TECHNICAL EVALUATION

of

PROPOSED METHOD OF CLASS 3 PIPE LEAK OPERABILITY DETERMINATIONS

Nuclear Management Company

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Section 1

INTRODUCTION

1.1 PURPOSE

This purpose of this document is to define a method of performance of operability determinations (OD) for low-pressure Class 3 piping leaks at NMC nuclear facilities. This evaluation will include technical discussion of corrosion and cracking in piping and its effect on serviceability, current enforcement practices, applicable codes and standards, and a clear process for performance of operability determinations of minor Class 3 piping leakage.

1.2 BACKGROUND

Corrosion of carbon steel ASME Class 3 raw water systems (e.g., Service Water) has become an increasingly important issue within the nuclear industry. Several aggressive programs have been implemented throughout the NMC fleet to monitor and replace Class 3 Service Water piping as a part of the company's aging management program. It is anticipated that some amount of minor through wall leakage will occur during this monitoring and replacement effort. While chemically controlled and relatively clean closed cooling systems (such as Component Cooling water) have not demonstrated as significant a degree of corrosion, infrequent leaks may occur in these Class 3 low energy systems as well.

A well-understood and consistent fleet plan for the evaluation of minor leakage is essential. If well implemented, actions will not be overly restrictive by inappropriately removing key safety systems from service while still assuring structural integrity of these cooling water systems. If operability determination processes are not applied correctly, small leaks may lead to the inappropriate forced shutdown of a unit due to technical specification requirements.

1.2.1 ASME Requirements

As defined by ASME, pressure boundary is the structural membrane of nuclear plant systems that provides a pressure-containing barrier to prevent catastrophic failure. Structural Integrity is the ability of the pressure boundary to remain in tact under all design conditions. Based on this explanation, a pinhole leak would be a breach of the pressure boundary that does not affect the structural integrity or measurably increase the likelihood of catastrophic failure.

ASME IWB requires that flaws, which exceed the code acceptance limits, be repaired in a Code acceptable manner before return to service.

1.2.2 NRC Regulations

GL 90-05 "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping" (June 15, 1990) allows for non-code repairs and provides requirements for evaluations. It allows "moderate energy" Class 3 systems to be returned to service prior to NRC approval of non-Code repair.

NRC Inspection Manual 9900 Section 6.15 "Operational Leakage" states "Upon discovery of leakage from a Class 1, 2, or 3 component pressure boundary (i.e., pipe wall, valve body, pump casing, etc) the licensee should declare the component inoperable. The only exception is for Class 3 moderate energy piping as discussed in Generic Letter 90-05. For Class 3 moderate energy piping, the licensee may treat the system containing the through-wall flaw(s), evaluated and found to meet the acceptance criteria in Generic Letter 90-05, as operable until relief is obtained from the NRC." This wording has been the source of confusion and conflicting interpretation. It is well understood that a Class 1 or 2 system through-wall leak is cause to declare components inoperable upon discovery.

The discussion of Class 3 systems clearly states that it is possible to consider the component operable until NRC relief is obtained. Inherent in this is the timely completion of an operability determination. This is a main focus of this evaluation. Discovery of minor leakage in an ASME Class 3 service water system will not result in the immediate declaration "inoperable" if certain screening criteria are met. The system will then remain operable until the flaw evaluations (i.e., GL 90-05 analyses) are performed. The OD will then be revised with the final operability status.

1.2.3 NRC Enforcement

The present enforcement of NRC requirements within Region III is clear. Until completion of an OD stating that the component is operable, the NRC expectation is that the component/system be declared inoperable. Performance of evaluations as described in this evaluation will satisfy these NRC expectations.

The following examples are provided for reference:

<u>Clinton Power Station (2003)</u>
The Licensee received an NRC violation for not immediately declaring a support system of the Emergency Diesel Generator inoperable and removing it from service after finding a minor leak in the system. The Licensee's initial assessment was that the leak was not significant via engineering judgment. A UT inspection was then performed to demonstrate that the remaining wall thickness met requirements for structural integrity. The NRC cited their Inspection Manual 9900 Section 6.15 as requiring declaration of inoperable upon discovery of the leak.

<u>Prairie Island Nuclear Generating Station (2003)</u>
In a Region III inspection report at Prairie Island a similar position was taken although a violation was not issued. The following is a quote from the report:

> *"On March 14, 2003, the inspectors identified that the licensee inappropriately concluded that a pinhole leak on a ¾-inch cooling water line for the 21 component cooling water heat exchanger did not result in the inoperability of the associated cooling water header."*

As a result of this and other experience, NMC has imposed a very conservative practice of declaring the component and affected system inoperable upon discovery of any leakage, regardless of Code Class or energy level. Operable status is not returned until the extent of degradation can be determined and associated structural evaluation completed. This has led to safety systems being removed from service and in at least one instance a premature a reactor shut down was commenced.

Section 2
EVALUATION

2.1 Fracture Mechanics

Service water and component cooling systems operate under low pressure (< 200 psi) and low temperature (< 200_F) conditions. These conditions are considered non-challenging in the area of fracture mechanics. In many cases the systems are fabricated from ASTM A106 (or similar) piping material that has excellent toughness characteristics. Typically the nil ductility transition temperature (T_{NDT}) for these materials is less than -20_F, well below the minimum service temperature of the service water systems. Put simply, small flaws (i.e., small leaks) do not propagate to become large flaws quickly. Because of the moderate system conditions, it takes a long time for a small flaw to become structurally significant. Brittle catastrophic failures of the piping material are not possible. Additionally, the loading, temperature and environment are such that fatigue, stress corrosion cracking or corrosion fatigue generally does not occur.

4 Corrosion / Erosion

Corrosion and/or erosion of service water system piping has been a concern for the nuclear industry for many years. System inoperability and piping replacements have been a large expense. As a result, corrosion prevention and monitoring programs are in place at every utility. These programs use methods such as cathodic protection, water chemistry limits, and chemical and mechanical cleaning to assure that general and localized corrosion does not challenge the integrity of the piping. More importantly, NDE examinations of susceptible areas of SW system piping are routinely performed. These programs give us strong assurance that areas of near through-wall corrosion/erosion do not exist in our service water systems. Therefore, suggesting that a small leak could be a precursor to complete piping failure due to corrosion over a short time interval is not credible.

2.3 Typical Evaluation Methodology

The priority for evaluation of these minor service water leaks is to assure the systems structural integrity is intact as well as to assure that adequate cooling water flow is still supplied by the system.

The structural analysis is typically performed using the guidance of ASME Code Case N-513. This analysis requires that a volumetric inspection be performed to determine extent and through-wall depth of the flaw. The flaw's location and shape are characterized and analyses are performed to determine the remaining piping life and margins to piping failure. A review of all available OE indicated that in every case the low-pressure service water system the leak was eventually defined as "not significant" because it would not have affected the systems ability to perform its intended function.

As will be discussed in the Recommendations Section, the threshold for the recommended OD process will be a very minor leakage (less than 1 gpm). One-gallon per-minute leakage will not challenge any Service or Component Cooling Water systems ability to deliver cooling water flow. The leakage should also be verified not to be an auxiliary safety hazard to equipment or personnel (e.g., not leaking on electrical panel).

Section 3

CONCLUSIONS & RECOMMENDATIONS

The conclusion of this evaluation is that minor leakage (1 gpm or less) from Class 3 service water or closed cooling systems does not challenge the structural integrity nor the ability of the system to deliver required cooling water flow in the short term. A prompt operability determination can be performed at the time of discovery using this as a basis. If several simple screening criteria are met, the system should declared operable pending completion of the GL 90-05 analysis.

The following recommendations may be employed at each site to augment their existing OD procedures and Operations/Engineering briefings. If performed correctly, these steps are in compliance with ASME and NRC rules on the topic and can prevent unnecessary system unavailability.

Discovery - Upon discovery of Class 3 moderate energy piping leakage the Operations Department should immediately notify Engineering.

Initial Assessment - Engineering should immediately inspect the component and characterize the leak location and estimate the leak-rate.

Prompt Operability - Engineering should then immediately provide a prompt Operability Recommendation to Operations. This may be verbal, with complete documentation per Fleet Procedure FP-OP-OL-01 to follow. The system may be declared **operable** unless the leak-rate is estimated to be greater than 1 gpm. The expectation is that a formal Operability Recommendation ("OPR") is initiated concurrent with the notification to Operations of the leak location. There should be no delay in the prompt Operability Recommendation.

The prompt Operability Determination should be active until the evaluation step is complete and the formal Operability Recommendation is documented and approved. This should be restricted to less than 72 hours.

Evaluation – Complete the required NDE inspection and structural evaluations (e.g., GL 90-05 evaluation). Document the results in the formal Operability Recommendation (OPR).

It is expected that this evaluation take no more than 72 hours. Therefore, it is important to have a set plan for quick notification/mobilization of the needed support groups. Maintenance Department support (i.e., scaffolding and insulation removal), Program Engineering support (i.e., NDE services), as well as others may be needed.

The attached flow chart summarizes this decision process. A more detail site-specific flow chart should be included in the augmentation of existing OD procedures and Operations/Engineering briefings.