Department of Nuclear Safety Engineering
Reactor Thermal Hydraulics

Shen Lab.

Xiuzhong SHEN, Dr. (Professor)

Thermal-fluid measurement, Database construction, and Two-phase flow modeling ▶ Advancement of practical reactor design and safety assessment technologies

1. Outline

Our laboratory advances reactor design and safety assessment through thermal-fluid measurements, database development, and the study and modeling of boiling heat transfer and gas–liquid two-phase flows, contributing to safer, more reliable, and efficient nuclear systems.

2. Research Topics

(1) Development of gas-liquid two-phase flow measurement and modeling technologies

Coolant boiling in BWRs and PWR accident conditions generates gas–liquid two-phase flows, whose understanding and modeling are essential for reactor safety assessment. Our laboratory develops advanced 4-sensor optical-fiber probes (Fig. 1) and performs local measurements in a rod-bundle test facility simulating fuel assemblies (Fig. 2) to build high-accuracy databases and develop interfacial transport models. These results are incorporated into reactor safety analysis codes to improve reactor design and safety evaluation technologies.

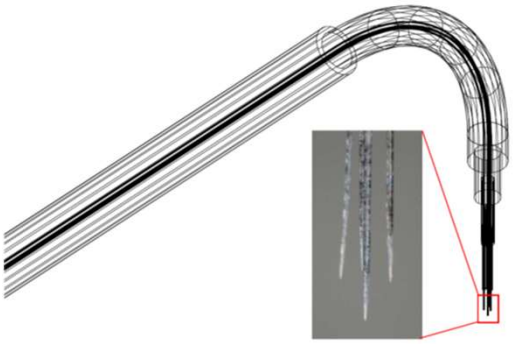

Fig. 1 Advanced 4 sensor probe

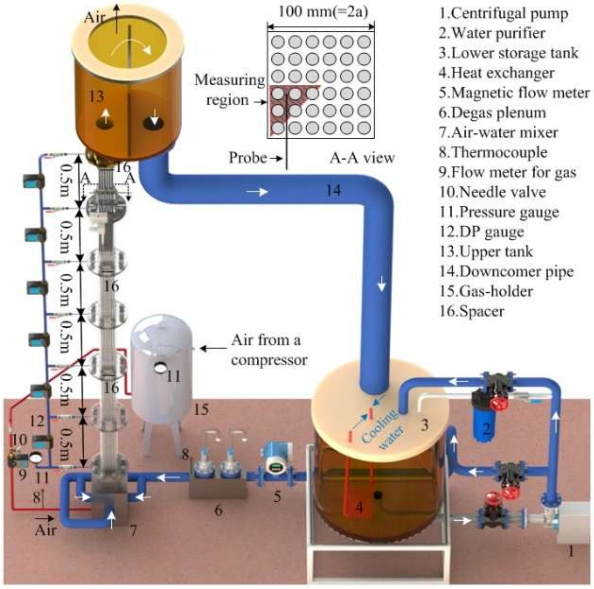

Fig. 2 LWR fuel assembly mock-up experimental apparatus

(2) Safety analysis and safety assessment studies of the research reactor

Using safety analysis codes such as THYDE-W, we analyzed the thermal-hydraulic behavior of the KUR (Fig. 3) and conducted safety assessments. As a result, it was confirmed that sufficient safety is maintained during operational transients and design basis accidents (DBA) even after fuel low-enrichment. Furthermore, analyses assuming severe events exceeding design-basis conditions showed that significant core damage does not occur.

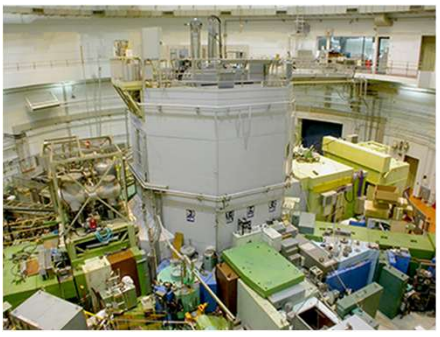

Fig. 3 Kyoto univ. research reactor (KUR)

3. Future Perspective

With our 4-sensor probe, we can measure hard-to-obtain gas-liquid interface information and construct a database.

High-precision measurements, elucidation, modeling, and safety assessment for thermal-fluid phenomena in nuclear reactors

Future AI/data-science-driven thermal-hydraulic analysis and model development

Message to applicants

Join us in exploring the thermal-hydraulic phenomena behind nuclear safety. Through experiments, advanced measurements, and simulations, you can contribute to safer nuclear systems and sustainable energy solutions. We welcome curious and motivated students eager to take on new challenges.