5-1 To Learn from Operating Experience

–Analysis of Primary Water Stress Corrosion Cracking Events at PWRs–

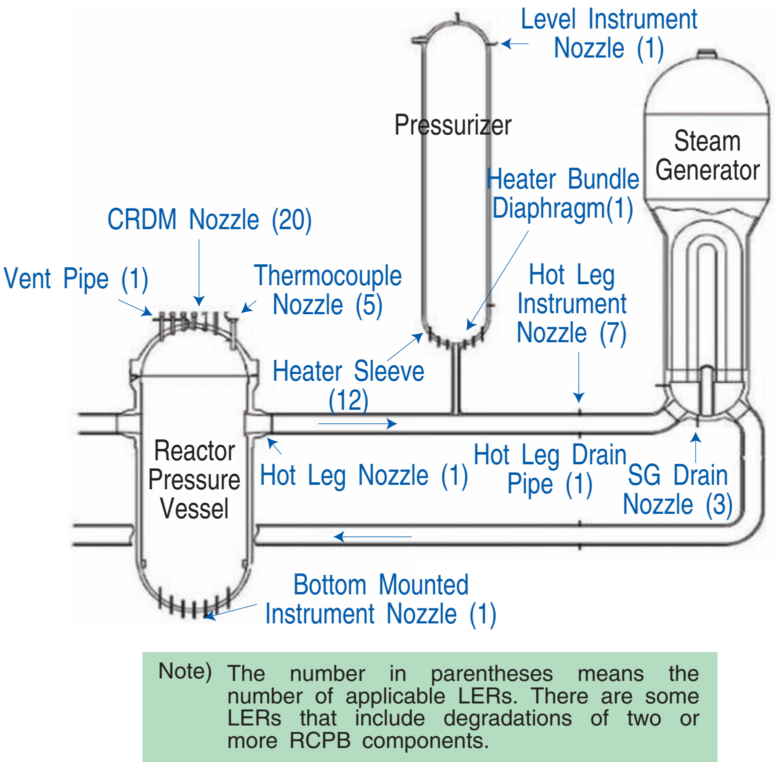

Fig.5-2 Summary of Reactor Coolant Pressure Boundary Components with PWSCC Observed
Although primary water stress corrosion cracking (PWSCC) has been observed since early 1990's, it was not then recognized as an urgent issue for reactor safety. However, recently several significant degradations originating from PWSCC in the reactor coolant pressure boundary (RCPB) components have been observed at U.S. PWR plants. We analyzed the U.S. experience with alloy 600 degradation by reviewing licensee event reports (LERs) from 1999 to 2005 to examine trends of such events mainly focusing on affected components, characteristics of cracking, and inspection approaches for detecting the PWSCC. This figure provides a summary of locations where PWSCC was observed. As shown in this figure, PWSCC was found to have occurred in the RCPB components exposed to the high temperature environment, such as the control rod drive mechanism (CRDM) nozzles on reactor vessel head, and thus high temperature condition is one of the factors causing high susceptibility to PWSCC.

It is worldwide recognized that it is important to learn from operating experience in all technologies. In the field of nuclear technology, nowadays, regulatory authorities and industries have been actively carrying out analysis of incidents to identify their causes and to feed back the lessons learned to the design, operation and maintenance of installations on an international basis.

Since a severe accident at a nuclear installation, in particular a nuclear power plant, could cause serious damage to the environment as well as the surrounding populace, it is generally considered essential to eliminate potential or latent causes that could lead to such an accident in advance. Therefore, it is necessary to collect and analyze event information to consider corrective actions for preventing recurrence of the event. Further, it is important to continuously conduct such activities. At JAEA, such activities have been carried out for some time, and the results from these activities have been provided to the regulatory authorities and utilities in Japan.

Fig.5-2 illustrates an example of results from analysis of recent events which occurred at nuclear power plants. This analysis was carried out on the events involving primary water stress corrosion cracking (PWSCC) observed in the reactor coolant pressure boundary components such as the reactor pressure vessel (RPV) and reactor cooling system (RCS) piping.

Should the RPV or RCS piping break, resulting in a loss-of-coolant-accident (LOCA), the capabilities of core cooling and confinement of radioactive materials would be degraded. To obtain insights useful for preventing such a serious condition from occurring, we analyzed PWSCC events focusing on where PWSCC was observed, a method which could detect PWSCC, and so on. The results from this analysis revealed that PWSCC tends to occur at alloy 600 components exposed to relatively high temperature, such as control rod drive mechanism (CRDM) nozzles and pressurizer heater sleeves. In addition, it was shown that depending on the component affected, the non-destructive examination such as ultrasonic testing and/or eddy current testing is generally needed to detect and/or confirm the PWSCC , as well as visual inspection and different repair techniques should be applied. These results have been published to provide the relevant regulatory authorities and industries in Japan with the lessons learned and insights gained that seem useful for the early detection of PWSCC at nuclear power plants.

Reference
Takahara, S., Watanabe, N., Trending Analysis of Incidents Involving Primary Water Stress Corrosion Cracking on Alloy 600 Components at U.S. PWRs, Nippon Genshiryoku Gakkai Wabun Ronbunshi, vol.5, no.4, 2006, p.282-291 (in Japanese).