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Stability Analysis of a natural circulation flow loop under supercritical condition RACHNA JAIN, MICHAEL CORRADINI, University of Wisconsin-Madison, SCW TEAM — The stability of natural circulation flow loop geometry is under investigation in a specific thermo-dynamic region that encompasses the supercritical temperatures and pressures. This flow configuration is pertinent to the design of passive safety systems in some innovative reactor designs proposed for future generations of water-cooled nuclear reactors. Earlier studies employing both transient and linear stability approach considered supercritical natural circulation flow loop systems having a semi-closed boundary condition which required only the continuity in the pressure of the system around the loop. This is only true for loops that are connected to a large reservoir which theoretically can absorb any fluctuations in the flow velocity or temperatures and thus keep the inlet conditions fixed. A more realistic approach considered in the present study where a periodic boundary condition is imposed for such systems and requires continuity in the pressure, temperature and velocity as an essential boundary condition. With a highly non-linear equation of state specific to supercritical fluid and periodic boundary condition, the stability of this flow system is mathematically challenging to analyze.

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