

Teaching Notes

Operational Reactor Safety Course

Lecture: 9 – Safety Systems and Functions

Objective:

To review the fundamentals of nuclear reactor safety and what goes into a safety analysis. Design basis accidents are reviewed as are the safety systems needed to mitigate accidents. Introduce the concept of defense in depth and the role of containment in the overall strategy of protection of the public. Follow Knief Chapter 13.

Key Points to Bring Out:

<u>Slide number</u>	<u>Points</u>
3	Be sure students understand the difference between prevention, protection and mitigation and concept of defense in depth which is the foundation of safety.
4-5	Establish the source of energy that need to be managed with the safety mission of heat removal to avoid, if possible, fuel failure and releases. Last mitigating measure is offsite emergency response.
15	Explain what a design basis accident is and how they are meant to assure that the plant is safe. General categories that are intended to cover most events that might be expected to occur during the life of the plant.
16	Point out the possible energetic reactions that need to be considered in design to address possible consequences - focus on Hydrogen and zirconium reactions for water reactors.
17	Review the complete schematic of at PWR identifying key components in the power cycle - point out difference in primary and secondary side. Explain the function of each component and system.
18	Review specific design basis accidents asking students what might

happen in the event in terms of what will happen with reactivity, cooling core, core temperature, pressure. Explain that these analyses are required by the NRC to be deterministically analyzed under specific conditions which are specified. (such as Appendix K for LOCA).

- 10 Point out engineered safety features - explain functions of containment spray, accumulator, high and low pressure safety injection and source of water for ECCS functions including sump recirculation.
- 11-12 Review Beyond Design Basis Accidents types including core melt scenarios and the availability of fission products for release in core melt accidents which is why they need to be avoided.
- 13 Go over the details of what happens in the event of a loss of coolant accident in terms of how one might get a release from containment upon failure of the emergency safeguards systems.
- 14-15 Go over the graphic of engineered safety systems followed by the slide showing what they are in a PWR.
- 16-17 The role of the Containment should be described here with the potential consequences of loss of containment sprays in PWRs on containment integrity due to overpressure.
- 18-20 Review engineered safety features for BWRs noting a different design for core and containment sprays. ECCS water goes directly into the vessel at the top of the core. LOCA blow down goes into inerted water suppression pools with heat removal systems needed to remove heat from the suppression pool. Other slides show more advanced BWR systems using same concept.
- 21 Containment leakage and what is actually released in the event of an accidents should be discussed here.

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