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Component Cooling Heat Exchanger Heat Transfer Capability Operability Monitoring

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The ultimate heat sink (UHS) is of highest importance for nuclear power plant safe and reliable operation. The most important component in line from safety-related heat sources to the ultimate heat sink water body is a component cooling heat exchanger (CC Heat Exchanger). The Component Cooling Heat Exchanger has a safety-related function to transfer the heat from the Component Cooling (CC) water system to the Service Water (SW) system. SW systems throughout the world have been the root of many plant problems because the water source, usually river, lake, sea or cooling pond, are conductive to corrosion, erosion, biofouling, debris intrusion, silt, sediment deposits, etc. At Krško NPP, these problems usually cumulate in the summer period from July to August, with higher Sava River (service water system) temperatures.

Therefore it was necessary to continuously evaluate the CC Heat Exchanger operation and confirm that the system would perform its intended function in accordance with the plant's design basis, given as a minimum heat transfer rate in the heat exchanger design specification sheet.

The Essential Service Water system at Krško NPP is an open cycle cooling system which transfers heat from safety and non-safety-related systems and components to the ultimate heat sink the Sava River. The system is continuously in operation in all modes of plant operation, including plant shutdown and refueling. However, due to the Sava River impurities and our limited abilities of the water treatment, the system is subject to fouling, sedimentation buildup, corrosion and scale formation, which could negatively impact its performance being unable to satisfy its safety related post accident heat removal function. Low temperature difference and high fluid flows make it difficult to evaluate the CC Heat Exchanger due to its specific design. The important effects noted are measurement uncertainties, nonspecific construction, high heat transfer capacity, and operational specifics (e.g. using CC Heat Exchanger bypass valves for CC temperature control, variation of plant heat loads, pumps performance, and day-night temperature difference, with lagging effects on heat transfer dynamics).

Krško NPP is continuously monitoring the Component Cooling (CC) Heat Exchanger performance using the on-line process information system (PIS). By defining the mathematical algorithm, it is possible to continuously evaluate the CC Heat Exchanger operability by verifying if the heat transfer rate calculation is in accordance with the heat exchanger design specification sheet requirements. These calculations are limited to summer periods only when the bypass valves are neither throttled nor open.

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