N96. Swedish Technology Provides Inside Knowledge Of U.S. BWR Vessels

The Scandinavians have been inspecting their BWR pressure vessels from the inside since the early 1970s, but in the U.S., it is only now that new NRC requirements are pushing operators to use this type of inspection.

With increasing plant age, the focus of inspection of reactor pressure vessels is moving from following known manufacturing defects to detecting and sizing those that may be caused by the operation of the nuclear plant.

The most straightforward way of detecting and sizing defects that penetrate the surface of a pressure vessel is to perform the inspection from the inside for inner surface defects and from the outside for outer surface defects.

Most BWR pressure vessels, however, are inspected from the outside by using an ultrasonic technique. The reasons for this are:

- There is limited or no access from inside the vessel. Permanent or difficult to remove nozzle inserts only allow for nozzle inspection from outside. The part of the vessel below the shroud support plate is only accessible from the outer surface.

- There is less impact on the refueling floor critical path than when inspecting from the inside surface. Most PWR and BWR inner surface inspection manipulators do not permit parallel activities in the reactor pressure vessel, and there may be a significant impact on the refueling floor critical path.

- The inspection is performed dry. This simplifies most parts of the inspection, for example, equipment set up, calibration, equipment changes, and decontamination.

- The inspection equipment is less complicated than for inner surface inspection as inspection under water and in the reactor pressure vessel requires special design considerations.

There are, nevertheless, difficulties associated with inspections from the outer surface:

- Interpretation of results. The inner surface of a vessel is inspected through thick steel which may cause uncertainty in the interpretation of the results.

- Access restrictions from the outside. A number of older BWR plants have insulation attached to the reactor vessel with minimum standoff from the vessel outer surface which cannot be easily removed, except the vessel nozzle penetrations and a few locations in the uppermost course of the vessel shell.

- The radiation exposure from an outer surface vessel inspection may be high, especially in an older plant.

The Scandinavians have, from the outset, adopted a different philosophy for BWR vessel inspection. The design of their BWR reactor vessel and its internal components allows for the internals to be easily removed, enabling inspection of most parts of the vessel welds, both shell and nozzle, from the inner surface.

Manipulators used in inner surface inspections have evolved from a central mast manipulator into a device called Sesam, which can perform shell and nozzle weld examinations while other in-vessel activities, such as refueling, control blade movements, and visual examinations are being performed. Placing the mast close to the vessel wall has advantages over center-mounted mast inspection manipulators typically used for PWR shell weld examinations:

- The mast and scanner occupy a small portion of the reactor cross section, which allows for other in-vessel activities to be done during the examination.
- A stable platform is provided for the transducers allowing for high positioning accuracy and high scanning speeds.

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