

## Reactor Vessel Bottom Mounted Instrumentation (BMI) Nozzle Contingency Repair

### Background

Primary water stress corrosion cracking (PWSCC) of Alloy 600 materials and bottom mounted instrumentation (BMI) Alloy 182/82 welds has become a top industry concern for pressurized water reactor (PWR) plants. PWSCC has produced significant availability losses and attracted considerable regulatory attention.

There are many locations within the reactor coolant pressure boundary (RCPB) that contain Alloy 600 base metal or weld metal that could be susceptible to PWSCC over time.

As part of a comprehensive Alloy 600 Program, future 88-05\* inspections for leakage will require inspection of the bottom head of the reactor vessel for plants utilizing BMI nozzles. Westinghouse has developed a BMI Mechanical Nozzle Seal Assembly (MNSA2) that can provide a contingency repair solution should a BMI nozzle inspection yield questionable results.

\* NRC Generic Letter No. 80-05

### Description

Early Westinghouse PWR designs had variable numbers and patterns of BMI nozzles. Typically, the number of penetrations is related to the number of loops:

- Four-loop: 58 penetrations
- Three-loop: 50 penetrations
- Two-loop: 35 penetrations

The BMI MNSA2 seals against leakage from the annulus between the BMI nozzle and reactor vessel caused by cracking initiated in the nozzle and propagating through the nozzle-to-vessel weld. Any Alloy 600 or 690 welded BMI Nozzle can be repaired using the MNSA2. The BMI MNSA2 replaces the weld and performs two functions:

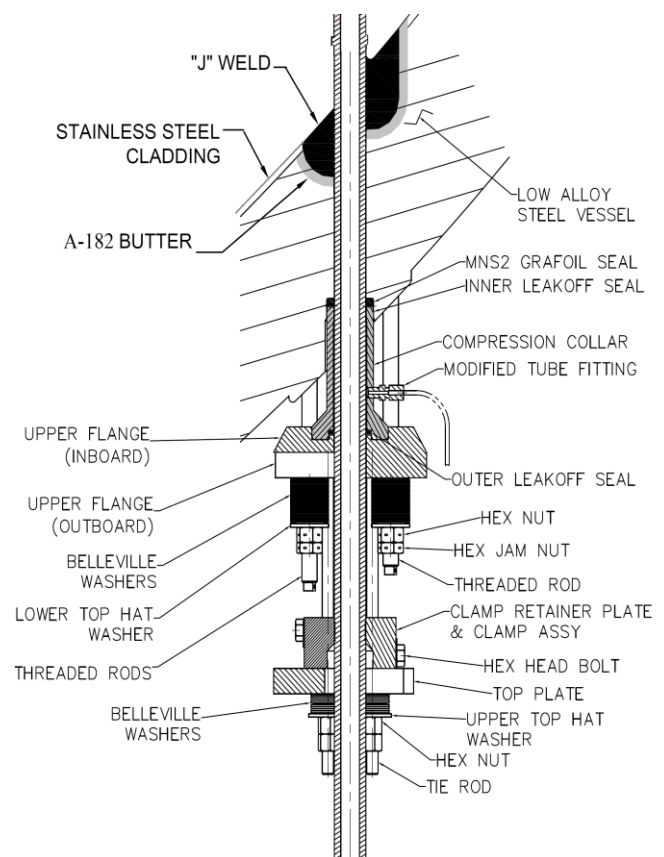
- Acts as the primary pressure boundary for the RCS
- Structurally replaces the weld to prevent the nozzle from ejecting from the reactor vessel

### Benefits

The BMI MNSA2 is similar to the MNSA used extensively on CE-designed pressurizers and small-diameter reactor coolant system (RCS) nozzles.

The BMI MNSA2 has the following benefits over a welded repair:

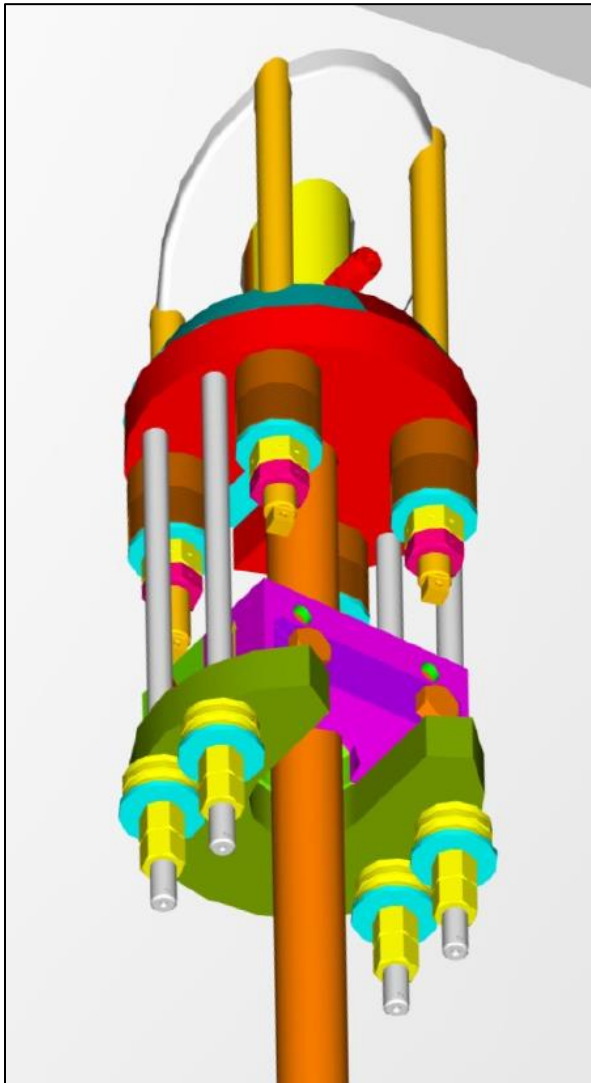
- Can be installed from outside the vessel without breaching the pressure boundary and requiring drain-down or core offload
- Can be installed on a leaking nozzle
- Can be installed in less time and with less dose than welded repairs
- Can assure no risk of rework for bad welds



MNSA Version 2 (MNSA2)

## Experience

The MNSA and MNSA2 repair has been implemented on many CE-designed pressurizers and RCS instrument nozzles. Westinghouse has installed a total of 45 MNSAs and MNSA2s at operating plants.



*CAD Model of MNSA2 Installed*



*Seismic Testing Assembly of MNSA2*