC Website "Glossary"

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Defense-in-Depth in the Regulations

- NRC regulations collectively implement the defense-in-depth (DID) philosophy
- However, DID is explicitly mentioned in only a few places in Part 50, e.g.:
  - 10 CFR 50.69, risk-informed categorization of SSCs
  - Fire protection (Appendix R; NFPA 805)

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Defense-in-Depth Elements

- Reasonable balance: prevention of core damage, prevention of containment failure, & consequence mitigation
- Avoid over-reliance on programmatic activities
- System redundancy, independence, and diversity
  - commensurate with the expected frequency, consequences of challenges to the system, and uncertainties
- Preserve defenses against common cause failures
- Do not degrade independence of barriers
- Preserve defense against human errors
- Maintain intent of the General Design Criteria

Source: RG 1.174

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Use of Risk in Licensing Actions

- For currently operating reactors, there is no requirement to have or use a PRA
  - risk-informed applications are *voluntary*
- New reactors licensed under 10 CFR Part 52 are required to have a plant-specific PRA

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Non-Risk-Informed Licensing Actions

- When regulations are complied with, there is a presumption of adequate protection of public health and safety
- However, "special circumstances" may arise
  - New information reveals an unforeseen hazard or a substantially greater potential for a known hazard to occur
- NRC has the statutory authority to require licensee action above and beyond existing regulations to maintain the level of protection necessary to avoid undue risk to public health and safety

Ref: SRP 19.2, Appendix D, "Use of Risk Information in Review of Non-Risk-Informed License Amendment Requests

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Meets deterministic requirements

Special circumstance? — N → Application acceptable

Inform licensee & management of risk concern

Management agrees? — N → Application acceptable

Request & review risk information

RG 1.174 not met? — N → Application acceptable

Assess in depth (adequate protection question)

No adequate protection?

Reject application on the basis of adequate protection

"Special circumstances" may exist if:

1. The situation was not identified or addressed in development of regulations, and could be important enough to warrant a new regulation if encountered on a widespread basis.

2. The reviewer has knowledge that the risk impact is not reflected by the licensing basis analysis, and has reason to believe that the risk increase would warrant denial if the request were evaluated as a risk-informed application.

SRP 19.2, App.

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Risk & Defense-in-Depth in re CAP

- License applications that use CAP credit:
  - Are often not risk-informed (e.g., EPU)
  - Comply with existing regulations
- NRC staff has not identified "special circumstances" that could rebut the presumption of adequate protection of public health and safety
- No basis to require risk information

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CAP and Risk

- NRC Office of Nuclear Regulatory Research performed generic risk assessment of CAP
  - BWR/3 with a Mark I containment
  - Large LOCA (only case where loss of containment integrity led directly to core damage)
  - Leakage non-detection interval of 1 month assumed (bounding for inerted containment
  - Risk dominated by pre-initiator failures of containment)
- Increase in CDF due to CAP was "very small"

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Conclusion

- NRC regulations as a whole implement the defense-in-depth philosophy
- CAP credit is not discussed within NRC regulations
- CAP does increase the dependency between containment and fuel cladding
- A generic BWR risk assessment concluded that CAP risk is "very small"
- NRC staff has not identified "special circumstances" related to use of CAP

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