Results of Follow-up Study to Check for Possible Errors in Report on "Urgent Safety Measures at Hamaoka Nuclear Power Station," Etc. (Overview)

Responding to instructions from the Nuclear and Industrial Safety Agency (NISA), Chubu Electric Power has conducted follow-up studies in order to check for errors in reports submitted to the agency. The causes of the errors discovered have been analyzed, and measures have been formulated to ensure that similar errors are not reported in future. An overview is provided below.

1. Scope of studies

Within the total scope of the studies initially requested by NISA, follow-up studies were conducted with regard to the following four reports submitted by Chubu Electric Power.

< 1 > "Report Responding to the directive of the Nuclear and Industrial Safety Agency entitled "Implementation of Emergency Safety Measures at Nuclear Power Stations, taking into Consideration the Accidents at the Fukushima Daiichi and Daini Nuclear Power Stations in 2011"" (termed "Emergency Safety Measures Report" below). (Submitted to NISA on April 20, 2011; announced on same day)

< 2 > "Report Responding to the directive of the Nuclear and Industrial Safety Agency entitled "Ensuring Reliability of External Power at Nuclear Power Stations"" (termed "Reliability of External Power Report" below). (Submitted to NISA on May 16, 2011; announced on same day)

< 3 > "Report Responding to the directive of the Nuclear and Industrial Safety Agency entitled "Implementation of Measures to Respond to Severe Accidents at Nuclear Power Stations, taking into Consideration the Accidents at the Fukushima Daiichi and Daini Nuclear Power Stations in 2011"" (termed "Severe Accidents Report" below). (Submitted to NISA on June 14, 2011; announced on same day)

< 4 > "Report Responding to the directive of the Nuclear and Industrial Safety Agency entitled "Regarding Earthquake Countermeasures at Switching Stations, etc. to Ensure Reliability of External Power at Nuclear Power Stations, etc."" (Report Concerning Directive of the METI's NISA) (termed "Earthquake Measures at Switching Stations, etc. Report" below). (Submitted to NISA on July 7, 2011; announced on same day)

2. Results of follow-up studies

The results of the follow-up studies indicated that, in addition to the three errors indicated to NISA in "Report Responding to the directive of the Nuclear and Industrial Safety Agency entitled "Regarding Measures Taking into Consideration Possible Errors in Reports on Emergency Safety Measures, Etc.,"" (termed "Follow-up Survey Report" below) submitted on September 28, 2011, a further six errors occurred in reports, as follows:

(1) "Emergency Safety Measures Report"・・・3 errors

・Error in saturation temperature of coolant in relation to reactor pressure

・Errors in internal capacity of temporary nitrogen cylinders

・Errors in pressure loss in internal pipes

(2) "Severe Accidents Report"・・・2 errors

・Inconsistency in formulas for calculation of power source capacity required for emergency generators

・Errors in specifications of heavy equipment for removal of debris

(3) "Earthquake Measures at Switching Stations, etc. Report"・・・1 error

・ Error in tolerance in relation to design seismic force for Unit No. 5 switching station equipment

No errors were found in "Reliability of External Power Report."

3. Details of errors in reports

The details of the six errors determined in the follow-up studies were studied and their impact was analyzed. In each case, it was determined that the errors had no effect on the evaluation of emergency safety measures, and the emergency safety measures that Chubu Electric Power has put in place are not compromised in any way.

(1) Errors in "Emergency Safety Measures Report"

○ Error in saturation temperature of coolant in relation to reactor pressure

a. Overview of error

An erroneous figure was reported for coolant saturation temperature in relation to reactor pressure.

- Coolant saturation temperature: (Error) Approx. 177°C → Correction) Approx. 181°C

b. Analysis of impact

Because the figure was not directly employed in the evaluation of emergency safety measures, the error had no impact on the evaluation.

○ Errors in internal capacity of temporary nitrogen cylinders

a. Overview of errors

Erroneous figures were reported for the internal capacity of the temporary nitrogen cylinders (when converted to internal capacity at minimum operating pressure) for opening the air-operated valves of the reactor containment vessel vent lines with strengthened pressure resistance installed as an emergency safety measure.

- Internal capacity of cylinders for Unit No. 3 (when converted to internal capacity at minimum operating pressure): (Error) Approx. 267 liters → (Correction) Approx. 227 liters
- Internal capacity of cylinders for Unit No. 4 (when converted to internal capacity at minimum operating pressure): (Error) Approx. 267 liters → (Correction) Approx. 227 liters

b. Analysis of impact

After correction, the capacity of the cylinders exceeded the capacity required to open the air-operated valves (61 liters for Unit No. 3 and 34 liters for Unit No. 4), and the errors therefore had no effect on the evaluation of emergency safety measures.

○ Errors in pressure loss in internal pipes

a. Overview of errors

Erroneous figures were reported for pressure loss in the internal pipes in the main water paths to the reactors and spent fuel pools due to the use of portable power pumps.

(a) Main water paths to reactors

- Pressure loss in internal pipes in Unit No. 3: (Error) 8.39 m → (Correction) 8.57 m
- Pressure loss in internal pipes in Unit No. 4: (Error) 8.25 m → (Correction) 8.23 m
- Pressure loss in internal pipes in Unit No. 5: (Error) 17.11 m → (Correction) 18.93 m

(b) Main water paths to spent fuel pools

- Pressure loss in internal pipes in Unit No. 3: (Error) 8.14 m → (Correction) 8.31 m
- Pressure loss in internal pipes in Unit No. 4: (Error) 8.18 m → (Correction) 8.08 m
- Pressure loss in internal pipes in Unit No. 5: (Error) 17.23 m → (Correction) 17.96 m

b. Analysis of impact

After correction, the total pressure loss in the main water paths (Pressure loss in hoses + Pressure loss in internal pipes + Static head difference) is a maximum of 50.29 m. This figure falls below the specifications of the portable power pumps (pump head*: 102 m), and the error therefore had no impact on the evaluation of emergency safety measures.

*Pump head refers to the height in meters to which a pump can raise water, and is an indicator of a pump's ability.

(2) Errors in "Severe Accidents Report"

○ Inconsistency in formulas for calculation of power source capacity required for emergency generators

a. Overview of error

In order to determine the necessary capacity of power sources for the emergency generators, the power source capacity required for each relevant device was calculated. However, the treatment of efficiency in the calculations was inconsistent, with some calculations performed with consideration of efficiency, and others with no consideration of efficiency.

The formulas for calculation of required power source capacity and the method of rounding fractions were rendered consistent, and the reported figures, including the figures reported in "Emergency Safety Measures Report," were corrected.

- Required power source capacity (Unit No. 1):

	<1> Power source capacity required for emergency safety measures 【kVA】	<2> Power source capacity for Central Control Room air conditioning 【kVA】	<3> Required power source capacity (<1>+<2>) 【kVA】	<4> Power source capacity required for emergency generators 【kVA】	<5> Power source capacity margin (<4>－<3>) 【kVA】
(Error)	28	Approx. 61	Approx. 89	250	Approx. 161
(Correction)	27	Approx. 69	Approx. 96	250	Approx. 154

b. Analysis of impact

The power source capacity available for emergency generators remained significantly in excess of the total power source capacity required in order to respond to a severe accident even when the calculation methods were rendered consistent, and the error therefore had no impact on the evaluation of severe accident measures.

○ Errors in specifications of heavy equipment for removal of debris

a. Overview of errors

Erroneous figures were reported for the specifications of heavy equipment prepared for the removal of rubble.

- Bulldozer shovel capacity: (Error) 2.2 m^3 → (Correction) 1.9 m^3
  Fuel consumption: (Error) 7 L/h → (Correction) 6.9 L/h
- Weight of hydraulic shovel : (Error) 19,500 kg → (Correction) 19,800 kg
  Fuel consumption: (Error) 10 L/h → (Correction) 15 L/h
- Fuel consumption of crawler carrier : (Error) 7 L/h → (Correction) 20.9 L/h

b. Analysis of impact

With regard to fuel consumption, despite the fact that figures have decreased for some heavy equipment following correction, satisfactory operation would remain possible based on the volume of fuel stored in tanks at Hamaoka Nuclear Power Station.

Bulldozer shovel capacity is a measure of the size of the blade, and does not affect the machine's traction, which is the required performance parameter.

The weight of the hydraulic shovel does not affect lifting load, the required performance parameter.

Given the above, the reported errors in equipment specifications did not affect the evaluation of severe accident measures.

(3) Error in "Earthquake Measures at Switching Stations, etc. Report"

○ Error in tolerance in relation to design seismic force for Unit No. 5 switching station equipment

a. Overview of error

An erroneous figure was reported for the tolerance of the switching station equipment for Unit No. 5 in relation to design seismic force (3 m/s^2), as specified in JEAG5003, "Electric Facility Seismic Design Guidelines for Substations, etc."

In addition to correcting the reported tolerance, the units employed for design seismic force (G) were revised to m/s^2 in accordance with JEAG5003.

- Tolerance for Unit No. 5 switching station equipment: (Error) 2.25 → (Correction) 2.21

b. Analysis of impact

After correction, the safety margin for the switching station equipment for Unit No. 5 remained in excess of the required safety margin (1.3), and the error therefore had no effect on the evaluation of earthquake measures at switching stations, etc.

4. Causes

The problems forming the causes of the six errors identified in the follow-up studies were compiled together with the causes of the errors determined in the previous studies. It was determined that the following problems exist in the report formulation process.

(1) Problems in system for checking and checking procedures

a. Problems identified in previous studies

< 1 > There were cases in which it was unclear as to which departments should check the details in the reports, and what the scope of those checks should be.

< 2 > There were cases in which the details of the assessments were not checked by the head of the department concerned.

< 3 > There were cases in which figures, etc. were not double-checked.

b. Problems identified in follow-up studies

< 1 > There were cases in which errors in units were overlooked as a result of fixed assumptions, and cross-checking with calculation bases was insufficient.

(2) Problems in calculation bases

a. Problems identified in previous studies

< 1 > There were cases in which checks were conducted using basic design documents that were not appropriate for use as calculation bases.

b. Problems identified in follow-up studies

< 1 > When verifying the adequacy of materials formulated by manufacturers used as calculation bases, there were cases in which inadequate checking was conducted (cross-checking with bases for input values for analysis codes, simulation models, etc., checking of manufacturers' calculation processes, etc.).

5. Measures to prevent the reoccurrence of errors

Based on the problem points outlined in 4. above, the following measures were formulated to prevent similar errors from occurring again.

It was determined that awareness of the need to meet deadlines for submission and consequent insufficiently rigorous checking, for example when it proved necessary to add details to a report at the last minute prior to submission, was a background factor in the errors outlined here. Given this, in future the measures to prevent reoccurrence of this situation indicated below will be implemented, and judgments concerning the extension of submission deadlines will be made as necessary and with appropriate consideration in the departments responsible for the compilation of reports.

(1) Clarification of system of checking and checking procedures

The following measures will be adopted in relation to the system of checking and checking procedures when reports are formulated for external agencies.

a. Measures to prevent the reoccurrence of errors formulated in previous studies

< 1 > Departments responsible for the compilation of reports will indicate the department responsible for checking and the scope for the checks.

< 2 > A member of staff of the department responsible for checking other than those staff members directly engaged in the checking process will review results using calculation bases, and the head of the department will approve the final results.

< 3 > Departments responsible for the compilation of reports will double-check figures using calculation bases.

b. Additional measures to prevent the reoccurrence of errors

< 1 > When cross-checking figures, etc. with calculation bases, the department responsible for checking will also consider the validity of calculation procedures and unit conversions.

(2) Clarification of calculation bases

The following measures will be adopted in relation to calculation bases employed in the formulation of reports for outside agencies.

a. Measures to prevent the reoccurrence of errors formulated following previous studies

< 1 > Documents appropriate for use in checks will be selected from the following when formulating reports. Onsite checks will also be conducted of parameters for which verification is possible.

- ・Requests for approval of installation (modification) of nuclear reactors, construction plans
- ・Detailed design documents
- ・In-house review documents
- ・Materials formulated by manufacturers

b. Additional measures to prevent the reoccurrence of errors

< 1 > When in-house review documents or materials formulated by manufacturers are employed as calculation bases, their reliability will be verified through cross-checking against standard benchmark figures, formulas, etc. and checking of the calculation process (figures, etc.).

(3) Checking of appropriateness by department responsible for quality assurance

a. Additional measures to prevent the reoccurrence of errors

The department responsible for quality assurance will conduct the following checks at the stages of planning and implementation of measures to prevent the reoccurrence of errors.

< 1 > Verification of appropriateness when the measures to prevent the reoccurrence of errors outlined in (1) and (2) above are reflected in procedures.

< 2 > Verification of the status of implementation of the measures outlined in (1) and (2) above by means of sampling studies in order to check the degree to which the measures have taken root.