ASME Class 1 Small-Bore Socket Weld Failure Summary

The original dataset for the Licensee Event Reports reviewed is available under ADAMS Accession Numbers ML093380258 and ML096680259.

Count	Description
141	Total Number of LERs Reviewed
30	Number of LERs not associated with Socket Welds (e.g., electrical sockets, Swagelok fittings, socket head cap screw, steam trap, etc.)
111	Total Number of LERs associated with Socket Welds
6	Number of LERs for which No Information Could be Located
105	Total Number of LERs associated with Socket Welds Available for Review
57	Number of LERs associated with Failures Outside the Reactor Coolant Pressure Boundary (Non-Class 1)
48	Total Number of LERS associated with Class 1 Socket Welds Available for Review

Of the 48 LERs associated with ASME Class 1 Small- Bore Socket Welds, the failures were distributed as follows:

- 24 involved Vibration-Induced High Cycle Fatigue as the main or contributing cause and half of those occurred in less than 15 years.
- 18 involved improper installation (e.g., inadequate weld preparation, lack of fusion, socket was "bottomed out," weld defect, poor workmanship, weld porosity, etc.).
- 2 involved stress corrosion cracking attributable to the wetting of asbestos insulation with subsequent leaking of chlorides to the pipe surface.
- 1 involved randomly applied mechanical loading during maintenance activities or from other unanalyzed conditions.
- 1 involved IGSCC. A poor weld fit-up and poor weld quality, which existed from original construction, contributed to high stress in the area of the coupling joint. A weld repair which added significant extra heat into the heat-affected zone surrounding the weld had the effect of sensitizing the stainless steel material, and increasing the susceptibility to IGSCC. The weld residual stresses would also be increased by this weld repair, increasing the stress component of susceptibility. Additionally, a piping strap (restraint) shown on the isometric drawing was found missing during inspections following this failure. The absence of this strap may have resulted in increased stresses but this effect is considered less significant than the existence of stress from the poor fit-up and weld. The IGSCC failure mechanism seen in this through-wall leak is believed to be an anomaly since this mechanism is rare for small bore piping.
- 2 involved unknown failure modes.

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For those LERs where a cause was identified, the bulk of the failures were due to either Vibration-Induced High Cycle Fatigue or improper installation (42 of 46). Two of the SCC failures were on the outside surface and are therefore not germane. One was due to a randomly applied load during maintenance. Although there was a failure associated with IGSCC, there were a large number of contributing factors not associated with aging (poor weld fit up, weld repair, nearby missing support, etc.).

This review indicates that the operating experience related to the failure of ASME Class 1 small-bore socket welds is not a safety-significant issue in terms of aging. The fact that ASME Class 1 small-bore socket welds have occasionally experienced leaks does not, in and of itself, suggest that the license renewal process would require additional aging management activities beyond those already in place under 10 CFR 50. As discussed in Revision 1 to NUREG-1800, Section A.1.1:

> *The license renewal process is not intended to demonstrate absolute assurance that structures and components will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the CLB during the period of extended operation.*

This review supports the position that the potential for small-bore socket weld failures does not represent a significant safety issue and surface examinations and visual inspections currently being performed are sufficient to identify and correct weld degradation prior to gross failure. The review confirms that the existing activities for managing ASME Class 1 small-bore socket welds provide reasonable assurance that the socket welds will continue to support the intended functions of the systems in which they are installed.