

Analysis of the natural circulation capacity of decay heat removal system in pool-type sodium-cooled fast reactor

Thursday 21 April 2022 14:16 (12 minutes)

The structure of pool type sodium-cooled fast reactor (SFR) is complex, which leads to the complicated thermal-hydraulic phenomena in the process of natural circulation for decay heat removal. The determination of natural circulation flow path and the decay heat removal capacity of natural circulation of each flow path are issues to be considered in the design of SFR. Core flow distribution, flow and heat transfer of inter-wrapper flow, thermal stratification of the sodium pool, thermal hydraulic interaction between the core and the sodium pool, and arrangement of the decay heat removal system are factors that affect the decay heat removal capacity in the reactor. Therefore, this paper analyzes the influence of the arrangement scheme of decay heat removal system on the removal of decay heat.

Firstly, the system program THACS is used to establish the decay heat removal system of coupling primary circuit and external circuit of SFR, and the analysis is carried out for the condition of station black out (SBO). Secondly, sensitivity analysis is conducted for the arrangement scheme of the decay heat removal system, so as to evaluate the decay heat removal capacity of the reactor. Two decay heat removal systems selected for comparative analysis are non-penetrating direct reactor auxiliary cooling system (NPDRACS) and penetrating direct reactor auxiliary cooling system (PDRACS). The results indicate that both decay heat removal system arrangements can effectively remove decay heat from the core. And for large SFR, the decay heat removal capability of the PDRACS is better, because the cold sodium from direct heat exchanger (DHX) can cool the core assemblies directly.

Country/Int. organization

China

Author: Dr LIU, Yapeng (Xi'an Jiaotong University)

Co-authors: Prof. ZHANG, Dalin (Xi'an Jiaotong University); Dr ZHOU, Lei (Xi'an Jiaotong University); Prof. WANG, Chenglong (Xi'an Jiaotong University); Prof. TIAN, Wenxi (Xi'an Jiaotong University); Prof. QIU, Suizheng (Xi'an Jiaotong University); Prof. SU, Guanghui (Xi'an Jiaotong University)

Presenter: Dr LIU, Yapeng (Xi'an Jiaotong University)

Session Classification: 6.4 Simulation Tools for Safety Analysis

Track Classification: Track 6. Modelling, Simulations, and Digitilization