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SMR-300 Fire Protection Program Status

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Meeting Agenda

- Introductions
- Purpose & Outcome
- Overview of Fire Protection Program and associated PSAR content
- Discussion on planned deviations from RG 1.189
- Open Forum

SMR-300 Fire Protection Program Development

- Ongoing efforts include the development of:
  - Fire PSA and supporting analyses (e.g. fire modeling, HRA)
  - Fire Safe-Shutdown Analysis
  - PSAR Chapter 9 Fire Protection Section
  - Fire Hazards Analysis (PSAR Appendix 9A)
  - Loss of Large Area analysis (LOLA)
  - Aircraft Impact Analysis (AIA)

Fire Protection Program Development (cont'd)

- FPP PSAR is under development
  - Format and content follows SRP Section 9.5.1.1
  - Defines all credited Codes and Standards
  - Includes integration of applicable guidance of NFPA 804
- Updating to dual-unit SMR-300 design
  - Fundamental design concepts are consistent with SMR-160
  - Most analysis is completed in draft form for SMR-160
  - Analysis will be updated to reflect uprated design

SMR-300 Fire Protection Program Formulation

- SRP Section 9.5.1.2 – Risk-informed FPP
  - SMR-300 FPP will be deterministic-based
  - Fire PRA will be performed
  - PRA risk insights inform plant design

Construction Permit Application Content

- Follow-up from February 2023 meeting
  - ✔ Reviewed RG 1.189 and the SRP
- Intend to provide
  - ✔ Description of physical equipment
  - ✔ Description of planned operational program
- Operational program will not be established until a date closer to receipt of fuel onsite

Implementation of RG 1.189 Guidance

- Notable insights to the SMR-300 design:
- Fire Hazards and Fire Safe-Shutdown analyses being developed proactively at the current design stage
  - ✔ Resultant insights used to inform the design
    - Resolution of all NEI 00-01 R4 PWROG MSO scenarios as an integral element of equipment selection, control and power circuit design, and cable routing design
- Early performance of the requisite LOLA and AIA analyses
  - ✔ Inform civil-structural design and electrical and mechanical equipment layout

Implementation of RG 1.189 Guidance

- Reliance on alternative shutdown is limited to the Control Room case
  - Remote shutdown station is credited
  - Dedicated shutdown is not credited or utilized
  - No credit is taken for post-fire operator manual actions
- Loss of function of all equipment in a given fire area is postulated
  - Proactive development of the fire PRA and supporting fire modeling is used to inform the ongoing design relative to equipment locations, cable routing, ventilation configurations, and the like

Implementation of RG 1.189 Guidance

- PSAR includes a conformance table to RG 1.189
  - Deviations are clearly defined
  - Address establishment of equivalent level of protection
- Key planned deviations from RG 1.189 positions:
  - Position 3.2.1.j – Seismic Category I standpipes/hose connections for manual firefighting
  - Position 4.1.3.6 – Automatic fire suppression for electrical cabinet areas
  - Position 6.1.2 – Automatic fire suppression for peripheral rooms in the Control Room Complex
  - Position 6.1.3 – Automatic fire suppression and number of entrances for Cable Spreading Rooms

Deviation - RG 1.189 Position 3.2.1.j

- Staff Position 3.2.1.j: provide the capability to manually align seismically-qualified standpipes to a seismic Category I water supply (e.g., essential service water) following a postulated DBE that could challenge the non-safety-related fire suppression water supply system.
- SMR-300 does not include any safety-related pumping trains
- Fire water supply is not explicitly designed to seismic Category I criteria
  - Applicable NFPA Standards (e.g., NFPA 20, 22) require the design to address location-specific earthquake effects
  - Fire loop piping will be designed to ASME B31.1
  - Pump house will be designed to location-specific seismic criteria

Deviation - RG 1.189 Position 3.2.1.j

- SMR establishes an alternative means of conformance:
  - Design will conform with ASME B31.1
  - Design will address seismic criteria in NFPA standards
  - Redundant fire pumps – electric and diesel-backed options
- Adequate water will be available where and when it is needed, including after a seismic event
- This approach is consistent with other recent plant designs

Deviation - RG 1.189 Position 4.1.3.6

- Staff Position 4.1.3.6: “Rooms containing electrical cabinets important to safety should be provided with … automatic fire suppression …”
  - Rooms with electrical cabinets important to safety such as safety-related equipment rooms are not provided with automatic fire suppression, based on the results of the Fire Hazards Analysis and the supporting Fire PSA.

Deviation - RG 1.189 Position 6.1.2

- Staff Position 6.1.2: "… Peripheral rooms in the control room complex should have automatic water suppression …"
  - The Fire Hazards Analysis does not identify the need for fixed suppression in the peripheral rooms of the control room complex, based on the results of the Fire PSA.
  - The Control Room is separated from the remainder of the plant by 3-hour-rated barriers.
  - Fire detection is provided throughout the complex.

Deviation - RG 1.189 Section 6.1.3 - Access

- Staff Position 6.1.3: "… Cable spreading rooms should have … at least two remote and separate entrances for access by fire brigade personnel"
  - The SMR design configuration accommodates only one entrance per cable spreading room. The room design features uncomplicated pathways and area-wide fire detection.
  - Given the insignificant ignition sources and area-wide fire detection, suppression of any credible fire by using staged fire extinguishers is expected.

Deviation - RG 1.189 Section 6.1.3 - Suppression

- Staff Position 6.1.3: "… The primary fire suppression in the cable spreading room should be an automatic water system …"
  - Automatic suppression is not anticipated, based on the results of the Fire Hazards Analysis, as informed by the Fire PSA.
  - Additional factors:
    - No fixed ignition sources
    - Administrative controls on transient combustibles and hot work
    - Full area coverage fire detection is provided
    - FSSA results demonstrate that safe shutdown can be achieved with deterministic full-room damage

Open Forum

Backup Slides

RG 1.189 Position 3.2.1.j

Provisions should be made to supply water to at least two standpipes and hose connections for manual firefighting in areas containing equipment required for safe plant shutdown in the event of a safe-shutdown earthquake. The piping system serving such hose stations should be analyzed for safe-shutdown earthquake loading and should be provided with supports to ensure system pressure integrity. The piping and valves for the portion of the hose standpipe system affected by this functional requirement should satisfy ASME B31.1, “Power Piping” (Ref. 76). The water supply for this condition may be obtained by manual operator actuation of valves in a connection to the hose standpipe header from a normal seismic Category I water system, such as the essential service water system. The cross-connection should be (1) capable of providing flow to at least two hose stations (approximately 284 L/min (75 gal/min) per hose station), and (2) designed to the same standards as the seismic Category I water system (i.e., it should not degrade the performance of the seismic Category I water system).

RG 1.189 Position 4.1.3.6

Electrical cabinets present an ignition source for fires and a potential for explosive electrical faults that can damage not only the cabinet of origin, but also equipment, cables, and other electrical cabinets in the vicinity of the cabinet of origin. Fire protection systems and features provided for the general area containing the cabinet may not be adequate to prevent damage to adjacent equipment, cables, and cabinets following an energetic electrical fault. Energetic electrical faults are more of a concern with high-voltage electrical cabinets (i.e., 480 volts (V) and above). High-voltage cabinets should be provided with adequate spatial separation or substantial physical barriers to minimize the potential for an energetic electrical fault to damage adjacent equipment, cables, or cabinets important to safety.

Rooms containing electrical cabinets important to safety should be provided with areawide automatic fire detection, automatic fire suppression, and manual fire suppression capability.

Electrical cabinets containing a quantity of combustible materials (e.g., cabling) sufficient to propagate a fire outside the cabinet of fire origin should be provided with in-cabinet automatic fire detection.

RG 1.189 Position 6.1.2

The control room complex (including galleys and office spaces) should be protected against disabling fire damage and should be separated from other areas of the plant by floors, walls, and roof having minimum fire-resistance ratings of 3 hours. Peripheral rooms in the control room complex should have automatic water suppression and should be separated from the control room by noncombustible construction with a fire-resistance rating of 1 hour. Ventilation system openings between the control room and peripheral rooms should have automatic smoke dampers that close upon operation of the fire detection or suppression system. If a gas extinguishing system is used for fire suppression, these dampers should be strong enough to support the pressure rise accompanying the agent discharge and seal tightly against infiltration of the agent into the control room. CO2 total-flooding systems are not acceptable for these areas.

RG 1.189 Position 6.1.3

A separate cable spreading room should be provided for each redundant division. Cable spreading rooms should not be shared between reactors. Each cable spreading room should be separated from the others and from other areas of the plant by barriers with a minimum fire rating of 3 hours. If this is not possible, an alternative or dedicated shutdown capability should be provided.

Cable spreading rooms should have the following:

a. at least two remote and separate entrances for access by fire brigade personnel,
b. an aisle separation between tray stacks at least 0.9 m (3 ft) wide and 1.5 m (5 ft) high,
c. hose stations and portable extinguishers installed immediately outside the room, and
d. area fire detection.

If division cables are not separated by 3-hour barriers, separation should meet the guidelines of RG 1.75, and the cables should have a suitable fire-retardant coating. (New reactor cables should meet the fire and flame test requirements of IEEE 1202.)

RG 1.189 Position 6.1.3

The primary fire suppression in the cable spreading room should be an automatic water system, such as closed-head sprinklers, open-head deluge system, or open directional water spray system. Deluge and open spray systems should have provisions for manual operation at a remote station; however, there should also be provisions to preclude inadvertent operation. Determination of the location of sprinkler heads or spray nozzles should consider cable tray arrangements and possible transient combustibles to ensure adequate water coverage for areas that could present exposure hazards to the cable system. Cables should be designed to allow wetting down with water supplied by the fire suppression system without electrical faulting.