Response to SDAA Audit Question

Question Number: A-4.6-1

Receipt Date: 04/24/2023

Question:

The SDAA is missing design specifications for the CRDS related to water cooling requirements, and environmental conditions such as pressure, temperature, and boron concentrations consistent with the U460 design. This information was included in the DCA and necessary for the staff to find that the system will meet design requirements and ensure the CRDS will perform its safety functions during normal, AOO, and accident conditions. The staff requests that this information be added back into the application.

Response:

The mechanical design of the control rod drive system (CRDS) is provided in the Standard Design Approval Application (SDAA) Section 3.9.4. SDAA subsection 3.9.4.3 provides the following design loads applicable to the control rod drive mechanisms (CRDMs):

- design pressure - 2200 psia
- normal operating pressure - 2000 psia
- design temperature - 650 degrees Fahrenheit (F)
- normal operating temperature - 540 degrees F
- pressurizer operating temperature - 636 degrees F

The CRDM design boron concentration matches the maximum reactor coolant boron concentration of 2000 ppm as listed in SDAA Table 5.2-4.

While continued cooling of the CRDMs is not required for safe shutdown, the reactor component cooling water system is specified to maintain the CRDM winding temperature below the maximum design temperature of 392 degrees Fahrenheit.

Markups of the affected changes, as described in the response, are provided below:

assembly that performs the rod withdrawal/insertion/reactor trip functions. Figure 4.6-6 illustrates the CRDM drive shaft interface with the CRA.

The CRDM assembly is an electro-mechanical device that moves the CRA in and out of the reactor core and holds the CRA at any elevation within the range of CRA travel. If electrical power is interrupted to the CRDM, the control rod drive shaft is released and the attached CRA drops into the reactor core.

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The CRDMs are mounted on the RPV head, and the CRDM pressure housings are safety-related American Society of Mechanical Engineers (ASME) Class 1 pressure boundaries. The CRDS components internal to the reactor coolant pressure boundary are designed to function in borated primary coolant with up to 2000 ppm boron at primary coolant pressures and temperatures ranging from ambient conditions up to the RPV design pressure and temperatures above normal operating conditions. The lower portion of the drive rod is submerged in the primary coolant at hot leg temperature flowing upward through the upper riser and CRA guide tubes. The electric coil operating conditions require active cooling by water through a CRDS cooling water distribution header to cooling jackets surrounding the drive coils of each CRDM as shown in Figure 4.6-3. The cooling requirements for the CRDMs are provided by the reactor component cooling water system, which maintains the CRDM winding temperature below the maximum design temperature of 392 degrees Fahrenheit (Section 9.2.2).

The CRDS cooling line is branched into supply lines inside the CNV to each individual CRDM. After passing through the CRDM cooling jackets, the return lines rejoin into a single return header leaving containment. A thermal relief valve is provided on the return header to provide overpressure protection for the CRDS cooling piping during a containment isolation event.

The structural materials of construction for the CRDS are discussed in detail in Section 4.5.1.

4.6.2 Design Bases

This section describes how the design of the CRDS conforms to General Design Criteria (GDC) 4, 23, 25, 26, 27, 28, and 29 of 10 CFR 50, Appendix A.

GDC 4 is applicable to the CRDS design as it requires the SSC important to safety to be designed to accommodate the effects of and to be compatible with the environmental conditions during normal plant operation as well as during postulated accidents as a result of equipment failures and external events. The CRDS complies with GDC 4. The CRDS components located inside the containment are protected against dynamic effects as described in Section 3.6. The CRDS structures, systems, and components are located inside the Reactor Building, which provides protection from events and conditions outside the plant. The ability of the CRDS to perform the required safety-related functions is not compromised by adverse environmental conditions. The control rod drive shafts are immersed in 540 degrees F water during normal full power operation. The upper portion of the control rod drive shafts