C.11 Flaw Evaluation

In accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.55a(g), structural integrity must be maintained in conformance with American Society of Mechanical Engineers (ASME) Code Section XI for those parts of a system that are subject to ASME Code requirements. 10 CFR 50.55a(g)(4) requires, "Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components (including supports) which are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI..." ASME Section XI, Article IWA 3000 contains the criteria for standards and examination evaluation for flaws found in welds. Sub-article IWA-3100(b) states if acceptance standards for a particular component, Examination Category, or examination method are not specified in this Division, flaws that exceed the acceptance standards for materials and welds specified in the Section III Edition applicable to the construction of the component shall be evaluated to determine disposition. Therefore, if flaws are found in components for which ASME Section XI has no acceptance criteria, then the construction code is to be used to establish the acceptance criteria. ASME Section XI is generally written for weld examinations and flaws in welds. When outside this area, the construction code is to be used to establish acceptance criteria.

The ASME Code contains rules describing acceptable means of inspecting welds and certain other locations in piping, vessels, and other pressure boundary components. The ASME Code also specifies acceptable flaw sizes based on the material type, location, and service of the system within which the flaw is discovered. If the flaw exceeds these specified acceptable flaw sizes, the ASME Code describes an alternate method by which a calculation may be performed to evaluate the acceptability of the flaw.

The NRC staff accepts ASME Code Case N-513-1, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 piping Section XI, Division 1," as an acceptable alternative to the ASME Code requirements for evaluating the structural integrity for flaws identified in moderate-energy piping. In addition, the NRC issued Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," which permits licensees to consider either the "through-wall flaw" or the "wall thinning" flaw evaluation approach when assessing the structural integrity of moderate-energy piping with identified through-wall flaws. If the flaw is found acceptable by the "through-wall flaw" approach, a temporary non-code repair may be made following NRC staff review and approval of the evaluation. If the flaw is found acceptable by the "wall thinning" approach, immediate repair of the flaw is not required; but the licensee should comply with the guideline for flaw repair and monitoring.

The NRC staff considers that GL 90-05, ASME Code Case N-513-1, and any other applicable NRC-approved ASME Code Case, also provide acceptable criteria for concluding that a TS-required operating ASME Code Class 2 or 3 piping system that contains a through-wall flaw has adequate structural integrity and is, therefore, operable but degraded. ASME Code Cases which describe methods, criteria, or requirements different from the ASME Code referenced in 10 CFR 50.55a cannot be used to evaluate the acceptability of a flaw without prior NRC review and approval unless the ASME Code Cases are endorsed in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1." ASME Code Case N-513-1 is endorsed in RG 1.147, therefore, a flaw that is evaluated in accordance with, and meets the acceptance criteria of, ASME Code Case N-513-1 is acceptable to the NRC.

ENCLOSURE

Comment [mas1]: When evaluating flaws, "Code conformance" is a different concept from "operability." Code nonconformance does not necessarily equal inoperability. The inability to satisfy a Code requirement requires an operability determination, but by itself may not constitute inoperability.

Comment [mas2]: Add, "for conditions detected during preservice and inservice inspection activities."

Comment [mas3]: Sentence should read, "ASME Section XI is specifically written for examination of the items identified in IWX-2500."

Comment [mas4]: Delete sentence.

Comment [mas5]: Past practice has not required prior NRC review.

Comment [mas6]: (a) Limited to flaws found during ISI. (b) A licensee may know it has a Code noncompliance, but can show sufficient margin to permit continued operation. Relates to our comment that Code compliance and Operability are different concepts.

NRC has accepted ASME Code Case N-513-1 for application in the licensee's inservice inspection programs, with the following conditions:

a. Specific safety factors in paragraph 4.0 of ASME Code Case N-513-1 must be satisfied, and

b. ASME Code Case N-513-1 may not be applied to:

(1) components other than pipe and tubing,
(2) leakage through a gasket,
(3) threaded connections employing nonstructural seal welds for leakage prevention (through-seal weld leakage is not a structural flaw, but thread integrity must be maintained), and
(4) degraded socket welds.

Therefore, to evaluate the structural integrity of flaws found in boiling or pressurized water-cooled nuclear power facility, components (including supports) which are classified as ASME Code Class 1, Class 2, and Class 3, the following table outlines the available methods.

Pipe Class/Energy	ASME Code Section XI/ Construction Code	NRC Approved Alternative	CC N-513-1	GL 90-05
Class 1/HE	X	X		
Class 2/HE	X	X		
Class 2/ME	X	X	X	
Class 3/HE	X	X		X
Class 3/ME	X	X	X	X

If an ASME Class 1 component does not meet ASME Code requirements, the requirements of an NRC endorsed ASME Code Case, or an NRC approved alternative the component should be considered inoperable. The basis for this statement is the need to assure the high degree of reliability required of ASME Class 1 components. When an ASME Class 2 or Class 3 component does not meet ASME Code requirements, the requirements of an NRC endorsed ASME Code Case, or an NRC approved alternative, then licensees must make a determination of whether the identification of the degraded or non-conforming condition results in a TS required feature or support feature being inoperable. For components identified as ASME Class 2 moderate or high energy components and Class 3 high energy components with identified through-wall leakage, the staff considers an immediate operability determination to not be feasible. Detailed non-destructive examination data would have to be available to support the determination, which would take more time to obtain than what would be allocated for an immediate operability determination. In addition, substantial operating experience with pressure boundary leakage and the degradation mechanism in the leaking system would be needed to establish a reasonable expectation of operability and this type of information is not generally available. As outlined under defined terms, Section 3.9, Reasonable Expectation,

Comment [mas7]: (a) Delete the first two sentences, because Code noncompliance does not necessarily result in inoperability.
(b) 3rd sentence should include Class 1.
(c) 4th sentence: Inconsistent with previous guidance because it excludes Class 2 ME components.
(d) 4th sentence: Industry believes that an immediate determination (ID) for Class 2 ME and Class 2&3 HE may be feasible in many cases.
(e) Detailed NDE is not essential for an ID.

there is no such thing as an indeterminate state of operability; an SSC is either operable or inoperable. Through-wall leakage and the methods to evaluate through-wall leakage are further addressed in section C.12.

Once a flaw is determined to be unacceptable, regardless of whether the degraded component is operable but degraded, or inoperable, the component must be restored to meet ASME Code requirements, requirements of an NRC endorsed ASME Code Case, or an NRC approved alternative. If this involves physical changes to the components, it must be completed in accordance with ASME Section XI, IWA-4000. Completion is expected by the next outage, or at least the next refueling outage, or upon return to service if identified while the component was out of service.

C.12 Operational Leakage From ASME Code Class 1, 2, and 3 Components

Leakage from the reactor coolant system is limited to specified values in the TSs depending on whether the leakage is from identified, unidentified, or specified sources such as the steam generator tubes or reactor coolant system pressure isolation valves. If the leakage exceeds TS limits, the limiting condition for operation (LCO) must be declared not met and the applicable conditions must be entered. For identified reactor coolant system leakage within the limits of the TS, the licensee should determine operability for the degraded component and include in the determination the effects of the leakage on other components and materials.

The regulations require that the structural integrity of ASME Code Class 1, 2, and 3 components be maintained in accordance with the ASME Code. In the case of specific types of degradation, other regulatory requirements must also be met. If a leak is discovered in a Class 1, 2, or 3 component in the conduct of an inservice inspection, maintenance activity, or facility operation, any corrective measures to repair or replace the leaking component must be performed in accordance with IWA-4000 of Section XI. Alternately, relief from compliance with ASME Code requirements may be requested from the NRC.

The operational leakage TS LCO does not permit any reactor coolant pressure boundary leakage. Upon discovery of leakage from a Class 1 pressure boundary component (pipe wall, valve body, pump casing, etc.), the licensee must declare the component inoperable. Upon discovery of leakage from a TS-required Class 2 or Class 3 component, the component is evaluated in an immediate determination of operability followed by a prompt determination if additional or supporting analysis needed to support a reasonable expectation of operability. In performing the immediate determination, substantial operating experience with pressure boundary leakage and the degradation mechanism in the leaking system would have to be available as a basis for a determination of operable. For ASME Class 2 moderate and high energy components and Class 3 high energy components that have through-wall leakage, the staff considers an immediate operability determination to not be feasible. The staff does not believe substantial operating experience with pressure boundary leakage exists for this category of components to support a reasonable expectation of operability determination. In addition, detailed non-destructive examination data would have to be available to support the determination, which would take more time to obtain than what would be allocated for an immediate operability determination. As outlined under defined terms, Section 3.9, Reasonable Expectation, there is no such thing as an indeterminate state of operability; an SSC is either operable or inoperable. There is much more experience with Class 3 moderate energy components with through-wall leakage, and as such have a higher likelihood of being

Comment [mas8]: (a) Inconsistent with 6/22/07 NRC Interim Guidance.
(b) Inconsistent with previous understanding of NRC positions expressed in February 2007.
(c) Industry believes it has sufficient engineering experience and expertise to determine with reasonable expectation of an item's operability for flawed Class 2&3 components in both moderate energy (ME) and high energy (HE) systems.
(d) The process for evaluating HE and ME situations is the same.
(e) Refer to Section 4.4 of NEI White Paper ("Treatment of Operational Leakage from ASME Class 2 and 3 Components," May 2007).

determined operable after an immediate operability determination, based on operating experience and the type of corrosion that they are subject to. GL 90-05 provides guidance for the evaluation of Class 3 piping and ASME Code Case N-513-1 provides guidance for the evaluation of Class 2 and Class 3 moderate energy piping.

As noted above, upon discovery of leakage from a TS-required Class 2 or a Class 3 pressure boundary component, the licensee must immediately evaluate the operability of the component, followed by a prompt determination of operability. In performing the subsequent prompt operability determination, the licensee must evaluate the structural integrity of the leaking component using the actual geometry of the through-wall flaw characterized or bounded with volumetric examination methods. It may be possible to use visual methods to determine the exterior dimension(s) and orientation of a through-wall flaw in a leaking component. However, even though the outside surface breaking dimension of a through-wall flaw is small, the length and extent of the flaw inside the component wall may be quite long and potentially outside the limits established by the ASME Code. To evaluate the structural integrity of the leaking component, the licensee may use the criteria in Section XI of the ASME Code or any applicable ASME Code Case approved in NRC RG 1.147. The licensee may evaluate the structural integrity of Class 3 piping by evaluating the flaw using the criteria of paragraph C.3.a of Enclosure 1 to GL 90-05. If the flaw meets the criteria, the piping is degraded but operable until relief from the applicable ASME Code requirement or requirements is obtained from the NRC and a temporary non-Code repair is made.

Comment [mas9]: (a) Please clarify - what does the word "criteria" mean in this sentence: Code or GL 90-05? (b) If an evaluation is done per Code rules approved by NRC and the results are satisfactory, then the item is no longer non-conforming.

Alternatively, the licensee can evaluate the structural integrity of leaking Class 2 or Class 3 moderate-energy piping using the criteria of ASME Code Case N–513-1, as discussed in section C.11, “Flaw Evaluation.” If the flaw in the leaking component satisfies the applicable structural integrity criteria, the piping can be deemed degraded but operable and continued temporary service of the degraded piping components is permitted. Components with these flaws must be restored to ASME Code requirements through repair/replacement or meet requirements acceptable to the NRC, as approved in a relief request or ASME Code Case approved under RG 1.147 prior to the completion of the next scheduled outage.

Comment [mas10]: What is meant by "structural integrity criteria" in this sentence?

If the licensee decides to control the leakage by mechanical clamping means, the requirements of ASME Code Case 523-2, “Mechanical Clamping Devices for Class 2 and 3 Piping Section XI, Division 1,” may be followed, because the NRC staff endorses this Code Case in RG 1.147. This Code Case applies to structural integrity of Class 2 and 3 piping which is 6 inches (nominal pipe size) and smaller and shall not be used on piping larger than 2 inches (nominal pipe size) when the nominal operating temperature or pressure exceeds 200°F or 275 psig. These and other applicable ASME Code Cases which have been determined to be acceptable for licensee use without a request or authorization from the NRC are listed in RG 1.147. These ASME Code Cases do not apply to Class 1 pressure boundary components.

The NRC has no specific guidance or generically approved alternatives for temporary repair of flaws (through-wall or non-through-wall) in Class 1, 2, or 3 high-energy system components, or for Class 2 or 3 moderate-energy system pressure boundary components other than piping. Therefore, all such flaws in these components must be repaired in accordance with ASME Code requirements, or relief from ASME Code requirements must be requested of and approval obtained from the NRC.