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Editorial: Nuclear Thermal Hydraulic and Two-Phase Flow

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Editorial on the Research Topic

Nuclear Thermal Hydraulic and Two-Phase Flow

Nuclear Thermal hydraulic and two-phase flow research is always a typical component in nuclear engineering research from the 1960s (D'Auria, 2017). In American Nuclear Society (ANS) annual meetings, thermal hydraulic and two-phase flow is always one of the largest branches. International meeting on nuclear reactor thermal hydraulic (NURETH) starts at the 1980s, provides the communication platform for all the scientists in this region. As the first research topic in Frontiers in Energy Research, Nuclear Section, this topic is with great expectation.

Along with the development of computer technology, more modern simulation tools are involved, together with experiments, make contributions to the thermal hydraulic and two-phase flow research. This technology is more about the highly geometry-dependent transient phenomena, provide structure design and safety optimization of nuclear power plants. The existing research regions mainly include: general thermal hydraulic, thermal hydraulic experiment, two-phase flow modeling, boiling and condensation, safety analysis of current reactors and Gen IV reactors, computation fluid dynamics simulation, system code development and validation, critical heat flux (CHF), core thermal hydraulic and subchannel analysis, severe accident and so on.

Experiment is still the most important part of basic thermal hydraulic. Mechanism study of steam condensation with air in an imaged reactor component vertical tube experimental facility is conducted by Wang et al.. Some basic thermal hydraulic is studied by self-developed code. A one-dimension gas turbine system transient code is developed for compressible flow simulation based on hybrid semi-implicit method by another Wang et al.

Thermal hydraulic modeling can now be studied by computation fluid dynamics simulation. Subcooled boiling, which may appear in the vertical pipe of a reactor system, is studied by Zhang et al.. The uncertainties from the software Fluent is also considered in Zhang's work. Another simulation work to study the flow distribution in reactor system heat exchangers is done by Zhou et al., who aims to reduce this situation to avoid system risk. Luchao studies the single-phase nanomaterial flow of CuO-water by looking into the hydromechanics and heat transfer mechanics (She and Fan). In the reactor, grids will affect the coolant flow, and bring in turbulence which may affect heat transfer. Dong et al. builds a model to study this situation by predicting the critical heat flux.

Thermal hydraulic is always coupled with neutronics, to provide highly accurate simulation of the core performance. For example, a theoretical Ultra-high temperature fuel is designed by Song et al. based on neutronics and thermal hydraulic analysis, which could provide capacity for the nuclear electric propulsion system. Core thermal hydraulic improves the primary use efficiency of nuclear power, and also gives the core safety performance analysis. Sun et al. works on this region, and also provide a core thermal hydraulic design to for a micro nuclear system.

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Severe accident turns to be one of the popular topics after Fukushima Daiichi nuclear disaster. Wang et al. made a review work on severe accident history and core degradation mechanics during his time at Xi'an Jiaotong University supervised by Prof. Guanghui Su. Yin et al. uses MELCOR, which is developed by Sandia National Laboratory, conducting a whole small modular reactor severe accident analysis to study its response during a station blackout. Containment is the final safety protective screen in nuclear power plants. Wen tries to find a way to help keeping containment integrity by testing surface tension of a kind of coolant material (Wen et al.).

Future thermal hydraulic research will have various difference. Multi-physical coupled code including neutronic, fuel, mechanics, and thermal hydraulic development is taking more important position. Meanwhile, more core thermal hydraulic experimental data are still required, especially for the critical heat flux, and accident tolerant fuels. Computation fluid dynamics technology is still developing, and it should be better for two-phase flow simulation. Severe accident and accident tolerant fuels thermal hydraulic are still important parts.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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