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Development of Coupled Interface System between the FADAS Code and a Source-term Evaluation Code XSOR for CANDU Reactors

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1. Introduction

An accident prevention system is essential to the industrial security of nuclear industry. Thus, the more effective accident prevention system will be helpful to promote safety culture as well as to acquire public acceptance for nuclear power industry.

The FADAS(Following Accident Dose Assessment System) which is a part of the Computerized Advisory System for a Radiological Emergency (CARE) system in KINS is used for the prevention against nuclear accident [1]. In order to enhance the FADAS system more effective for CANDU reactors, it is necessary to develop the various accident scenarios and reliable database of source terms. This study introduces the construction of the coupled interface system between the FADAS and the source-term evaluation code aimed to improve the applicability of the CANDU Integrated Safety Analysis System (CISAS) for CANDU reactors.

2. FADAS and XSOR

The purpose of the FADAS system is to protect human beings and the environment from a radiation exposure by providing the technical support and advisory services to the national radiological emergency response system. In the case of a radiological emergency from a radiation accident at a nuclear facility, the FADAS enables to predict the dispersion of the radioactive materials into the environment, estimation of the following accident doses to the public and so on.

The XSOR code is a source-term evaluation program, which provides rapid calculation of source terms for a large number of Accident Progress Bins (APBs) for each observation of a Latin Hypercube Sampling (LHS) sample. The LHS program selects a single value for every issue in each observation. Therefore, the XSOR code is able to calculate a source-term for each APB in each observation. Moreover, since the case structure specified by the experts is preserved, additional cases are not necessary to consider the expert panels. Therefore, distributions for additional cases are typically proportional to the distribution of the most closely analogous case considered by the experts. The programs are also able to produce single point-value estimates. The point estimate can be the median (or other measure) of each issue distribution, or a simulation of the Source Term Code Package (STCP) or any other suite of codes.

3. Coupled Interfaces between FADAS and XSOR

The XSOR codes run based on 11 parameters, which represent APBs. Some of the safety variables from the FADAS system are directly linked to the XSOR parameters, but others are not. This research has developed an algorithm so that the XSOR parameters can be determined based on the safety variables and the engineering judgment from the variables.

Table 1 lists up the safety variables from the FADAS system used for the interface with the XSOR code.

CARE Variables	Descriptions
CVPr	Containment Vessel Pressure
RVHdLvl	Reactor Vessel Head Level
CVSpray	Containment Vessel Spray
CVH2	Containment Vessel Hydrogen Density
CVSmLvl	Containment Sump Level
SG1Lvl	Steam Generator #1 Level
SG1Pr	Steam Generator #1 Pressure
SG2Lvl	Steam Generator #2 Level
SG2Pr	Steam Generator #2 Pressure
DAERad	Deaerator Effluent Radiation
PZRPr	Pressurizer Pressure

Table 1. CARE Safety Variables for the XSOR Interface

The algorithm logically links the safety variables and their set points to the XSOR parameters. For example, the Containment Failure Time, which represents containment related XSOR parameters, is determined based on the FADAS variables corresponding to the containment vessel pressure (CVPr) and the reactor vessel head level (RVHdLvl). The Containment Sprays parameter is mapped with the FADAS variables corresponding to the Containment Vessel Spray (CVSpray) and the Containment Vessel Pressure (CVPr). The Core-Containment Interaction parameter is also mapped with the FADAS variables corresponding to the Containment Vessel Spray (CVSpray) and the Containment Vessel Pressure (CVPr). The RCS Pressure before VB parameter is mapped with the CARE variable corresponding to the Pressurizer Pressure (PZRPr). The Mode of Vessel Breach parameter is coupled with the values of the RCS Pressure before VB parameter. The Steam Generator Tube Rupture parameter is mapped with the FADAS variables corresponding to the Steam Generator #1

Level (SG1Lvl), the Steam Generator #1 Pressure (SG1Pr), the Steam Generator #2 Level (SG2Lvl), the Steam Generator #2 Pressure (SG2Pr), and the Radiological Density. The Amount of Core not in HPME available for CCI parameter is coupled with the values of the Mode of Vessel Breach parameter. Since the Zr Oxidation parameter could not be determined based on the FADAS safety variables, it is determined randomly. The High Pressure Melt Ejection (HPME) parameter is coupled with the values of the Mode of Vessel Breach parameter. The Containment Failure Size parameter and the Holes in the RCS parameter can not be determined based on the FADAS safety variables, thus they are determined randomly. Table 2 shows an example algorithm for the interface (for the case of Containment Failure Time).

CARE Variables	Logic	Setpoint	XSOR Parameter Value
CVPr		54 >	A, B
RVHdLvl	AND	54 >	C
CVPr		5 >	
RVHdLvl	AND	54 >	D
CVPr		1 >	
RVHdLvl	AND	5 < (2 hr. over)	E
CVPr		54 >	
RVHdLvl	AND	5 < (24 hr. over)	F
CVPr		54 >	
CVPr		54 <	G

Table 2. Algorithm for the Interface (Containment Failure Time)

The algorithms for other parameters are similar to the above algorithm. All the algorithms are implemented in the computer program shown in Figure 1.

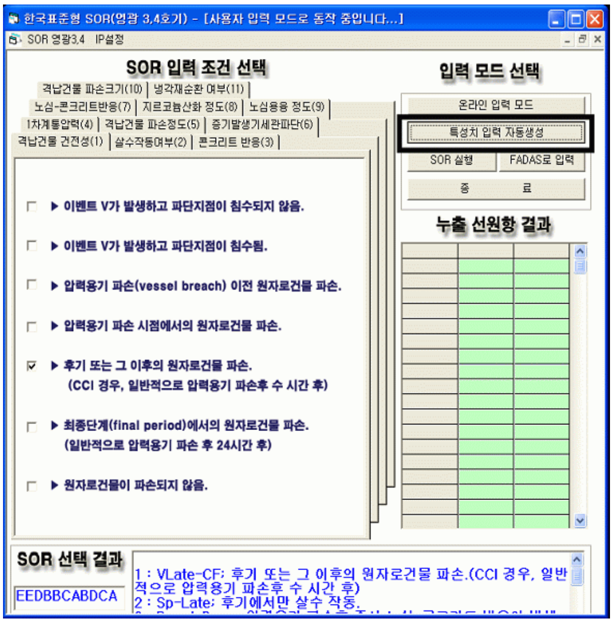

Figure 1. Interface Program for CARE and XSOR

4. Conclusions

The coupled interface program between FADAS code and XSOR code is developed to simulate the various accident scenarios and reliable database of source terms for CANDU reactors. The coupled interface program will be incorporated into the CANDU Integrated Safety Assessment System (CISAS) so that it can be applied for CANDU reactors.

REFERENCES

[1] KINS, http://care.kins.re.kr
[2] USNRC, Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants: Final Summary Report, NUREG-1150, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, December 1990.