Nuclear Technology Research Laboratory

Brief Overview

The Nuclear Technology Research Laboratory aims at positively contributing 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 is accepted by society in a positive manner.

Achievements by Research Theme

Fuel Engineering and Reactor Physics

[Objectives]

To clarify the FP gas release behaviour of high burn-up MOX fuel, neutronic property changes with a high plutonium ratio and the embrittlement and defect mechanisms of fuel claddings in order to support effective fuel utilisation up to higher burn-up levels.

[Principal Results]

- In the Halden test reactor, correlation data between the rod internal pressure and the pellet-cladding gap width were obtained for the over pressure tests using the fuel rods irradiated to high burn-up levels in commercial reactors. In LOCA (loss-of-coolant accident) simulation tests, data on the temperature and deformation of the pellet and cladding were also obtained till the fuel rod failure.
- Kinetic parameters in PWR start-up physics test were analyzed with our original methods using the continuous energy Monte Carlo code, to show the schemes for improving the measurement accuracy of control rod worth.

Technical Basis for Nuclear Reactor System Safety

[Objectives]

To develop the technological basis to evaluate the safety of current and future nuclear power systems for the purpose of assessing safety improvement measures for light water reactors and fast reactors.

[Principal Results]

- In order to validate statistical safety evaluation method for existing and next generation light water reactors, a new device to acquire the boiling two-phase flow at high temporal and spatial resolutions was developed.
- The verification of a plant dynamic analysis code CERES for the FBR was performed by using an actual plant data. The safety of a FBR using metal fuel was evaluated by the CERES code.

Risk Information Technology

[Objectives]

To improve the operation and maintenance of light water reactors based on risk-relevant information for the optimisation of maintenance planning.

[Principal Results]

- The hierarchical Bayes reliability analysis method used for reliability parameter evaluation for probalistic risk assessment (PRA) was refined for its application to the domestic implementation criteria, etc., establishing a safety unavailability estimation method using a Bayesian statistical model (Fig. 1). [L08009]
- The scope of the subject equipment for the common cause analysis method developed by the Laboratory was expanded to advance the familiarity and technical capability, including engineering judgements, of this analysis method. [L08008]

Assessment of Technical Concepts of Innovative Energy System

[Objectives]

To identify the development issues required to realise a future energy system, make recommendations on the prospect of and a road map for such future energy system, and clarify the development targets.

[Principal Results]

- The impacts of electric and plug-in hybrid vehicles on petrol consumption and CO_2 emission reduction were assessed together with the effect of the combination of energy source in the electric grid system. A method to analyse the effect of introducing charging stations is also developed in order to understand the critical issue for the use of electric cars.

・The conceptual design was conducted for a liquid metal blanket of an inertial fusion reactor, clarifying the merits and technical challenges of such a blanket.

Application of Basic Nuclear Power Technologies

[Objectives]

To extend high performance and highly reliable nuclear power technologies to other industrial fields to advance the technological base of the power industry.

[Principal Results]

・The surface modification technology of titanium, Fresh Green, developed by the Laboratory for an excellent abrasion resistance and peel strength was successfully applied to Zircaloy cladding and halved the amounts of corrosion and hydrogen pick-up (Fig. 2). [L08014]

・The positive prospect of technology transfer was established for the unique rapid cooling and liquid atomisation process utilising sustainable vapour explosion (CANOPUS) which was developed by the Laboratory.

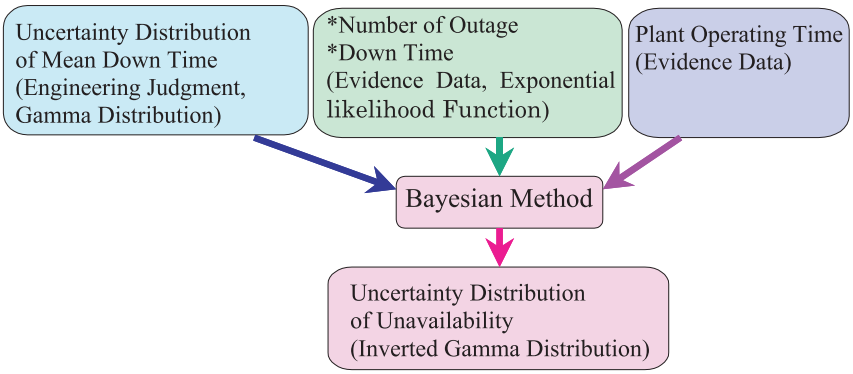

Fig.1 Conceptual diagram about method for Bayesian inference of unavailability

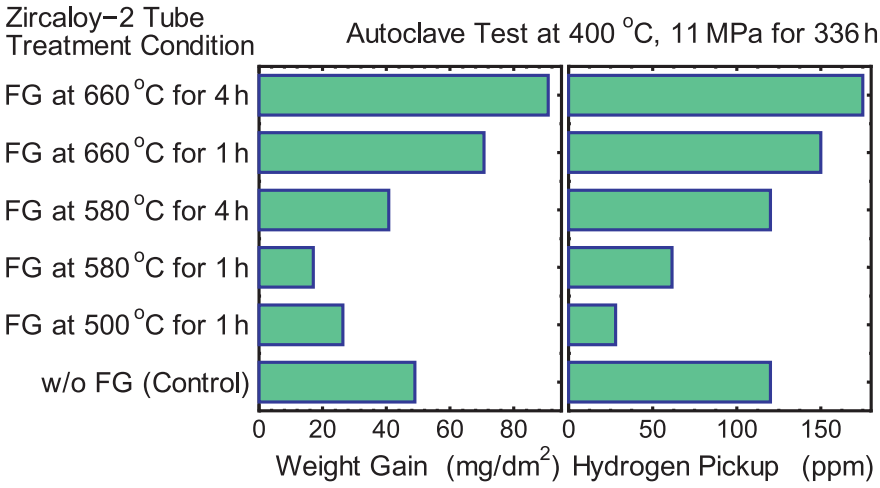

Fig.2 Weight Gain and Hydrogen Pickup after General Corrosion Test