N254. Managing CRDM Nozzle Cracking

The cracking in nozzles of control rod drive mechanisms (CRDM) in the reactor vessel closure heads has recently been observed. Pure water stress corrosion cracking (PWSCC) in Inconel 600 material has previously been observed in some steam generators. However, cracking in CRDM nozzles is a recent phenomenon, and repairs can be expensive and time consuming. A phased programmatic approach to inspections, retardation of the cracking mechanism, and repairs will minimize down time. CRDM nozzles cracking was first reported in a French power plant in 1991, when a pressure hydro test of the reactor vessel indicated a leak. The European nuclear community evaluated this problem as an "operational" issue, and is implementing inspections during scheduled outages and repairs. The U.S. nuclear community considers that CRDM nozzles cracking would be a "non-safety related" issue. The engineering evaluations by government and industry have concluded that a "leak before break" event would happen if cracks went through-wall. U.S. Utilities must ask, "What actions should we implement to monitor for CRDM nozzle cracking, and what are the risk of not inspecting versus inspecting?" Eventually, inspections of the CRDM nozzles will probably be required by the U.S. Nuclear Regulatory Commission (NRC). A plan must be implemented which considers not only inspection, but also repair and mitigation. Ideally, the vendor which is chosen by the utility to perform this work should be able to provide solutions for all possible situations which may arise from the inspection and be ready to implement a complement program.

When To Inspect

The cracking susceptibility for each plant appears to be a function of Effective Full Power Hours (EFPH), material properties, and vessel head operating temperatures. Each plan can evaluate its specific data and make an educated analysis of expected results. Actual results of inspection in Europe have shown that there are exceptions which do not follow the calculated susceptibility; therefore, these calculations cannot conclusively predict failures. The decision to inspect should be based on operational safety and reliability. Early inspections may detect smaller cracks that can be repaired. This could prevent the development of major through-wall cracks which could cause the plant to be off-line for longer periods of time. Long shutdowns might be prevented with a program of routine inspection and mitigation. Delaying action until a leak occurs could greatly increase the magnitude of corrective action. Early detection and mitigation of PWSCC appears to be the most sensible approach to avoid the through-wall cracks which could shut down the plant for an extended period. Inspection and repair processes have been successfully used and qualified in European plants. These processes can be adopted for use in the U.S.

Taken from "Managing CRDM Nozzle Cracking," M.G. Tierney, R.N. Brown, and R.L. Willia, Nuclear Plant Journal, p. 82, May-June 1993. For details, contact Roy N. Brown, ABB Combustion Engineering Nuclear Services, 120 Riverfront Parkway, Chattanooga, Tennessee 37402; telephone (615) 752-2304, Fax: (615) 752-2249