SUPERCRITICAL WATER COOLED REACTORS

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As the demand for electric power is increasing as well as the issues related to climate change, there is a need to develop new sustainable enviromentally friendly energy systems. Research activities are currently underway worldwide to develop Generation IV nuclear reactorconcepts with the objective of improving thermal efficiency and increasing economic competitiveness of (NPPs) compared to modern thermal power plants. There is a great interest in many countries in the research and development (R&D) and conceptual design of SCWRs (one of the six reactor technologies selected for research and development under the Generation IV program).

The supercritical water reactor (SCWR) is an innovative water-cooled reactor concept that uses supercritical water as the working fluid. SCWRs resemble light water reactors (LWRs) but operate above the thermodynamic critical point of water (374C, 22.1MPa), with a direct once-through cycle like a supercritical boiler. This concept offers high thermal efficiencies (i.e., about 45% vs. about 33% efficiency for current LWRs) and a simplified reactor system (i.e., the need for a pressurizer, steam generators, steam separators, and dryers is eliminated), and is hence expected to help improve its economic competitiveness as the main mission of the SCWR is generation of low-cost electricity. At supercritical pressures, there is no boiling (liquid-vapor phase transition), so the coolant remains single-phase throughout the system, therefore, there' s no such a thing as Critical Heat Flux or burn out. At supercritical pressures, heating can be made to be closer to the heat source temperature than a subcritical cycle with the same steam temperature that shows an abrupt change in temperature within the two-phase region. Looking at it another way, the supercritical pressure cycle receives more of its heat at higher temperatures than a subcritical cycle with the same turbine inlet steam.As SCWRs operate at relatively higher temperatures than other LWRs, we should consider fuels with high thermal conductivities, takinng into account the change of thermal conductivity with the increase in temperatures.

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