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INSREC: Computational System for Quantitative Analysis of Radiation Effects Covering All Radiation field

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1. Introduction

Computational system for quantitative analysis of radiation effects (INSREC Program) was developed. To develop this program, essential methods and theories suitable to analysis steps or phenomena of radiation effects were gathered according to each program features. Also, to improve user's convenience, this program adopted the form of window based program and included database searching system based on AI(artificial intelligence) technology. In case of using searching system, terms, explanation, laws and theories for radiation field can be searched very easily through server systems constructed in our laboratory. Reliability for each program was verified by using methodology suitable to each algorithms applied to program.

2. Structure of INSREC Program

This program was developed to be applied to below 4 cases for radiation field.

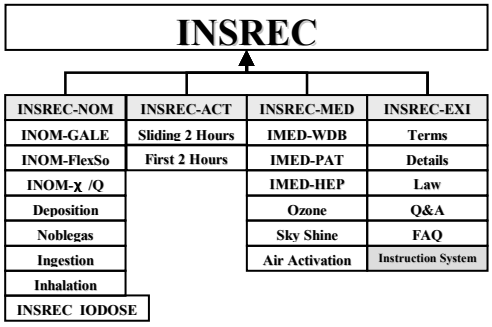

Fig. 1. Block Diagram of INSREC

2.1. INSREC-NOM

As you see above, INSREC-NOM of first sub-program of INSREC is the program which can evaluate on/off-site dose of nuclear power plant in normal operation. To evaluate off-site dose, 3 parts of sub-program were inserted into the INSREC-NOM program. Each sub-program is Source Term Evaluation program, atmospheric dispersion factor evaluation program and dose evaluation program respectively. Source term evaluation program is consisted of INOM-GALE, INOM-FlexSo. INOM-GALE is suitable to PWR by correction factor evaluation in reference reactor. On the other hand, INOM-FlexSo is the source term evaluation program for any-type of general nuclear power plant. Atmospheric dispersion factor evaluation program is INOM-X/Q and this program is used to consider dispersion condition at surroundings of nuclear power plant. Third program of INSREC-NOM, dose evaluation program is consisted of 4 sub-programs related to deposition/inhalation/ingestion /noblesgas. INSREC-IODOSE for evaluating on-site dose is the database program which is based on the dose data related to each works inside nuclear power plants.

2.2. INSREC-ACT

INSREC-ACT program is the program which can evaluate on/off-site dose of nuclear power plant in accident. By applying this program, dose for sliding 2 hours/first 2 hours can be evaluated.

2.3. INSREC-MED

INSREC-MED program is the program which can evaluate dose related to the hospital and is consisted of 6 parts of sub-program. This program has features which are the types of database program and dose evaluation program based on experimental formula[1]. Each sub-program is database program based on dose data related to radiation workers and patients in the hospital, dose evaluation program dependent upon treatment room design, and dose evaluation program for ozone-production/sky-shine/air-activation based on experimental formula, respectively.

2.4. INSREC-EXI

INSREC-EXI program is the database program which is based on terms, explanations, laws, theories for radiation fields. Also, this program has the detailed theories and application methods related to developed INSREC program. As the additional sub-programs, this program has the web-based Q&A and FAQ boards for general users and workers in the radiation fields.

3. Captured Image of INSREC Program

The Shape of INSREC program is below. Each program was developed as window based form by using Visual C++ 6.0. Contrasting with existing console-typed evaluation program, this program can serve an improved user's convenience.

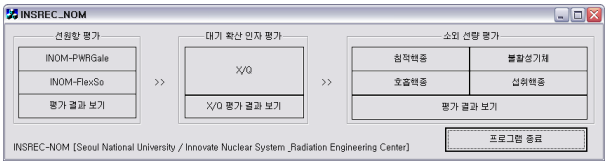

Fig. 2. INSREC-NOM

Fig. 3. INSREC-IODOSE

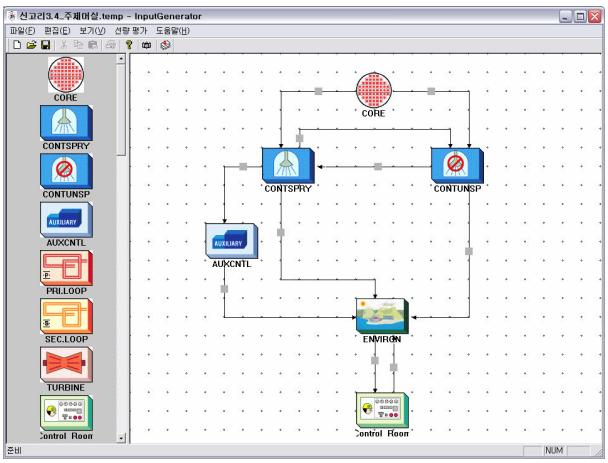

Fig. 4. INSREC-ACT

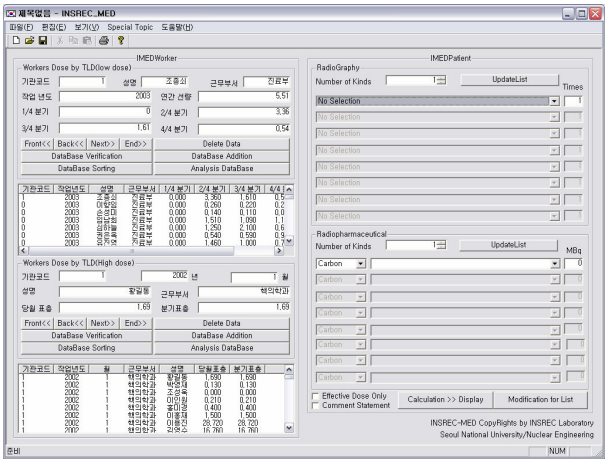

Fig. 5. INSREC-MED

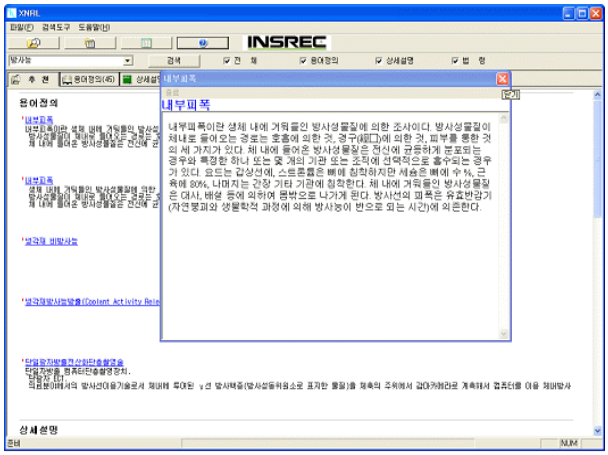

Fig. 6. INSREC-EXI

4. Validation and Conclusion

To verify the reliability of INSREC-NOM/INSREC-ACT program, 3/4 units of under construction KORI nuclear power plant were selected as the subject of verification.

To do for INSREC-NOM, PSAR[2] was referred to for obtaining the initial data for dose evaluation and these initial data gathered were inputted into INSREC-NOM program. The result of verification was that internal/external exposure dose calculated by INSREC-NOM was not matched to the evaluation result of PSAR[2]. But total effective dose was similar to the evaluation result of PSAR[2]. Therefore, it was proved that INSREC-NOM program has the reliability for dose evaluation of nuclear power plant.

To do for INSREC-ACT, accident scenario (DBA LOCA) of nuclear power plant was designed. After designing the scenario, necessary data were inputted into the each program. The result of verification was that there were the meaningful errors comparing evaluation results of INSREC-ACT with PSAR[2]. The reason is existence and nonexistence of Spray Lambda. For that reason, additional research for verification is in progress to reduce the errors in dose evaluation.

To do for INSREC-MED, general type of treatment room was selected. Based on this room's geometry, Monte Carlo Simulation[3] was accomplished to compare with the result of dose evaluation of INSREC-MED. The result was that dose result of INSREC-MED was slightly larger than the result of MCNP[3]. But the error of comparison was in 10% range, so INSREC-MED was proved having the reliability for dose evaluation for treatment room.

REFERENCES

[1] Patton H. McGknley, Ph.D., D.A.B.R., D.A.B.H.P. "Shielding Technique for Radiation Oncology Facilities", Medical Physics Publishing Madison, Wisconsin.

[2] KHNP CO., "APR1400 SSAR", "APR1400 PSAR"

[3] RSIC Computer Code Collection, MCNP 4C, Oak Ridge National Laboratory