Development of GOD MASTER Program for Accident Dose Effect in DBA/BDBA

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1. INTRODUCTION

The final safety analysis report includes design-based accidents, and the accident management plan includes multiple failure accidents and severe accidents. In this study, we will introduce the development of an integrated-combined program GOD MASTER(Great Off/on sites accident's Dose analysis MASTER) that can comprehensively evaluate these accidents.

And it has comprehensive capabilities to analyze inputs and outputs, generate inputs and perform accident dose evaluations.

In this paper, the code structure and system will be introduced. Here, we will verify the computational function that performs various evaluations of atmospheric dispersion factors at once among many functions.

In particular, this calculation process is carried out in conjunction with the PAVAN code from NRC [1].

2. METHODOLOGY

2.1. Development of GOD MASTER

The GOD MASTER code uses several computer languages. It was created using FORTRAN, PASCAL, and PERL. In the end, PERL is main process, and the calculation modules of each part are built using FORTRAN, PASCAL and PERL. The calculation part is mainly written in FORTRAN, and the linked part is used in PERL. The rest of the calculations were written using PERL and PASCAL[2].

Perl is a highly capable, feature-rich programming language over 30 years of development. And various program modules can be used. In this study, the Perl system's CPAN modules were used to compile and create executable files.

In Fortran parts of calculation function, Intel Fortran Compiler was used.

The calculation part, including text file extraction, which is difficult to implement in FORTRAN, was written in PERL.

Fig. 1 shows the system of GOD MASTER. This code has the function to analyze input/output statements, extract specific parts, and use the extracted information as variables to perform new calculations.

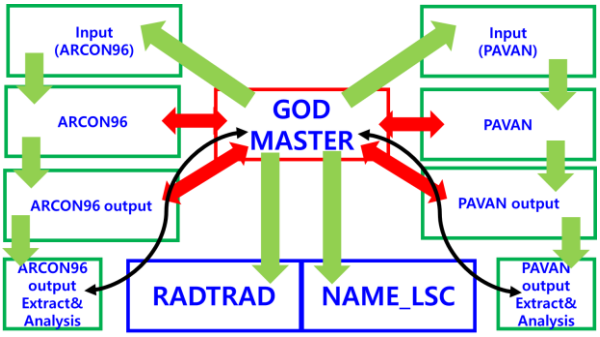

Fig. 1 Integration system of GOD MASTER code.

In these calculations, the input generation of RER evaluation and the execution information of the PAVAN code and ARCON96 code can be extracted to make the specific calculation of atmospheric dispersion factors for specific purpose.

2.2. Analysis of Various Execution and Output Calculation Generations

When performing calculations and applying the full option, approximately 132 different calculation results and output results are generated.

The overall calculation procedure is summarized as follows.

There is a step to read the raw data and convert the format into a form that can be analyzed.

The next step is to extract the necessary information. Next, there is a step of storing the extracted information as a variable and structuring it in an array format to organize the necessary parts.

Next, there is a fitting step using only the information needed for calculation. There is a step in which various analyzed and calculated results are generated from output information. When the output results are generated, "Results_arrange.txt" file and "Results_arrange2.xlsx" are generated. The final results summarization are always written in xlsx format.

Ultimately, this code can perform multiple calculations of various complex procedures simultaneously and efficiently. Otherwise, the existing evaluation method produced separate input data in every process and each separate calculation was performed for a long time to arrive at the final results.

3. RESULTS AND DISCUSSIONS

3.1. GOD MASTER's Various Output Results

As shown in Fig. 2, 3, it shows the initial screen for starting the program and various output files created after execution. And finally, one of the final organized output results is shown in Fig. 4.
Here, Fig. 4 will be used as data for code verification.
Looking at Fig.2 in more detail, what is labeled "stage" means extracting specific data by analyzing the output text in detail. And the files named "output" organize the extracted data in an orderly manner.
Calculations are performed for each direction through organized data, and final input data and atmospheric dispersion factors are generated in various ways to suit the purpose. These files can be useful when examining intermediate calculation process and results during the development stage.

Fig. 2 Initial screen of GOD MASTER code

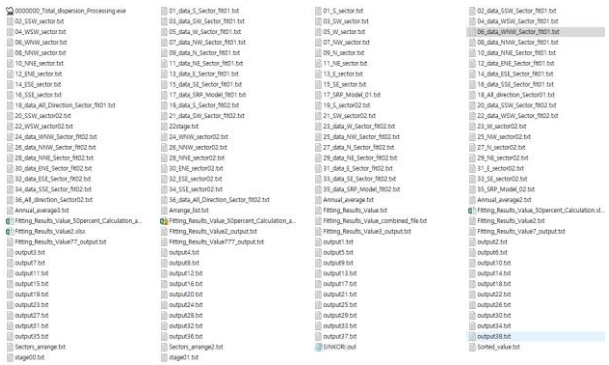
Fig. 3 Various output files from GOD MASTER execution.

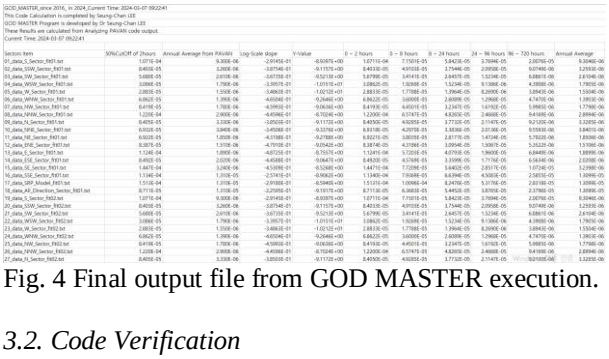
Fig. 4 Final output file from GOD MASTER execution.

3.2. Code Verification

In order to verify the code, the calculation results of this study, shown in Fig. 4 were compared with the existing evaluation results. Table 1 is a list of the results in Fig. 4 organized by sectors. The largest value was selected in Table 1, and also the largest value was also selected in the existing results. The results compared for verification are summarized in Table 2.

Looking at the comparison results in Table2, it can be seen that the results of the GOD MASTER code developed in this study are in good agreement with the existing results. In addition, it can be seen that several previously complex calculation steps can be processed efficiently at once through this code development.

Table 1. Calculation results of each sector from GOD MASTER in Fig. 4.

sector	0 ~ 2 hours	0 ~ 8 hours	8 ~ 24 hours	24 ~ 96 hours	96 ~ 720 hours
S	1.0711E-04	7.1501E-05	5.8423E-05	3.7694E-05	2.0076E-05
SSW	8.4033E-05	4.9103E-05	3.7544E-05	2.0958E-05	9.0749E-06
SW	5.6799E-05	3.4141E-05	2.6457E-05	1.5234E-05	6.8861E-06
WSW	3.0862E-05	1.9269E-05	1.5234E-05	9.1386E-06	4.3908E-06
W	2.8833E-05	1.7788E-05	1.3964E-05	8.2690E-06	3.8943E-06
WNW	6.8622E-05	3.6000E-05	2.6089E-05	1.2968E-05	4.7470E-06
NW	8.4193E-05	4.4501E-05	3.2347E-05	1.6192E-05	5.9985E-06
NNW	1.2200E-04	6.5747E-05	4.8265E-05	2.4668E-05	9.4169E-06
N	8.4050E-05	4.9285E-05	3.7732E-05	2.1147E-05	9.2120E-06
NNE	6.9318E-05	4.2970E-05	3.3836E-05	2.0136E-05	9.5593E-06
NE	6.9221E-05	3.8035E-05	2.8177E-05	1.4724E-05	5.7922E-06
ENE	8.3874E-05	4.3186E-05	3.0954E-05	1.5067E-05	5.3522E-06
E	1.1241E-04	5.7203E-05	4.0793E-05	1.9600E-05	6.8449E-06
ESE	8.4920E-05	4.5769E-05	3.3599E-05	1.7176E-05	6.5634E-06
SE	1.4471E-04	7.7209E-05	5.6402E-05	2.8517E-05	1.0724E-05
SSE	1.1340E-04	7.9369E-05	6.6394E-05	4.5083E-05	2.5855E-05
SRP	1.5131E-04	1.0096E-04	8.2476E-05	5.3176E-05	2.8318E-05
All	8.7113E-05	6.3683E-05	5.4452E-05	3.8765E-05	2.3796E-05
Maximum	1.5131E-04	1.0096E-04	8.2476E-05	5.3176E-05	2.8318E-05

Table 2. Comparisons between this study results and the existing calculation results

Maximum Results	0~2 hours	0~8 hours	8~24 hours	24~96 hours	96~720 hours
50% cut off (this study)	1.5131E-04	1.0096E-04	8.2476E-05	5.3176E-05	2.8318E-05
50%cut off (existing)	1.5131E-04	1.0096E-04	8.2477E-05	5.3176E-05	2.8319E-05

In conclusion, the code developed of this study can be said to be a program that analyzes output statements through integrated linkage, extracts necessary data, and performs all calculations at once using the extracted data. From this perspective, the calculation results of the GOD MASTER code can be significant in increasing the efficiency of evaluation because it is a

method that breaks away from the existing method of calculating through several separate procedures.

4. CONCLUSIONS

In this study, the following conclusions can be obtained from Fig. 3 and Fig. 4 and from Table 2.

When calculating with the full option of the GOD MASTER code, various calculations are performed simultaneously, as shown in Fig. 3. And Fig. 4 shows that the organized calculation results produce the final output in xlsx format. As a result of code verification, the results showed very good agreement, as shown in Table 2. From Table 2, all calculations that require complex and multi-step calculation procedures are efficiently performed from one-through calculation of GOD MASTER.

REFERENCES

[1] KHNP-CRI, Seung-Chan LEE, “Study for Atmospheric Dispersion Factors and Stability in NPP Sites”, KNS Virtual Autumn Meeting, October (2021).
[2]Larry Wall, “Programming Perl”, (2000).