STRESS CORROSION CRACKING OF CRD STUB TUBE JOINT AND REPAIR AT HAMAOKA UNIT 1

Taizo Matsunaga, and
CHUBU Electric Power Co., Inc,

Keiji Matsunaga
TOSHIBA CORPORATION Power systems & Services Company

1 INTRODUCTION
The Hamaoka Nuclear Power Station has 4 units. All of them are Boiling Water Reactors producing steam for direct use in the steam turbine. About 26 years have passed since Unit 1 began operating.
On November 9, 2001, after the pipe rupture incident of the Residual Heat Removal system (RHR), plant personnel found the leak from the bottom of the Reactor Pressure Vessel (RPV). Afterwards, with underwater visual inspection, plant personnel found an axial cracking on one of the stub tube’s weldments.

The purpose of this study is to explain the cause of the leak and how it was repaired.

2 ABSTRACT
On November 9, 2001, after the pipe rupture incident of the Residual Heat Removal system (RHR), plant personnel found the leak from the bottom of the Reactor Pressure Vessel (RPV). Afterwards, with underwater visual inspection, plant personnel found an axial cracking on one of the stub tube’s weldments.

In order to join the Nickel base material (Alloy 600) stub tube, a similar weld material (Alloy 182) is deposited to the low-alloy metal (LAS) vessel. From the examination of a boat sample it was found that the cracking in the Alloy 182 weld metal was due to interdendric (intergranular) stress corrosion cracking, which had progressed into the Alloy 600. Residual and applied stress during an in-service analysis explained that the location could have high tensile stress (330MPa and over).

In order to repair this cracking, a replacement method was applied. The stub tube and weld joint including the crack area was completely removed, and a new stub tube consisting of high corrosion resisted material was installed and welded. Remote automatic equipment was applied during the replacement process because of the high radiation environment.
After inspecting the rest of the 88 stub tube’s joints, there were no indications of any further problems. For higher reliability, the application of laser-peening technique is being examined.

3 CONCLUSIONS
The cracking on the lower welding portion (Alloy 182) of the stub tube was specified inter-granular stress corrosion cracking. The replacement method was applied because weld repair cannot be applied by removal of the boat sample. This work was the first stub tube replacement within an actual plant and has been completed.