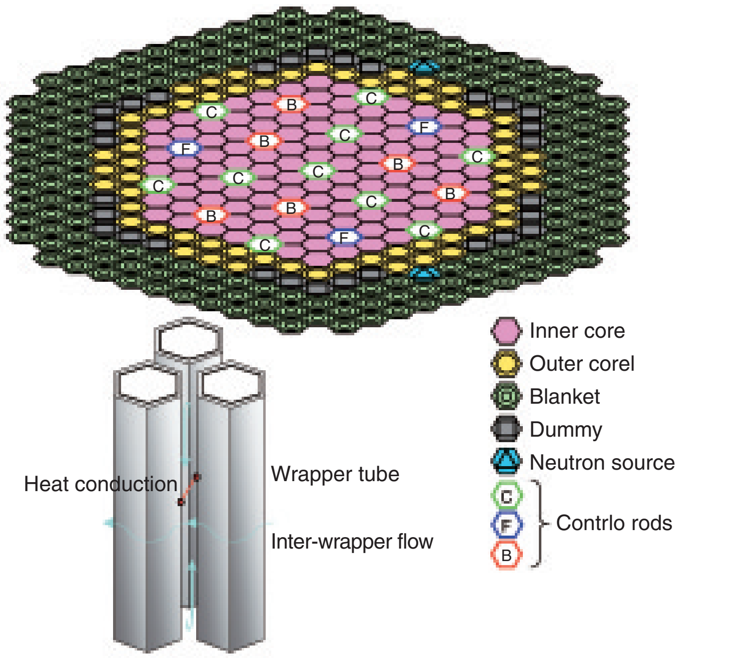
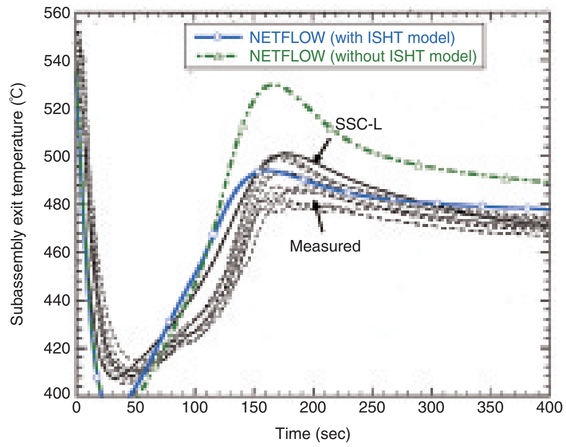
# 1-4 Accurate Temperature Analyses of FBRs in Low Flow Conditions
## —Heat Conduction and Heat Transfer between Subassemblies—



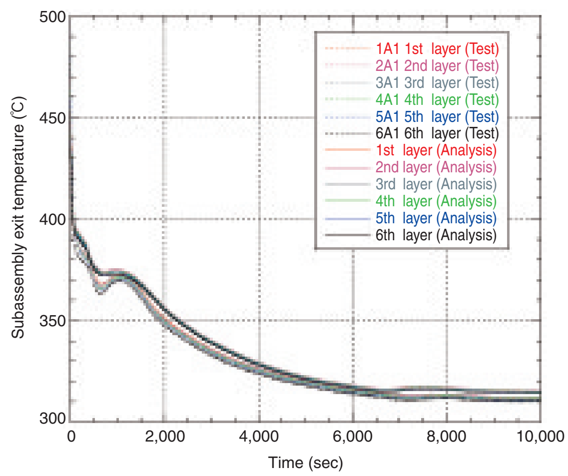




**Fig.1-10 (upper) Core of “MONJU” and inter-subassembly heat transfer (ISHT) model**
Heat transport from the center of the core to peripheral subassemblies is evaluated by heat conduction of sodium and heat transfer caused by inter-wrapper flow.

**Fig.1-11 (upper right) Comparison of “JOYO” assembly exit temperature (at 3rd layer)**
The ISHT model is validated through a calculation of the natural circulation test conducted at the “JOYO” reactor with 100 MW irradiation core. Exit temperatures are overestimated when the ISHT model is not used.

**Fig.1-12 (lower right) Comparison of “MONJU” subassembly exit temperature during reactor trip from 45% thermal power**
Subassembly exit temperatures during turbine trip test were calculated with a calculation model of the NETFLOW code from the primary heat transport (HT) system to the 3rd HT system. The Monju reactor was cooled by forced circulation at 1/10 of the rated flow rate by pony motors after the scram, and flow distribution was appropriate even at low flow rates. There was little temperature difference between subassemblies at the center and at the periphery. This situation was properly calculated by the code.

The NETFLOW code has been developed in order to simulate simply and accurately complex flow systems like heat transport systems (HTSs) and auxiliary cooling systems of a nuclear power plant. The calculation accuracy has been confirmed through analyses in light water reactor systems and test results of the forced circulation of the “MONJU” reactor. This code is already provided to graduate school students for their education.

In order to do accurate simulation under low flow rate conditions of the liquid metal cooled fast reactors, a model to calculate the heat transfer between subassemblies (SAs) was proposed and validated. In this model, six neighboring SAs’ overall heat transfer coefficients for heat conduction by liquid metal and for low flow heat transfer around SAs, i.e. inter-wrapper flow, were applied (Fig.1-10). Generally, temperature at the center SA is higher than the peripheral SAs. It is realistic that SAs should be analyzed by radial layers from the center outward rather than one by one. Therefore, the model calculated temperatures from data matrices consisting of kinds (fuels, blankets, control rods, and reflectors) and numbers of SAs neighboring the SA in question. The results are shown in Fig.1-11 and Fig.1-12; exit SA temperatures are simulated, like the SSC-L code developed in USA. Since exit temperatures were calculated appropriately, the temperature behavior can be understood before a calculation with a 3D model is done. The present ISHT model can be applied to other one-dimensional plant dynamics codes.

**Reference**

Mochizuki, H., Inter-Subassembly Heat Transfer of Sodium Cooled Fast Reactors: Validation of the NETFLOW Code, Nuclear Engineering and Design, vol.237, issue 19, 2007, p.2040-2053.