

N280. Japanese Wrestle with Tube Problems

Japan's first PWR, Mihama 1, was commissioned in 1970 and soon suffered steam generator tubing problems. Since then, the industry has had to deal with a variety of tube degradation problem culminating in February 1991 with the country's first steam generator tube rupture. This was at Mihama 2, where Japan's first steam generator replacement project is now underway. Maintaining the integrity of steam generator tubing is today the most important factor in assuring plant reliability and safety in Japan. The technical standard set down in Japan requires that if a tube defect is found, the plant should not be operated. Therefore, all tubes are plugged or repaired by sleeving. In the early years, explosive plug and welding plug techniques were used for repair. Since 1981, mechanical plugging has been used in order to reduce the amount of radiation as well as working hours. From 1989, plugs of Alloy 690 have been used in order to reduce the sensitivity to stress corrosion cracking of mechanical plugs.

In 1980, sleeving instead of plugging was first applied in order to avoid a reduction of allowable plugging margin of steam generator. At first, the welding sleeve was used, and then the mechanical sleeve was employed, with which repair work is easier. Since 1984, brazing sleeves were used to repair the intergranular attack occurring in the tube support plate crevice. Laser welding of sleeves was put into use in 1989.

To maintain and enhance the integrity of steam generator tubing, national and joint research projects are being carried out by utilities and manufacturers. Their investigations cover the following area:

- IGA (intergranular attack) of Alloy 600.
- Chemical substances which affect the sensitivity to IGA.
- Concentration and precipitation behavior of trace impurities in water.
- The effect of various oxides on the electric potential of Alloy 600 in alkaline.
- Development of sleeving techniques.
- Verification of effectiveness of IGA prevention measures.
- Chemical cleaning of the steam generator secondary side.

Although various techniques have been applied, IGA has not yet been arrested completely, and remains the gravest threat to steam generators in Japan. That is why Japan's first steam generator replacement project is now underway.

Taken from, "Japanese Wrestle with Tube Problems," by Seiji Yashima, Nuclear Engineering International, pp. 23-26, October 1993. The author is Executive Director of Japan Power Engineering and Inspection Corp., Akasaka 1-chome, Minato-ku, Tokyo 107, Japan.