Nuclear Technology Research Laboratory

Brief Overview

The Nuclear Technology Research Laboratory aims to make a positive contribution to the solving/alleviation of energy and global environmental problems by means of developing nuclear technologies, including base technologies to support the operation and maintenance of light water reactors, so that the use of nuclear energy will become socially acceptable.

Achievements by Research Theme

Nuclear Power Generation Technology

【Objectives】

To help improve plant capacity factor, high burn-up of fuel, introducing the MOX-fuel, and power-up rating of current light water reactors using basic technologies for risk informed safety analysis, core fuel integrity, reactor physics, and thermal hydraulics.

【Principal Results】

- Established a analytical method for common cause failure (CCF), and estimated CCF parameters for PSA of nuclear power plants based on the domestic operation actual results by using NUCIA database (Fig. 1).
- To measure sub-criticality (criticality safety margin) of a spent fuel assembly in a water pool, simulation technology has been developed using 3D nuclide density distribution. The simulation results have shown that neutron leakage probability is less sensitive to burn-up of fuel. Thus, quantification of neutron absorption outside fuel assembly is considered one of the feasible methods for the measurement [L09005].

Advanced Nuclear Fuel Cycle

【Objectives】

Basic technology of metal fuels & pyro-reprocessing and elemental technology of aqueous reprocessing will be developed and improved for applying to FBR fuel cycle and a next commercial reprocessing plant.

【Principal Results】

- For simulating the irradiation behavior of metal fuel, kinetics of phase separation behavior was developed. Transport properties of molten salt were measured for development of pyro-reprocessing technology.
- As for aqueous reprocessing technology, a batch-type glass test melter was installed and a simple observation method of the noble metal in the glass was developed and the aggregational state of the noble metal in the glass was investigated (Fig. 2).

Reactor Systems Safety

【Objectives】

To contribute to the establishment of a rational safety evaluation method which can improve operation and maintenance of LWRs, we validated numerical methods and computational tools of the safety analysis codes through experiments to obtain both realistic values and their uncertainties.

【Principal Results】

- The basic design of the test facility named ‘SIRIUS-T’, which can simulate steady states, quasi-steady states and transients of BWRs under the realistic pressure and temperature with single flow channels and pin bundle flow, has been completed.

・The bundle wire mesh sensor method and the high-density multipoint electrode method have been developed to measure the gas-liquid two-phase flow [L09008].

Nuclear Power Technology Applications/Innovative System Assessments

【Objectives】

・To apply innovative technologies obtained from nuclear power R&D to other industrial fields.

・To contribute to settlements on R&D strategies of future nuclear power systems by assessment on the key technologies of the system.

【Principal Results】

・We devised rapid-solidified powder production technology CANOPUS, which is expected to produce new functional powders as materials for innovative products in the electric power industry. We transferred the CANOPUS technology to a material production company on the basis of licensing agreement between the company and us.

・A commissioning method for the fusion power plant without the initial tritium fuel has been proposed, and its operation parameters such as a fusion power, a plasma density, etc. were clarified.

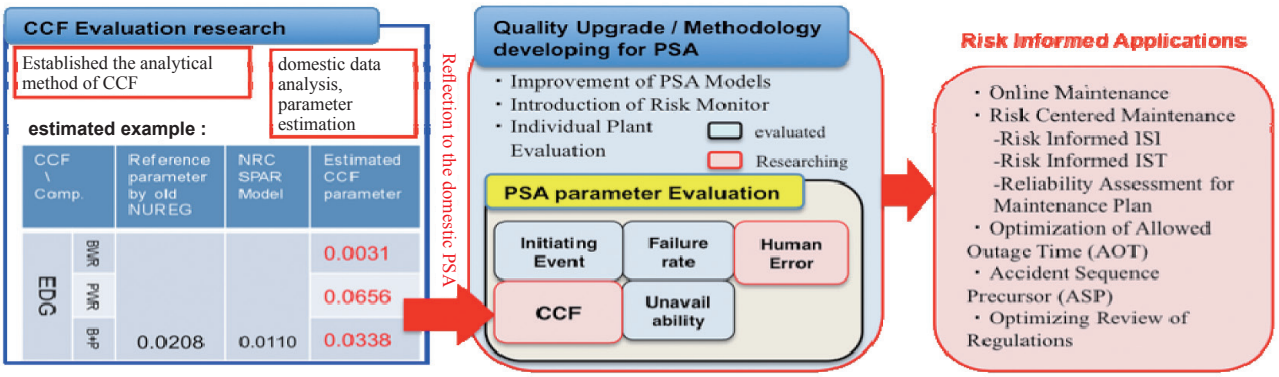

Fig. 1　CCF evaluation research and reflection of the results for Risk informed Applications.

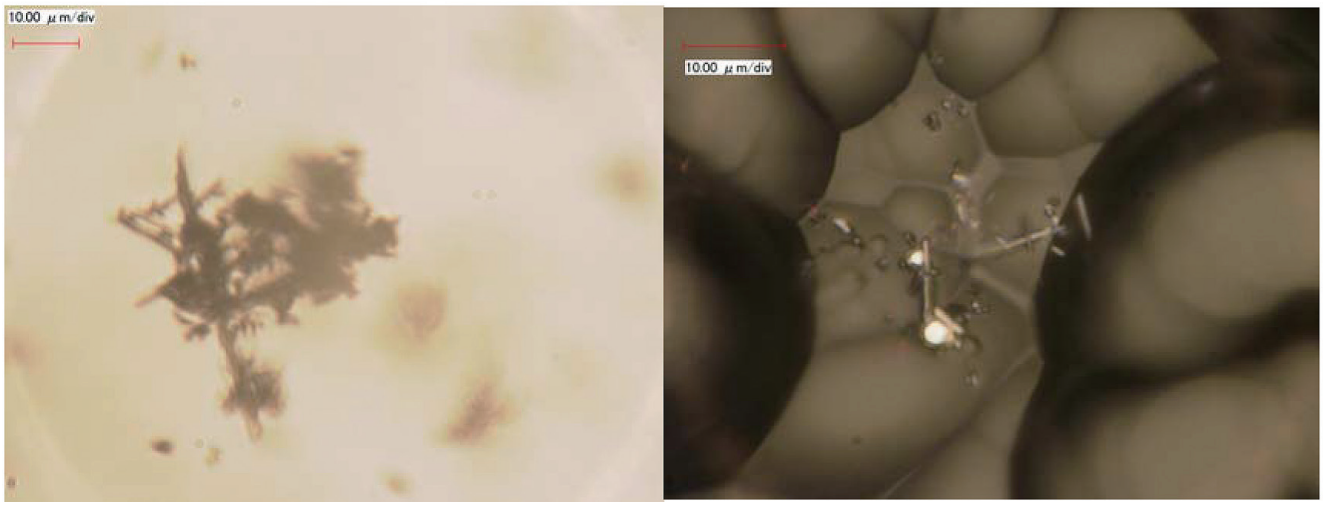

Fig. 2　Aggregation of the noble metal observed through our developed method