ABSTRACT

Pipe wall thinning is an aging process that has a significant effect on the safety and safe operation of power plants and its appropriate management is an issue common to all electric power companies. Tohoku Electric Power Co., Inc. has been putting an emphasis on pipe wall thickness management since 2006, when a through-hole possibly due to droplet-impact erosion was found in the vent piping of high-pressure feedwater heater No.2 at Onagawa Nuclear Power Station unit 2. Following this incident, extensive revisions were made to the pipe wall thickness management program and we have been making efforts to improve the efficiency of the management. This report addresses such issues.

THROUGH-HOLE INCIDENT AT ONAGAWA UNIT 2

Outline of pipe wall thinning in feedwater heater vent system

In May 2006, a through-hole possibly due to droplet-impact erosion was found in the vent piping of high-pressure feedwater heater No.2 at Onagawa Nuclear Power Station unit 2. (see Fig.1)

We thoroughly looked into this incident and found out that the cause of this incident has a lot to do with the unique structure “center vent hole” on the end surface of the internal vent pipe in the heater. It is estimated that condensed water generated in the heater easily flows into the vent pipe through this hole structurally, when rust and other materials are accumulated in the surface of the internals and discharge of the condensed water near the center vent hole is obstructed. (see Fig.2)
We also estimated that the amount of condensed water flowing into the vent pipe increases and the condensed water is entrained in the fast flow of steam when it went through the orifice, then a through-hole occurs as fast-speed droplets collide with the elbow wall. (see Fig.3)

We took these two equipment-based measures to deal with it.

- Closure of the center vent hole
- Relocation of the orifice into the condenser

Management-based measures also taken are mentioned in the next section.

**Figure 3 - Collision of Droplets**

**Social impact of through-hole occurrence at NPP**

NISA issued an order for full implementation and improvement of the pipe wall thickness management and the local governments also requested us to improve management. The through-hole was located in a negative pressure pipe leading to the condenser, and therefore there was no possibility of pipe fluid leakage in spite of the occurrence of the erosion-induced hole. However, the fact that a through-hole occurred in nuclear power plant piping had a significant social impact on the local society.

**REVISIONS OF MANAGEMENT**

**Review of management**

Following this incident, extensive revisions were made to the pipe wall thickness management program. It was thus specified that inspection should be performed on locations potentially subject to wall thinning at a higher frequency, such as “once in 5 years” to accumulate data. And we decided that all locations must be measured thickness, although there are a lot of locations that potential of thinning must be low and therefore random sampling was permitted.
Impact of management reviewing

According to this policy, 2,000 or more locations have been measured in recent outages (see Table.1), resulting in increasing and continuing workloads on those involved. But they are making efforts and managing to cope with this situation.

<table>
<thead>
<tr>
<th>Outage</th>
<th>Number of locations to measure (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oshagawa unit 1</td>
<td>18th (2008)</td>
</tr>
<tr>
<td>Oshagawa unit 2</td>
<td>10th (2009)</td>
</tr>
<tr>
<td>Oshagawa unit 3</td>
<td>5th (2008-2009)</td>
</tr>
<tr>
<td>Higashidori unit 1</td>
<td>2nd (2008)</td>
</tr>
</tbody>
</table>

Table 1 - Number of Locations to Measure in Recent Outages

ACTIVITIES TO IMPROVE MANAGEMENT EFFICIENCY

Introduction of computer system and application of affiliated company’s resources

As mentioned before, we have to measure thickness at large number of locations and manage a lot of data. And there is a possibility of human errors, such as erroneous transcription on the data sheet. So we decided to introduce a computer system and launched strengthening partnership with our affiliated company.

We set up a new group in “Tohatsu” (Tohoku Electric Power Engineering & Construction Co., Inc.) to address various issues related to maintenance and some part of pipe wall thickness measurement work is assigned to Tohatsu, rather than plant vendors.

Verification of applicability of a online pipe wall thickness monitoring system on an actual plant basis

We had been searching for new method that would replace UT to save labor in scaffolding and insulator removal, which are burdensome whenever we conduct UT, and to monitor wall thinning during operation in case of an emergency.

The Field Signature Method (FSM) might be a hopeful method based on potential difference and is already in use at petrochemical sector.

We are now verifying applicability of this monitoring method on an actual NPP basis since December 2007. (see Fig.4)
CONCLUSION

Extensive revisions were made to our pipe wall thickness management because of the through-hole incident in the feedwater heater vent piping at Onagawa NPS unit 2, and since then, we are making some activities to improve the efficiency of our management.