Plant Data of Fukushima Daiichi Nuclear Power Station at the time of the
Tohoku-Chihou-Taiheiyou-Oki Earthquake

May 16th, 2011

Tokyo Electric Power Company

Disclaimer
This English translation is only for reference purpose. When there are any discrepancies between original
Japanese version and English translation version, the original Japanese version always prevails.
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1. Description of data

Fukushima Daiichi Nuclear Power Station was hit by the Tohoku-Chihou-Taiheiyou-Oki Earthquake occurred at 14:46 on March 11th, 2011, and the following massive tsunami, and the plant facilities got severely damaged. While plant data at around the time of the earthquake remained at the site including the main control room of each unit, we had no choice but to focus on the work for stabilization of the plants. Since it was difficult to take the printed data directly to the uncontaminated area due to the high level air dose around the plants including the main control rooms and the prints themselves were contaminated, we could not computerize the data by staying in the main control rooms for long hours. However, as the situation gradually improved, we collected and organized as much plant data as possible in accordance with the instructions from the national government. Data collected and organized are as below.

(1) Charts
Recording papers widely used to record various data of the plants. Plant data are recorded in roll paper with color ink.

(2) Data of abnormal events including alarm records
A kind of data output from process computers, including the times of abnormal events and operation logs of the plant systems. They are basically printed out and kept as printed records.

(3) Operation logs
Operation records, data recorded by operators in the main control rooms and daybooks with handover messages for operators of the next shift.

(4) Data of process computers
Process computers also store data indicating plants' behavior. Their functions are similar to the transient recorders described below.

(5) Data of transient recorders
Triggered its operation by the occurrence of abnormal events, a transient recorder records numerical data on plant's behavior for a few minutes prior to and 30 minutes after the event.

The amount of data above varies, depending on the plant situation and the type of the computer. For example, Unit 4 was in the regular inspection and all of the fuels were taken out to the spent fuel pool in order to replace its shroud. Since the process computer was being replaced at the same time, related data does not exist. Also, since the transient recorder of Unit 6 was not in operation due to the unit's regular inspection, transient record of Unit 6 does not exist. Data organized in this report are described in Table-1.

While most of major data were collected and organized in this report, please note that there still can be some data unrecorded due to the damage of the detectors caused by tsunami. As further facts are getting revealed by detailed analyses of other parameters and reliable
evidences from persons involved, it is expected that additional information such as operation records of equipments will be known in the future. In such a case, we will report them accordingly.

2. References
   (1) Unit 2, Fukushima Daiichi Nuclear Power Station
       Restoration of alarm records
   (2) Unit 3, Fukushima Daiichi Nuclear Power Station
       Adjustment of the recorded times of the transient recorders
<table>
<thead>
<tr>
<th>Plant status</th>
<th>Unit 1</th>
<th>Unit 2</th>
<th>Unit 3</th>
<th>Unit 4</th>
<th>Unit 5</th>
<th>Unit 6</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>In operation</td>
<td>In operation</td>
<td>In operation</td>
<td>In outage (All fuel pulled out)</td>
<td>In outage (During pressure test on RPV)</td>
<td>In outage (RPV closed)</td>
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<tr>
<td>Chart</td>
<td>Plant charts continued to record data after the earthquake. However, the amount of data actually collected was very little as the tsunami caused the loss of signals and power for measurement instruments in most cases. Data recording resumed after the restoration of power supplies for instruments for some of the plant charts, but plant-related parameters have been gathered and attached for data continuity.</td>
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<tr>
<td>Process computer system data (Operation data)</td>
<td>Data entries up to 15:00 on March 11 obtained</td>
<td>Data entries up to 19:00 on March 11 obtained</td>
<td>Core performance data up to 19:00 on March 11 and typer output on control rod position data, etc. up to 18:00 on March 11</td>
<td>Peri odic data recording function was suspended as the plant was in outage.</td>
<td>Typer output for approx. 2 minutes after the earthquake Typer output resumed from around 18:50 on March 11 Data up to 16:18 on March 12 was recovered from the collected hard disk.</td>
<td>Core performance calculation, control rod positions, etc.</td>
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<tr>
<td>Additional description of the process computer system’s performance</td>
<td>Typer output for approx. 10 minutes after the scr am</td>
<td>Typer output for approx. 2 minutes after the scr am; Data up to 15:50 on March 11 was recovered from the collected hard disk.</td>
<td>Typer output up to 18:00 on March 11</td>
<td>Typer output up to around 15:39 on March 11</td>
<td>Typer output up to around 15:04 to 14:07 on March 11 Typer output resumed at around 9:00 on March 12</td>
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<td>Al arm activation records and other data</td>
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<td>Operation log</td>
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<tr>
<td>Operation log for March 11 obtained</td>
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<tr>
<td>Shift turnover logs</td>
<td>There are separate shift logs for shift supervisors and shift members. Both logs from two night shifts on March 10 and one day shift from March 11 have been obtained. The log for March 11 from the time of the earthquake was written on the whiteboard in MCR and transcribed to the logbook later. Notes and memos showing the information written on the whiteboard have also been obtained.</td>
<td>There are separate shift logs for shift supervisors and shift members. Both logs from two night shifts on March 10 and one day shift from March 11 have been obtained. Notes and memos written by shift members at the Anti-Seismic Building have also been obtained.</td>
<td>There are separate shift logs for shift supervisors and shift members. Both logs from two night shifts on March 10 and one day shift from March 11 have been obtained.</td>
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<tr>
<td>Miscellaneous</td>
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<tr>
<td>Status</td>
<td>The recorder had its hard disk removed and data recovered. Difficult to recover the hard disk itself, but the device was turned on to recover data. The recorder had its hard disk removed and data recovered.</td>
<td>Transient event recorder being replaced</td>
<td>Event recording function was suspended for outage. Difficult to recover the hard disk itself, resulting in no data recovery.</td>
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<td>Short-cycle event data (reported on May 16, 2011)</td>
<td>* 10ms cycle data over approx. 35 minutes from 14:42:03 on 3/11</td>
<td>* 10ms cycle data over approx. 35 minutes from 14:41:56 on 3/11 and 35 minutes from 15:12:06 on 3/11</td>
<td>* 0.1s cycle data from around 14:41 to 15:45 on 3/11</td>
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<tr>
<td>Miscellaneous (Reported on July 17, 2013)</td>
<td>* 1min cycle data from 12:00:59 to 15:36:59 on 3/11 (Records starting at 10:59:59 on 3/3)</td>
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</table>

※Average, maximum, minimum and RMS binary data in 10ms cycle up to 15:00 on 3/11 at Unit 1. Instantaneous, average, maximum, minimum and RMS binary data in 1h cycle up to 15:00 on 3/11 at Unit 2. Average, maximum, minimum and RMS binary data in 10ms cycle up to 16:50 on 3/12 at Unit 5 are available. However, they have been deemed unnecessary based on the amount of data already reported and additionally reported this time (July 17, 2013).
1. Introduction

It is recognized that the alarm equipment (function of output alarm records to Alarm Typer) of Unit 2, Fukushima Daiichi Nuclear Power Station produced records for approximately 2 minutes immediately after the scram, but stopped thereafter for some reasons. We restored alarm records based on the data stored in hard drives.

2. Overview of the functions of alarm equipments

The alarm equipments have functions to collect information about plant status from process computers and produce alarm records to Alarm Typer.

Items of information produced to Alarm Typer are as below.

- Status changes of Digital Input Points (changes of contact points)
- Changes of the position of control rods
- Monitoring Alarm (excess of the limits/restoration)
- Operation records (data insertion / alarm exclusion / scan exclusion)
- Transferred results of outputs from computers
- Time and messages

The restoration of alarm records this time was conducted as to and , based on the record of plant process data produced by the process computer of Unit 2. The ways to produce and are as below.

a. Way to produce the status changes of Digital Input Points
   In the case of occurrence of change of contact point the time and the situation are output to Alarm Typer.

b. Way to produce Monitoring Alarm (excess of the limits/restoration)
   In the case that the monitored Analogue Input Point exceeds the alarm limit or deviates from the designated range or that indicator trouble occurs, the time and the situation are output to Alarm Typer.

3. Methodology for the restoration of alarm records

Among records, 1171 Analogue Input Points and 503 Digital Input Points of the plant process data were used for the restoration of alarm records. Position data related to the movement of control rods were not used.

In the restoration, automatic process methods searching for record data (excel files) were
adopted as below.

(1) Digital Input Point
Search for the time of occurrence of change in status of the target input point and output the time, PID and the value before and after the change

(2) Analogue Input Point
Search for the time of occurrence of change in quality information of the target input point and output the time, PID and the value before and after the change

End
In the case of Digital Input Point:
【In the case of Analogue Input Point】