Mechanical Nozzle Seal Assembly (MNSA)

Engineering Services

Background

Instrument nozzle penetrations are common to pressurizer and hot/cold leg reactor coolant system (RCS) piping. Inconel 600 partial penetration welded nozzles typical to these areas are susceptible to stress corrosion cracking (SCC). Small leaks in these nozzles can cause expensive delays in plant operation.

As a result, Westinghouse has developed the Mechanical Nozzle Seal Assembly (MNSA), a unique mechanical seal that has effectively eliminated leakage caused by primary water stress corrosion cracking (PWSCC) in Inconel 600 nozzles under 2 inches in diameter.

Benefits

- Arrests leakage caused by PWSCC in Inconel 600 nozzles
- Costs significantly less than traditional cutting and welding type repairs
- Eliminates need to off-load core and/or drain down
- Uses Grafoil seal material, which has been used successfully in similar installations for over a decade
- Is fully tested at operating temperature and pressure conditions
- Is installed quickly (within one shift per location) to meet ALARA and cost objectives
- Comes with full engineering and support services
- Is ASME Section III Class B1 Code design (not N-stamped)

Description

The MNSA is designed to seal against leakage from the annulus between the instrument nozzle and pressurizer/RCS pipe, due to cracking initiated in the instrument nozzle and propagating through the nozzle-to-pressurizer/RCS pipe weld. A secondary function of the MNSA is to restrain the instrument nozzle from ejecting should the nozzle-to-pressurizer/RCS pipe weld completely fail. The MNSA is designed to seal against a pressure of 2500 psi at a temperature of 700°F.

The seal is created by compressing the Grafoil seal against the instrument nozzle at the nozzle-to-pressurizer/RCS pipe interface. The compression collar transmits the load to the Grafoil seal, while the seal is retained within the packing retainer and lower flange. The compressive load is generated when the hex-head bolts are threaded into the pressurizer/RCS pipe and torqued. This load is then transmitted to the compression collar through the upper flange.

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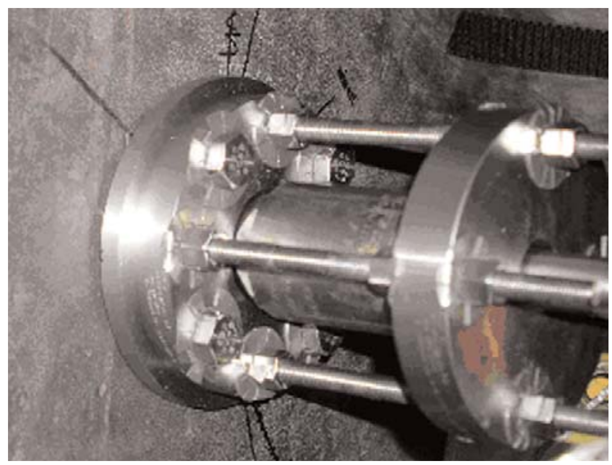
The instrument nozzle is kept from ejecting by the top plate, which is anchored to the upper flange through four tie rods, and secured into place by hex nuts. The top plate is installed with a 0.010-inch to 0.020-inch gap between the (resistance temperature detector) nozzle and its bottom surface. Only if the nozzle-to-pressurizer/RCS pipe weld fails will the top plate act as a restraint. Otherwise, the weld is subject to no additional load during operating conditions.

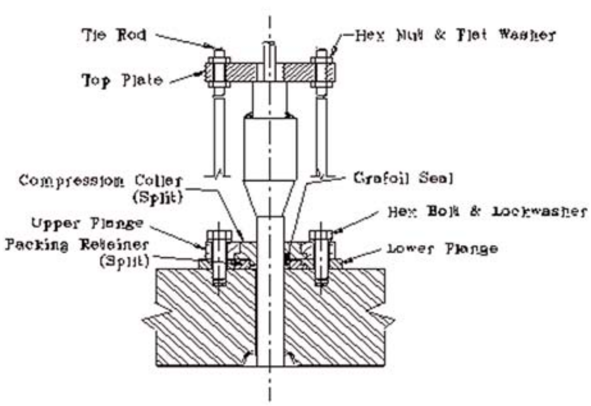
Deliverables

- MNSA
- Installation
- Engineering analyses



Experience

- SONGS 2 and 3 -- Two MNSAs on leaking hot leg nozzles (removed and replaced with Alloy 690 nozzles); five on pressurizers, and two on steam generators (preventive)
- Waterford 3 -- Three MNSAs on leaking hot leg nozzles
- Palo Verde -- Two MNSAs on leaking hot-leg resistance temperature detector nozzles
- Fort Calhoun -- one MNSAs on pressurizer steam space nozzle (preventive)
- Calvert Cliffs -- Twenty-two MNSAs ordered for pressurizers and hot legs; ten installed on pressurizers (preventive)
- Millstone 2 -- Two MNSAs installed on leaking heater sleeves
- ANO 2 -- Six next-generation MNSAs; two installed on heater sleeves



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