EXERGY ANALYSIS OF WATER-COOLED NUCLEAR-POWER PLANTS

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Energy-exergy analyses based on the first and second laws of thermodynamics are performed to determine the sources, locations and magnitudes of exergy destructions, hence, to reveal the locations of potential improvements for the plant efficiency. In this work, energy-exergy analyses studied for three specific water-cooled nuclear-power plants (NPPs) are reviewed, compared and discussed. The considered plants are (i) the pressurized-water reactor (PWR) NPP proposed for construction in Turkey and China, (ii) the LaSalle County Nuclear Power Station that uses boiling-water reactor (BWR), (iii) and the Pickering Nuclear Generating Station that uses Canadian deuterium uranium (CANDU) reactor. Comparisons for the exergy destruction of these plants indicate that (i) the calandria together with the CANDU reactor in it and the reactor pressure vessels with BWR and PWR are the most inefficient components in these NPPs, (ii) among them, the calandria enclosing the CANDU reactor is the most inefficient reactor vessel, the reactor pressure vessels of BWR and PWR follow it respectively, (iii) regarding the thermodynamic efficiency, the PWR NPP proposed for construction in Turkey and China is the most efficient design, the LaSalle County Nuclear Power Station and the Pickering Nuclear Generating Station follow it respectively.