# Development of Operational Safety Monitoring System and Emergency Preparedness Advisory System for CANDU Reactors (I)

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## 1. Introduction

As increase of operating nuclear power plants, an accident monitoring system is essential to ensure the operational safety of nuclear power plant. Thus, KINS has developed the Computerized Advisory System for a Radiological Emergency (CARE) system to monitor the operating status of nuclear power plant continuously. However, during the accidents or/and incidents some parameters could not be provided from the process computer of nuclear power plant to the CARE system due to limitation of To enhance the CARE system more effective for CANDU reactors, there is a need to provide complement the feature of the CARE in such a way to providing the operating parameters using to using safety analysis tool such as CANDU Integrated Safety Analysis System (CISAS) for CANDU reactors.

In this study, to enhance the safety monitoring measurement two computerized systems such as a CANDU Operational Safety Monitoring System (COSMOS) and prototype of CANDU Emergency Preparedness Advisory System (CEPAS) are developed. This study introduces the two integrated safety monitoring system using the R&D products of the national mid- and long-term R&D such as CISAS and ISSAC code.

## 2. Operational Safety Monitoring System

The purpose of the COSMOS is an analysis tool to assess the accident and incident so as 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 the accident or incident taking place at a nuclear facility, the operating parameters are transferred from a nuclear station to the CARE system in the real-time based. In a meanwhile, CISAS is a integrated safety analysis tool for evaluating the accident and incident. Therefore, if CARE is coupled with CISAS in the platform, it is a useful tool to monitor the plant status under the accident and incident condition. COSMOS is developed as a prototype to couple those two systems, CARE and CISAS for CANDU reactors,

Furthermore, FADAS-CANDU in the CISAS enables to predict the dispersion of the radioactive materials into the environment, estimation of the following accident doses to the public.

The general structure of COSMOS is shown in Fig. 1

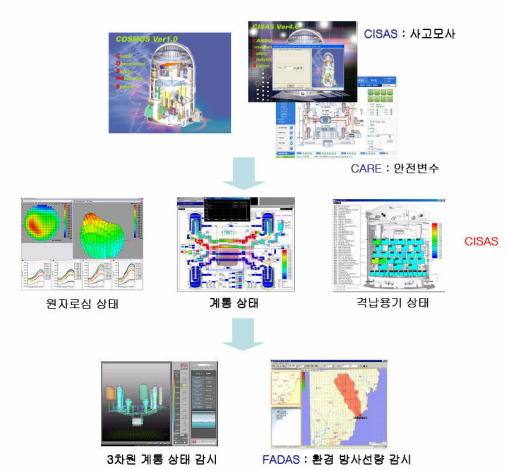


Figure 1 The general structure of COSMOS

## 3. Emergency Preparedness Advisory System

The emergency preparedness advisory system (CEPAS) for CANDU reactors is an analysis tool not only to assess the severe accident, but also to provide the technical support and advisory services to the national radiological emergency response system.

In the case of the radiological emergency from a radiation accident taking place at a nuclear facility, there is a need to predict the dispersion of the radioactive materials into the environment, estimation of the following accident doses to the public aimed to evacuating the public in accordance with the national radiological emergency plan. In the nuclear station, the national radiological emergency training is conducted regularly in the basis of deterministic scenario and guideline. However, there are not any guidelines for CANDU reactors so far. Hence, in this study a computerized technical support and advisory system for the national radiological emergency training (CEPAS) is developed as a prototype.

The CEPAS is consisted of ISSAC, XSOR and FADAS-CANDU and enables to predict the severe accident, radiological source term and dispersion of the radioactive materials into the environment. The ISSAC code is a computer tool to simulate the phenomena of severe accident for CANDU reactors and is developing in the basis of MAAP-CANDU code by KAERI. 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.

The FADAS-CANDU code is to predict the dispersion of the radioactive materials into the environment, estimation of the following accident doses to the public for Wolsong site. 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.

Therefore, if CARE is coupled with CEPAS in the platform, it is a useful tool not only to predict the severe accident, radiological source term and dispersion of the radioactive materials into the environment, but also to provide the technical support and advisory services to the national radiological emergency response system. Furthermore the CEPAS enables to generate the scenarios in the national radiological emergency response training as a real-time based.

Figure 2 shows the general system structure of CEPAS.

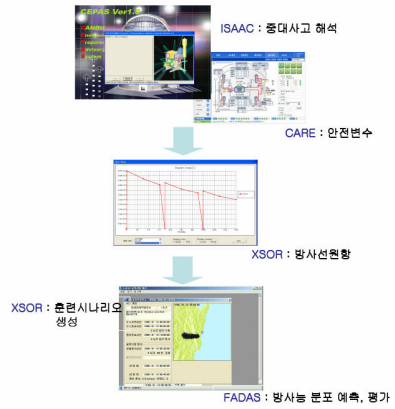


Figure 2. The general system structure of CEPAS

## 4. Conclusions

Two computerized systems such as a CANDU Operational Safety Monitoring System (COSMOS) and prototype of CANDU Emergency Preparedness Advisory System (CEPAS) are developed to enhance the safety monitoring measurement for CANDU reactors. While the COSMOS is developed to assess the accident and incident, the CEPAS is an analysis tool to assess the severe accident aimed to providing the technical support and advisory services to the national radiological emergency response system and training.

## 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.