

Partial correction of the report on results of earthquake response analysis of Unit 2 at Fukushima Daini Nuclear Power Station using observed seismic data during the Tohoku-Taiheiyou-Oki Earthquake

1, Outline of the event

On August 17, 2011, we submitted to NISA a report on results of earthquake response analysis of reactor building, facilities and pipes important to earthquake safety in Unit 2 at Fukushima Daini Nuclear Power Station using observed seismic data during the Tohoku-Taiheiyou-Oki Earthquake (hereinafter referred to as “the Report”). And, we discovered an error in the evaluation results of the main steam system piping arrangement in the Report.

The error was caused because inputted moment of the piping arrangement was different from a proper value during evaluating stress of the piping arrangement. According to the inconformity, the evaluation results of the main steam system piping arrangement in the Report needs to be corrected.

2. Contents

(1) Computer program for analysis of piping systems (HISAP)

Hitachi-GE Nuclear Energy, Ltd. (hereinafter referred to as “Hitachi-GE”) conducts analysis of piping systems using HISAP as a computer program.

The inside of HISAP is divided into four parts, which are composed of sub program A, main program B, sub program C and main program D. The sub program A functions to convert formats of batch process setting files, and generate data to be transferred to the main program B. The main program B functions, which is a general-purpose finite element method program (SAP), functions to calculate moment at each point of piping arrangement model. The sub program C functions to convert formats of moment calculated by the main program B and generate data to be transferred to the main program D. The main program D is a program for calculating stress based on moment. (Refer to Figure 1)

(2) Contents of inconformity occurred in the past and countermeasures

There was a case where an evaluation result was in error in the past. (Already reported to NISA on September, 2008) The content of the inconformity was that the sub program C of the previous version HISAP Ver.51 Rev.0 was defective, which caused false calculation of stress of piping arrangement.

At that time, the file was changed by hand as an emergency measure. (Refer to Figure 1 [before program improvement]) Later, the defect of the sub program C was modified and HISAP was revised under the name of Ver.51 Rev.1. This update realized to directly read files generated by the main program B into the sub program C and to calculate stress of piping arrangement properly. (Refer to Figure 1 [after program improvement])

The latest version is Ver.52 Rev.0. There is no relation between this inconformity and upgrading from Ver.51 Rev.1 and Ver.52 Rev.0.

(3) Inconformity event occurred this time

For evaluating the main steam system piping arrangement, a batch process setting file to input

HISAP (Ver.52 Rev.0) was developed, diverting from the batch process setting file which was utilized when the emergency measure was made against the past inconformity. For that reason, the name of the file read by the sub program C was changed regarding the original batch process setting file. In addition, inside the diverted work folder, not only files generated by the main program B but also files modified by hand existed.

To properly conduct the analysis this time, the modification of the designation of the file name to be read by the sub program C should be done, but weren't done. Moreover, since not only the batch process setting file but also all the other files inside the original work folder were copied to the work folder for this analysis, the sub program C read in the file whose code was changed and the false stress was calculated. (Refer to Figure 1 [Occurrence of the event])

3. Result of reevaluation

Table 1 shows the evaluation result of the stress of the piping arrangement after inputting proper moment of the piping arrangement.

The reevaluation result shows that the calculated value is lower than the evaluation standard value and there is no problem for safety. (Refer to Table 1)

Table 1 Reevaluation result of the main steam system piping arrangement (Unit: MPa)

| Facility to be evaluated | Part to be evaluated | Stress clarification | Calculated value (before modification) | Calculated value (after modification) | Evaluation standard value |
|--------------------------------------|----------------------|----------------------|--|---------------------------------------|---------------------------|
| main steam system piping arrangement | Pipe | Primary | 164 | 172 | 374 |

4. Horizontal development

This inconformity influences the evaluation corresponding to all of the following four (4) conditions.

Evaluation in which analysis procedure was changed according to upgrading the computer program for the said analysis

Evaluation diverted input data before the version upgrade

Evaluation which does not confirm whether input in correctly done based on the procedure change by the version upgrade

Evaluation in which the comparative verification with the original is not done

Regarding all of input data in the above-mentioned evaluations, when we confirmed whether there was an error similar to this conformity, it was confirmed that there was no same error except for the evaluation in question.

5. Investigation results of the cause

We described investigation result of the cause of this nonconformity as follow;

- We should have to change the input file to Subprogram C due to version up of calculation program.
But, the person responsible for analysis didn't recognize necessity of changing input file name because the change had not announced well and had not described on operation procedure.
- The person responsible for analysis didn't know the change of file name due to upgrade of calculation program. Therefore, he used input data of past analysis as input data (batch process

configuration file) of this analysis. He judged there was no need to evaluate all items of input data and conducted only valuation of load condition because these data have evaluated in the past. He confirmed input data other than load condition are the same as original input data and judged the input data were valid.

- The reviewer acknowledged the person responsible for analysis used input data of past analysis as input data of this analysis. But he didn't assume the person copied files other than input data. Therefore, he judges the data were valid by confirmation of load condition and the fact that the calculation program worked without incidents .(If we diverted only input data, the calculation program would not work without incidents)

6. Measure for prevention of recurrence

Although we assume we could avoid this nonconformity with adequate valuation for input data, we conduct countermeasures as follow:

- At the Hitachi-GE, they have to announce the changes when the calculation program upgrade. Additionally, they have to describe changes of analysis procedure as precaution on operation procedure when the analysis procedure changed.
- At Hitachi-GE, they have to confirm all items of input data relating to valuation of input data. When they don't conduct confirmation of all items, they have to conduct confirmation of input data by evaluate the appropriateness for exclusion of some items from confirmation coverage.
- At TEPCO, we try to rise caution by describing this nonconformity as nonconformity case on applicable document of our manual.
- Hereafter, we will confirm the conduction of valuation of input data has conducted certainly by Hitachi-GE.

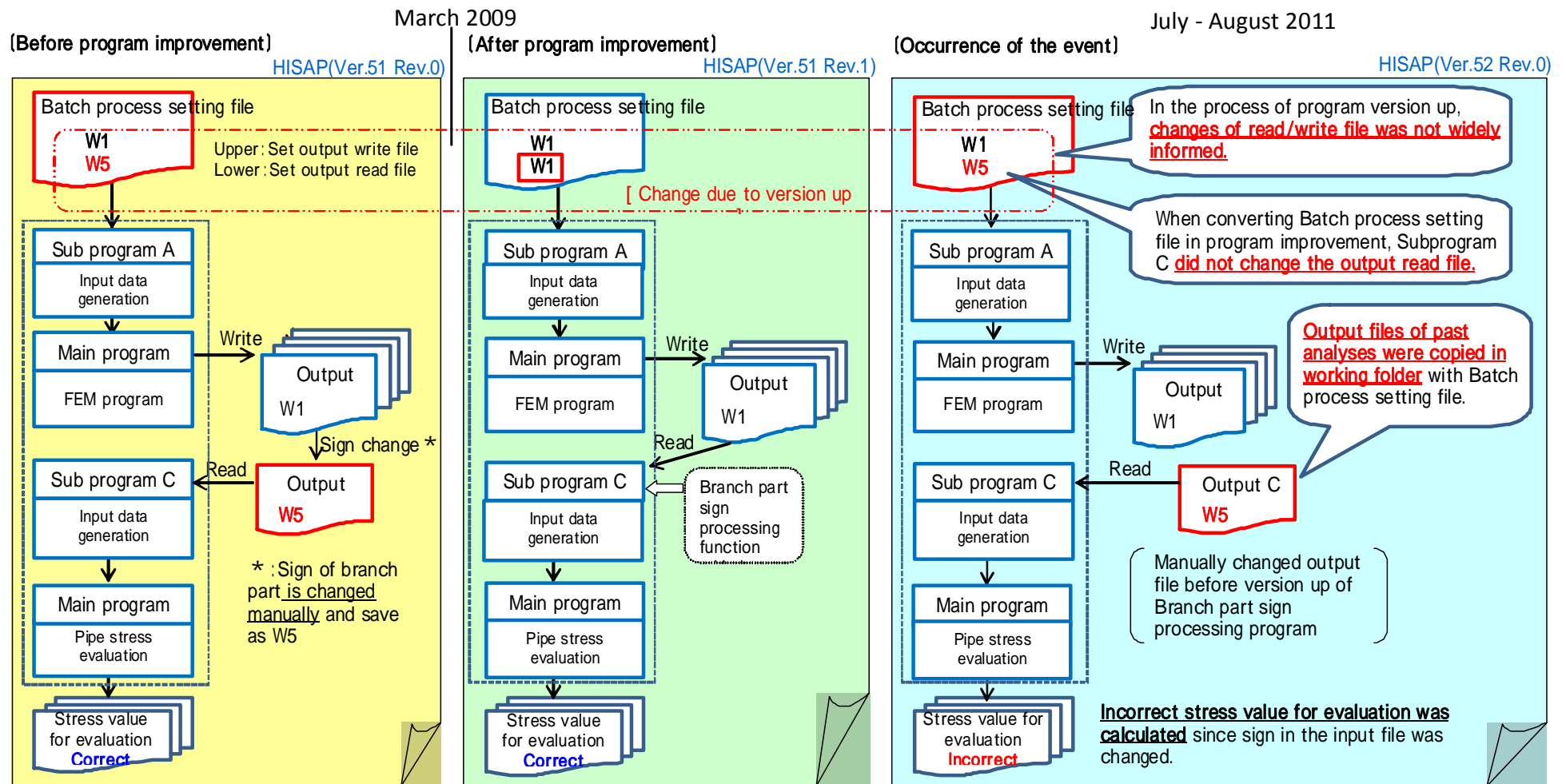


Figure 1 Explanation of the evaluation work flow and the inconformity event