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NRC Meeting: SMR-160 Reactor Coolant Makeup Capabilities & GDC 33

January 11, 2023

Meeting Agenda

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- Introductions
- Purpose & Outcome
- Overview of SMR-160 Reactor Coolant Makeup Methods
- GDC 33
- Recent Design Compliance with GDC 33
- Questions provided to NRC
- Open Forum

Introductions

- NRC staff
- Holtec staff

Purpose & Outcome

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PURPOSE: to give a high-level overview of Holtec's design of the SMR-160 normal and safety-related reactor coolant makeup methods.

OUTCOME: To obtain feedback from the NRC staff on GDC 33 and understand how it applies to the SMR-160 reactor coolant makeup design.

Overview of SMR-160 Reactor Coolant Makeup Methods

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- During normal operations, two charging pumps in the Chemical and Volume Control System (CVCS) provide makeup.
  - Pumps individually sized to provide makeup commensurate with a 3/8" equivalent break in the Reactor Coolant Pressure Boundary (RCPB).
  - While charging pumps are nonsafety-related and are not credited for providing makeup during design basis events, they serve as a defense-in-depth makeup method if available.
- During design basis events, the Passive Core Makeup Water System (PCMWS) provides safety-related makeup, as needed.
  - PCMWS consists of two accumulators for medium pressure injection and two tanks for low pressure injection.
  - The Automatic Depressurization System (ADS) performs timely depressurization to allow passive makeup injection.

Overview of SMR-160 Reactor Coolant Makeup Methods

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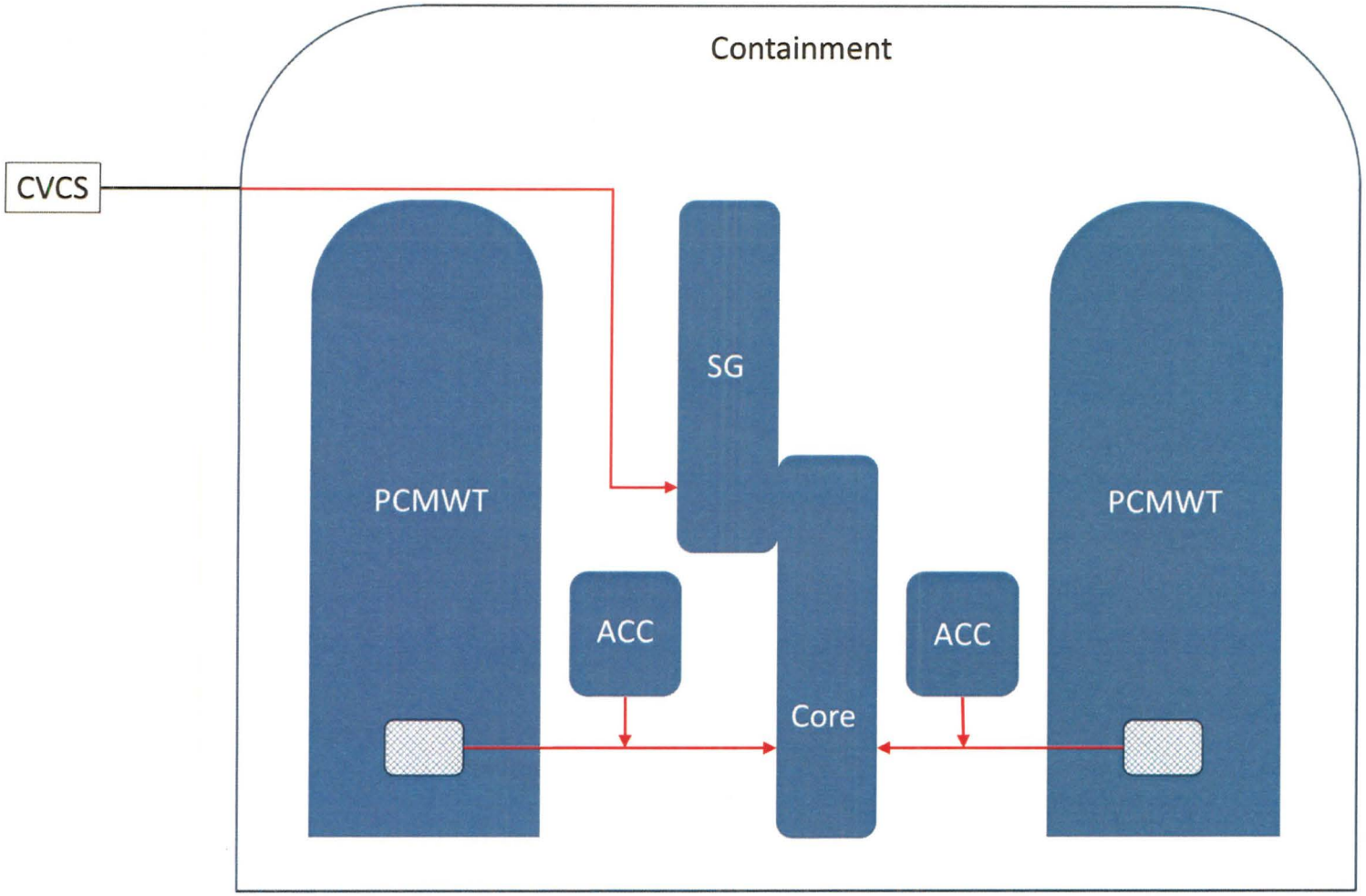
- In the event of leakage or an equivalent 3/8" break in the RCPB with the CVCS charging pumps unavailable, the Reactor Coolant System (RCS) will slowly drain.
- The volume of the pressurizer would decrease slowly, eventually initiating a reactor trip and/or safety signal on low pressurizer level or high containment pressure. The Passive Core Cooling System (PCCS) would then bring the plant to safe shutdown.
- The inherent large RCS water volume to power ratio is capable of keeping the core within specified acceptable fuel design limits (SAFDL) throughout the event.

Overview of SMR-160 Reactor Coolant Makeup Methods



GDC 33

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- GDC 33, *Reactor Coolant Makeup*, states:
  - A system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary shall be provided. The system safety function shall be to assure that specified acceptable fuel design limits are not exceeded as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal power operation.

NuScale Compliance with GDC 33

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- NuScale can provide reactor coolant makeup through pumps in the CVCS system during normal operations. Since the pumps are nonsafety-related, NuScale requests an exemption from GDC 33.
- The underlying purpose of GDC 33 is still met as actuation of the emergency core cooling system ensures SAFDLs are not violated by maintaining core inventory and coolability.

AP1000 Compliance with GDC 33

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- Changes in the reactor coolant volume will be accommodated by the pressurizer level program for normal power changes, including the transition from hot standby to fill-power operation and returning to hot standby. In addition, the pressurizer has sufficient volume to accommodate minor reactor coolant system leakage.
- Safety-related passive reactor coolant system makeup is provided to accommodate small leaks when the normal makeup system is unavailable and to accommodate larger leaks resulting from loss of coolant accidents. Safety-related reactor coolant makeup and safety injection are provided by two core makeup tanks, two accumulators, and an in-containment refueling water storage tank. Long-term cooling is provided by containment gravity recirculation of reactor coolant within containment. See Section 6.3 for additional information. The safety-related reactor coolant makeup relies on the Class 1E and UPS system. Neither onsite or offsite ac power is required.
- In addition, the nonsafety-related chemical and volume control system automatically provides inventory control to accommodate minor leakage from the reactor coolant system, expansion during heatup from cold shutdown, and contraction during cooldown. This inventory control is provided by letdown and makeup connections to the chemical and volume control system purification loop. Redundant pumps with connections to redundant nonsafety-related onsite ac power are provided when offsite power is not available and these pumps can be supplied from offsite power when onsite power is not available. See Section 5.2 for additional information.

AP1000 Compliance with GDC 33

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- AP1000 has nonsafety-related pumps in the CVCS system to provide reactor coolant makeup during normal operations.
- AP1000 credits passive systems such as Core Makeup Tanks (CMT) for providing safety-related reactor coolant makeup to comply with GDC 33.
  - CMT inlets are open to the RCS cold leg to maintain inventory at RCS pressure, but valves prevent injection of the coolant via the discharge line during normal operations. This allows coolant in the CMTs to cool relative to the RCS cold leg.
  - Upon receipt of a safety signal, valves in the CMT injection line open and RCS cold leg coolant recirculates the colder, denser CMT inventory into the core, resulting in a net increase of coolant mass available in the RCS. The safety signal also initiates a reactor trip.

Questions

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- What does the NRC mean by "the system safety function can be accomplished … to maintain coolant inventory during normal operations" in GDC 33?

- Context: The NRC does not credit the nonsafety-related CVCS for compliance with GDC 33 in either the NuScale or AP1000 design. AP1000 credits the CMTs that provide high pressure injection, though it is unclear the operation of these tanks is considered within normal operations. Could the SMR-160 PCMWS be credited for compliance with GDC 33?

Open Forum