Incorporation and Development of NUCIRC module in COMPAS

Daeyu Park, Hyungbum Suh*, Eung Kon Kim, Jinil Kim, Seongmin Kim*, Choongsub Yeom
Institute for Advanced Engineering, Yongin P.O. Box 25, Gyeonggi-Do 449-863, dypark@iae.re.kr
** Wolsong Nuclear Power Division, Korea Hydro & Nuclear Power*

1. Introduction

The purpose of COMPAS (CANDU cOre Management Procedure Automation System) is to support efficient core management and error-free operation of CANDU core[1]. One of the important functions of COMPAS is to check the coolant flow rate, which is a main function of NUCIRC (Nuclear Circuit Program for heat transport system by thermo-hydraulic analysis) code. The purpose of NUCIRC code is to guarantee the integrity of fuel by maintaining normal flow in core[2].

This module has 3 functional modes like monthly check, single-phase modeling and two-phase modeling. The applications of the modes depend on the core status which are divided into the normal run and the restarting.

This paper introduced the functionality of the NUCIRC module in COMPAS and some issues related with the flow management.

2. Functions of the NUCIRC Program of COMPAS

The flow inspection work is carried out according to the core status, which are classified into the normal state and the restarting.

In normal run status, the coolant flow inspection is carried out using NUCIRC code(ITYPE 2). NUCIRC code is the thermo-hydraulic code for making analysis of core status related with coolant and it consists of 9 calculation modules.

In restarting status, single & two-phase modeling are carried out. The main purpose of these modeling is to create the design flow of coolant using NUCIRC codes.

Table 1 describes roles of each ITYPE Code.

Fig 1 shows a flow management process according to the core status.

To complete a flow inspection process, firstly user needs to get DCC (Digital Control Computer) data through gateway and RFSP run output for bundle power distribution. If these data are acquired, 8 input tape files can be updated by using them and be used to run ITYPEs.

NUCIRC module of COMPAS is operated in the WEB environment and has been developed by the *Smart Client* technology of *Microsoft Visual Studio .NET*. It can provide high operation speed as window form as well as high access and security ability in web environment.

Table 1 NUCIRC ITYPE Description[3]

Code	Desc.
ITYPE1	To get $\Delta P_{H\text{-}H}$ for a given channel flow and feeder shape
ITYPE2	To get channel flow for a given $\Delta P_{H\text{-}H}$ and feeder shape
ITYPE3	To select a size of feeder according to fixed feeder size selection guide
ITYPE4	To Predict pressure, temperature and flow distribution of thermo transport system
ITYPE5	To select channel flow for a given $\Delta P_{H\text{-}H}$, feeder shape and fuel loading boundary condition
ITYPE6	To predict temperature, pressure and flow distribution about whole thermo transport loops
ITYPE7	To predict a capacity of steam generator
ITYPE8	To predict volume and direction of bypass flow between loops which go through coolant purification common line.
ITYPE9	To predict volume and a direction of bypass flow between loops which go through pressurizer

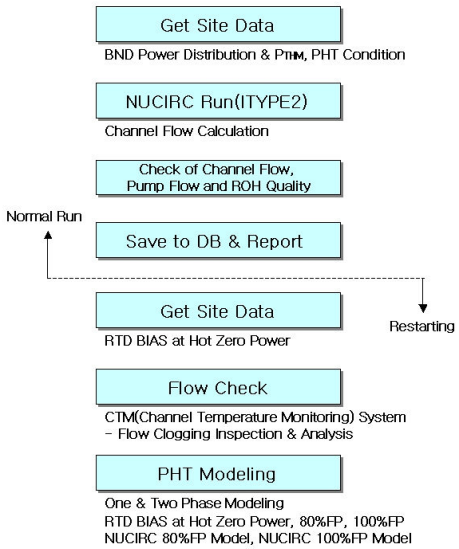

Fig 1 Channel Flow Management Process

2.1 Monthly Flow Check

NUCIRC program provides "monthly check" mode as shown in Fig 2. It can be run while the reactor is running in normal state. Channel flow, ROH Quality and coolant pump flow are calculated once a month.

Only ITYPE 2 is run on this mode. If calculated values are satisfied with the limit then the process is finished.

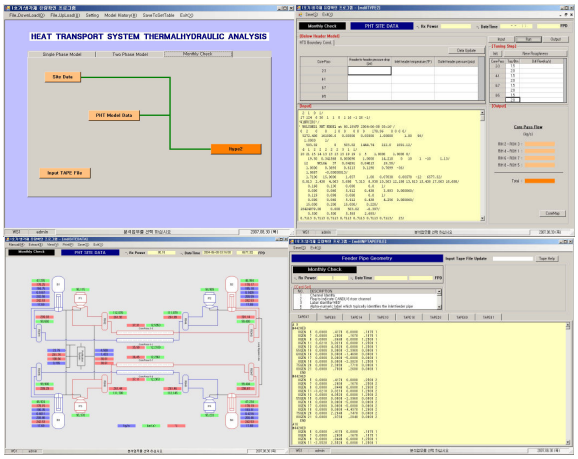

Fig 2 Monthly Flow Check

2.2 Single & Two Phase Modeling

The goal of this mode is to calculate the design flow. To obtain it, user has to select DCC out data like RTD Bias from Gateway. And user updates input tape files for ITYPE running. Single-phase modeling is to set up constant values to be used for modeling. It uses ITYPE2, ITYPE8, ITYPE7 and ITYPE 6. Actually ITYPE2 and ITYPE 6 are repeated to satisfy each limit value. In case of two-phase modeling, IYPE8, ITYPE6 and ITYPE2 are used. Two phase modeling is to create manifold model for calculation of real channel flow and CCP(Critical Channel Power). Fig 3 shows a simple work flow diagram of single and two-phase modeling in NUCIRC program.

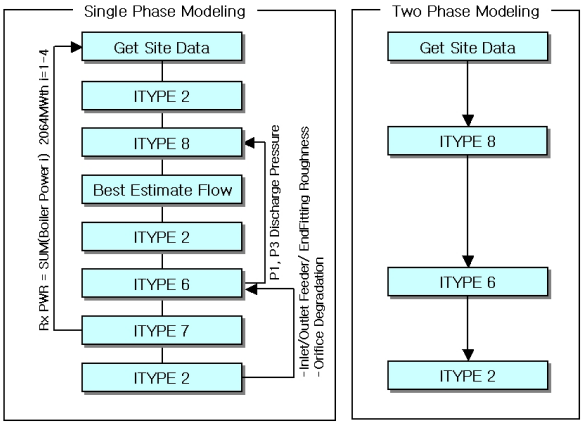

Fig 3 Single & Two Phase Modeling Process

NUCIRC module in COMPAS provides an automatic process to carry out this work and easy to use user interface to run a complicated tuning process. It contributes a time reduction of channel flow inspection and calculating design channel flow.

Fig 4 shows some examples of single and two phase modeling on NUCIRC module.

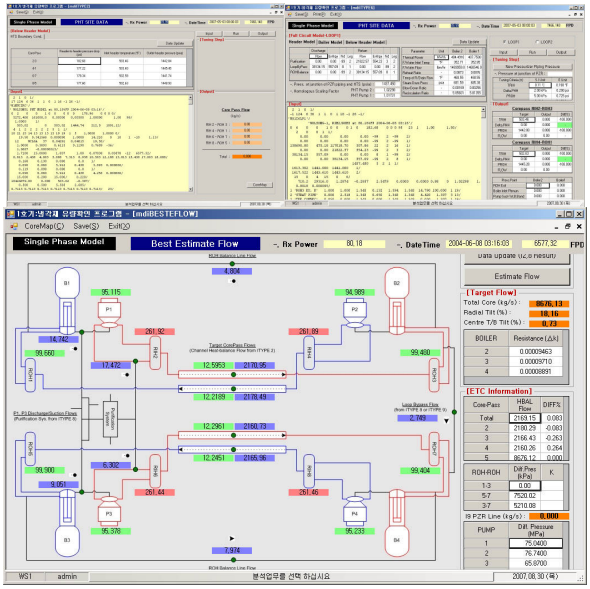

Fig 4 Single & Two Phase Modeling Mode of NUCIRC Module

3. Conclusions

The automated modeling and calculation of channel flow and management program have been developed. The NUCIRC module in COMPAS provides an automated channel flow check and calculation of design flow instead of the existing manual process.

These functions of the module can save the time, effort and potential error of the related worker. Actually the total time needed in modeling and calculation of the module can be reduced to one day, which takes two weeks in manual process.

REFERENCES

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