LEAKSEAL.TG

ON-LINE LEAK SEALING GUIDELINES FOR ASME CODE CLASS 1 AND 2 COMPONENTS

A. PURPOSE

To provide information to inspectors regarding licensees' use of leak-sealing activities for liquid-filled systems.

B. BACKGROUND

On-line leak sealing is an activity outside the scope of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) because gaskets and packing, the items being sealed, are not structural elements. However, activities connected with executing an on-line leak seal may affect the structural elements (the pressure boundary) and thus require suitable evaluation and controls. The only industry guidance on this subject is contained in Electric Power Research Institute/Nuclear Maintenance Assistance Center (EPRI/NMAC) NP-6523-D, "On-Line Leak Sealing." The staff does not endorse this published guidance because some of the suggested applications are incompatible with staff positions. However, it does contain useful information and at least mentions most of the major issues surrounding execution of on-line leak-sealing activities.

C. STAFF POSITION

Leak sealing is an allowable temporary measure for mitigating gasket and packing leaks. It may also be employed to mitigate valve seat leaks when the measured seat leakage is within the Technical Specification limit for seat leakage and system requirements permit the valve seat to be sealed.

Leak seal material itself is outside the scope of the NRC regulations and the ASME Code when its use is restricted to that of a sealant, much like a gasket or packing material. Gaskets and packing are not pressure boundary materials and are not ASME Code materials. Thus, the staff's position is that as long as sealants are used only as such and not as a replacement for the pressure boundary, the sealants are exempted from ASME Code requirements. Thus, for leak-sealing gaskets or packing, the sealant is viewed as a replacement for the gasket or packing material. In the case of valve seat leaks the staff finds that as long as the seat leakage is within the Technical Specifications, sealing the seat is not regarded as a pressure boundary repair or modification.

Although the sealant is not an ASME Code controlled material, other aspects of a leak-sealing operation are ASME Code controlled activities that are subject to regulatory audit. Those aspects of leak sealing include the following:

1. ASME Code controlled activities, such as modifications to the pressure boundary, that are performed as part of the leak-sealing process. Examples include drilling holes into flanges and calculating the new loads on flange bolts that result from sealant injection. As such, the licensee is required to have on file the appropriate calculations and analyses.

2. Licensee procedures would require an operability assessment that addresses issues such as the quantity of leak sealant to be injected, the impact of the entry of any excess sealant into the system, consequence analysis for downstream plugging, and possible chemical contamination of the system.

3. A leak-sealed valve seat would require an operational assessment because of the change to the system operability. Once sealed, it must be assumed that the affected valve is no longer operational, it is blocked closed.

4. A repair plan that includes a risk-informed assessment of the leak-sealing operation versus other repair options.

Although the staff does not endorse it, EPRI/NMAC publication NP-6523-D does outline many of the considerations that should precede the use of the method. The staff cautions against the use of those portions of the guidance that discuss repairs of pressure boundary leaks. Use of clamps with sealants may be appropriate, for a limited time, in some instances in which nonisolable leaks occur in small-diameter threaded or socket-welded connections. Such action requires prior staff review and approval, on a case-by-case basis, under 10 CFR 50.55a(a)(3).

Peening with pneumatic hammers or other hand-held power tools creates a substantial risk of breaching the pressure boundary and, thus, is contrary to the interests of nuclear safety. If any peening is performed, it should be limited to a slight upsetting of the flange edges (see NP-6523-D, page 31, Figure 2-21). Excessive peening, which results in wedging the flange faces against each other, can impose stresses sufficient to fail the flange bolts (see Information Notice 93-90).

Injection of sealant should be limited to two attempts. If after two sealant injections the leak continues, the method should be abandoned. This course of action will minimize the potential for causing undue fatigue loading on the bolts resulting from the high injection pressures normally employed. Additionally, it limits the amount of material that could be injected into an operating system. This recommendation to limit injections to two does not include later injections when a leak seal has been successful and a resealing is needed during or after start-up from a subsequent outage. This statement does not imply that resealing should be repeated indefinitely. The staff notes that the sealants often cannot withstand the differential expansions that occur during a unit outage or a restart cycle and thus are not considered permanent replacements for packing or gaskets. A permanent repair would normally be expected at the next refueling outage (see item 11 herein).

Normally, flange or bonnet studs or bolts are not exposed to water or steam. By the design of the on-line leak-sealing methods, the studs or bolts will usually become part of the wetted area of the system. The effect of water or hot boric acid upon the fasteners must be considered. Low-alloy steel fasteners (such as SA-193, grade B7) must not be exposed to borated solutions for periods lasting months when the solution concentration is increased as a result of steam flashing or rapid evaporation as occurs at a leak location. Corrosion rates of as much as 1.6 inches per year have been measured in laboratory studies of the effect of hot borated solutions on carbon and low-alloy steel fasteners. Stainless steel fasteners are suitable for resisting the effects of borated water. It must be verified that stainless steel fasteners such as types 410 and 17-4 PH are tempered grades and not high-hardness grades. High-hardness grades have tensile strengths greater than 150 ksi and are susceptible to stress corrosion cracking.

Following any leak repair activity that could affect the operability of a safety-related component, the component must be tested or otherwise shown to be capable of performing its safety function (i.e., verify valve stem travel after leak-sealing the packing).

D. INSPECTION GUIDANCE

When assessing on-line leak sealing actions by the licensee, give first priority to ASME Code Class 1 components, followed next by safe-shutdown items.

Ensure that the licensee has considered the items listed below in its procedures and controls. This is essentially the core of a logic path that should indicate whether it is reasonable to mitigate a gasket or packing leak with this process. In other words, has the licensee followed a well-considered logic path from the discovery of the problem to the conclusion that performing an on-line leak seal is a safe solution? The staff notes that leak-sealing attempts that resulted in failure or created an adverse situation were fundamentally the result of a programmatic breakdown (an Appendix B violation) and not the result of an inherent problem with the process. Note that the following items are guidance, NOT requirements.

Has the licensee--

1. Involved plant and corporate management and engineering groups in evaluating the proposed on-line leak sealing? Evaluated leak sealing on a risk-informed basis against other options?

2. Considered and followed the guidance contained in EPRI/NMAC NP-6523-D (except as prohibited by the staff's position regarding the use of measures for pressure boundary leakage)?

3. Performed a structural integrity assessment of any pressure boundary modification or replacement, such as hole drilling, adding structural or pressure retaining clamps, or removing or replacing fasteners?

4. Considered the effect of a borated environment or a higher temperature on the fasteners?

5. Assessed the most likely cause of the leak?

6. Performed calculations of fastener loading during sealant injection that consider operating pressure, injection pressure, and the added pressure boundary area created by having the sealant or system fluid acting in the annulus between the old gasket and the outside of the bolt circle (as appropriate)? Does the procedure limit the number of sealant injections to two per attempt?

7. Installed positive stops on drill bits to control depth during drilling? Considered use of a drill guide or a similar fixture to align the drill and better ensure that only the intended part of the component is drilled?

8. Prohibited use of pneumatic or other power tools when peening?

9. Performed a consequence analysis posing "what if" a structural failure occurred as a result of pressure boundary modifications or related activities? Does a mitigation plan exist?

10. Established clear notification and communication with operations forces (shift supervisor or the senior reactor operator) before execution of the work?

11. Committed to replace the leaking element by the next refueling outage or performed an assessment for deferral that is risk informed?

END