Modification of the Visual Inspection System for Flow Distribution Plates of Nuclear SG

Woo-tae Jeong [a*], Seok-tae Kim [a], Seok-chul Kang [b], Young-kug Kim [b]
[a] *KEPCO Research Institute, Nuclear Power Lab., 103-16 Munji-dong, Yusung-gu, Daejeon, Korea 305-380*
[b] *Sae-An Engineering Corporation, Rm910, Byucksan Digital Valley II, 481-10, Gasan-dong, Geumcheon-gu, Seoul, Korea 153-803*
[*] *Corresponding author: a39leb@kepco.co.kr*

1. Introduction

A visual inspection system developed for acquiring image of FDP and joining bolts was developed for application to inspect FDP of Ulchin NPP #3 SG. During hot application in 2010, we successfully inspected FTPs of the SG. However, we decided to modify and develop several components of the inspection system for more successful application.

2. Visual Inspection of FDP Bolts

In this section we will review the previous visual inspection system which was developed and applied for acquiring visual image of the FDP plates of Ulchin NPP #3 SG. A difficulty we encountered during the hot test will be defined and a new device to replace the previous inspection system will be introduced.

2.1 Previous Visual Inspection System

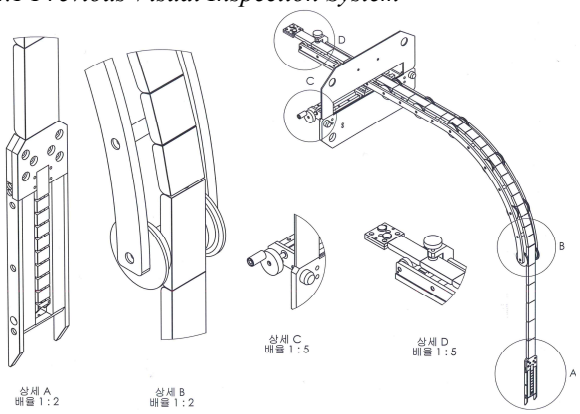

Fig. 1. Previous Visual Inspection System

The previous visual inspection system for Flow Distribution Plate is presented in Fig. 1. The probe guide subassembly is composed of rectangular links with a passage for an endoscope. It is serially connected by stainless steel wire and an endoscope is inserted through the passage of circular holes. A serially connected links could be adjusted in its position using a rotating wheel as shown in detail C. A ball screw and two linear motion guides attached to the rotary wheel make the probe guide subassembly move toward left or right.

The man-way mount is to be fixed on the man-way of SG by two bolts. Mount cover is also attached to the man-way threads to prevent foreign objects to be inserted in SG. Change in direction of the endoscope could be made by pulling the wires through the segments. A detailed description about the inspection system could be found in references 1 - 4.

2.2 Review of the Previous Inspection Results

During the hot application of the visual inspection system for inspecting the FDPs of Ulchin #3 SG, we observed that soft sludge is coated on the surface of the FDPs as shown in Fig. 2 and 3. We also could acknowledge that the bolts joining upper and lower plate of the FDP do exist at the expected locations. However, further research on the captured movie file informed us that all the joining bolts could not be observed. Several bolts are located at higher places, and we could not reach the places with the flexible endoscope. A means to adjust the height of the endoscope tip is necessary for complete inspection of the joining bolts.

Fig. 2. Image of the Flow Distribution Plate

Fig. 3. Image of the Lower Flow Distribution Plate

Two operators from Sukwon Industrial Co. participated for the inspection. Fig. 4 is a picture showing an operator adjusting endoscope to inspect the

FDP. The visual inspection system is firmly attached to the man-way of the nuclear SG. A custom made quarts endoscope from GE was selected for acquiring visual image.

Fig. 4. Operator Inspecting the FDP at Ulchin

2.3 Modification of the Inspection System

An unexpected problem we encountered during the visual inspection is that the endoscope is so flexible that we cannot control the height of the endoscope tip. Therefore, we designed components presented in Fig. 5. The upper left component of Fig. 5(1), we call it a flexible segment, has two holes for tensioning wire. The interconnected flexible segment is flexible in one and rigid in other direction.

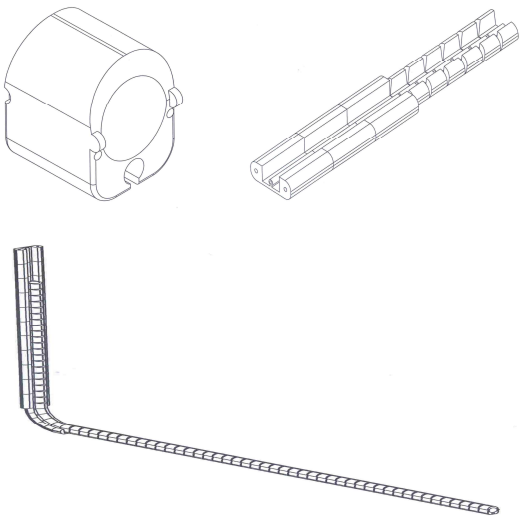

Fig. 5. Components of the Modified Inspection System
(a) Upper left: flexible segment
(b) Upper right: Guide assembly
(c) Down: Complete assembly

The complete assembly in Fig. 5(c) shows the flexible segment assembly is joined through the groove in the guide assembly. When the tip of the flexible segment assembly reaches to the center of the FDP, we could adjust the height of the endoscope tip by moving the complete assembly upward or downward.

Designing and fabrication of the flexible segments will not be easy because it should be rigid enough to support the endoscope, and at the same time, flexible enough to be bent 90 degrees to change its direction from downward to center of the SG.

As the flexible segments are composed of many segments, if an accident of breaking down of the tensioning wire may be disastrous. It may create many foreign objects inside the SG, and removal of the foreign objects will be very difficult, tedious and time consuming.

3. Conclusions

We modified and designed several components of the existing visual inspection system to enable more effective inspection. We did not fabricate or test the performance yet, however, based on our prior experience on developing similar equipments, we expect a more reliable and versatile inspection system for acquiring video image of the FDPs and FDP bolts will be developed in near future.

After the successful application of the inspection system, further development of a retrieval tool for foreign objects which are located in almost unreachable location of SG also could be developed using the developed components of this study.

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