UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

CODE REPAIR REQUIREMENTS

ASME CODE CLASS 1 EQUALIZATION LINE

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

1.0 INTRODUCTION

By letter dated December 14, 1992, the Power Authority of the State of New York (the licensee) requested relief from the repair requirements of the ASME Code, Section XI, IWA-5250(a)(2) and IWA-4130(a)(2), in order to perform a temporary non-Code repair to the Reactor Water Cleanup (RWC) system at FitzPatrick Nuclear Power Plant. The purpose of the temporary repair was to provide structural reinforcement and leak mitigation to a cracked and leaking 1/2-inch Nominal Pipe Size (NPS), schedule 80, grade TP316L stainless steel pipe. This pipe is part of a bonnet equalization line on a 6-inch NPS carbon steel manual isolation valve. These items are part of the RWC system, which is classified as ASME Code Class 1. Design conditions are 532 °F at 1147 psig.

The leak was discovered during a hydrostatic test on the RWC system. It occurred at the socket weld joint between the 1/2-inch line and the 6-inch valve body. The flaw was a circumferential crack at the weld toe of the fillet. The leak cannot be isolated by normal means since the leak is on the upstream side (reactor coolant system side) of the manual isolation valve.

A preliminary root cause analysis attributed the leak to the difference in thermal expansion coefficients between the stainless steel equalization line and the carbon steel valve. This difference in expansion rates is postulated to have caused a cyclical bending stress at the crack site. Crack initiation and propagation was concluded to be the result of thermal fatigue as the system experienced operating temperature fluctuations.

The licensee proposed a temporary repair consisting of sleeving over the failed weld and adjoining 1/2-inch NPS pipe with a larger pipe (1 1/2 inch diameter). The larger pipe would be split longitudinally and slipped over the smaller pipe and weld. The larger pipe would be welded at one end to the 6-inch valve body. The other end of the pipe sleeve would be welded to an existing 1/2-inch NPS elbow that is part of the equalizing line. The longitudinal welds and connecting girth welds of the larger pipe would meet

appropriate ASME Code, Section III, requirements, including a hydrotest. This temporary repair would in effect surround the existing flaw with a new, Code-designed pressure boundary. Relief was requested to employ this temporary repair until the next refueling outage in 1994.

2.0 DISCUSSION

Submittal of this relief request followed several conference calls between the licensee and the NRC staff. These calls were concerned with the technical issues of the proposed temporary repair and the hardship of performing a Code repair with a shut down but fueled reactor. At the time of discovery, the unit was shut down for a scheduled refueling outage. Normally, Code repairs, not temporary repairs, are executed during planned outages. This is the requirement of ASME Section XI, paragraph IWA-5250, which states that pressure boundary leakage detected during the conduct of a hydrotest must be corrected with a Code repair. In this case, performing a Code repair would require off-loading fuel. The licensee submitted that an unusual hardship existed in this instance, and that relief was justified. Furthermore, the licensee asserted that the proposed temporary repair would provide an equivalent level of safety to that of a Code repair.

During the course of discussion, the licensee cited the provisions of 10 CFR 50.55a(a)(3) as justification for the proposed temporary repair. The Code of Federal Regulations at 10 CFR 50.55a(a)(3) provides for consideration of alternatives to the rules of the ASME Code. The provisions of the paragraph are as stated: "The applicant must demonstrate that (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements of this section would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety."

In addition to deviating from the requirements of IWA-5250, the proposed temporary repair also deviates from the ASME Code requirements in the following two areas. ASME Code Paragraph IWA-4130(a)(2) includes a requirement for flaw removal as part of the repair process. Flaw removal is not accomplished in the proposed repair. Instead, the original pressure boundary is essentially replaced by a new surrounding pressure boundary. The original flaw remains in place. The residual effect, if any, of leaving the flaw in place must be evaluated on an individual basis. For this case, the staff finds the effect of leaving the flaw in place to be inconsequential to the structural integrity of the system. This is due to the fact that the new pressure boundary meets the Code design criteria.

however, other effects must be considered. By enclosing the original pipe inside another pipe, a closed, stagnant chamber is created which has insignificant flow or interchange with the bulk of the system fluid. This geometry is a classic crevice condition for encouraging certain forms of corrosion. Due to the limited exchange of fluid between the system and the crevice, detrimental ions are encouraged, by electrochemical processes, to migrate and concentrate in the crevice. Thus, the local chemistry in the

crevice can be substantially different from that of the bulk fluid. This frequently causes accelerated localized corrosion (pitting) or stress corrosion cracking (SCC) within the crevice. Stainless steels are susceptible to this condition.

To help alleviate the concerns regarding corrosion, the licensee proposed to utilize type 316L stainless steel for the sleeve. This is a grade of stainless that has proven to be more resistant to the types of attack described. The staff notes that an incubation time is required before any corrosion degradation occurs with this type of stainless. For a BWR, (FitzPatrick) the incubation time may be years. Due to this experience, the staff finds the material choice to be reasonable for the proposed period of use, one fuel cycle.

A second Code issue involves the remediation of the root cause(s) of a component failure. Paragraph IWA-7220 of ASME Section XI states, in part: "If cause of failure appears to be a deficiency in the specification for the existing item, the specification for the item to be used for replacement shall reflect appropriate corrective provisions." For this case, the licensee attributed the failure cause to be the result of the coefficient of thermal expansion mismatch between the carbon steel valve body and its bonnet equalization line (stainless steel). This was a reasonable engineering judgment as to the deficiency cause, but it was not conclusive. Since no failure analysis was conducted (the flawed weld was not removed for metallurgical study), no conclusive finding was possible regarding root cause. The proposed temporary repair did not, of course, address a change in valve (12RWC-46) material (to stainless steel) since that level of effort was asserted to be unreasonable. Thus, the analysis/remediation aspect of the Code was not satisfied under the proposed temporary repair plan. The staff finds the licensee's proposed repair to be an acceptable alternative to this aspect of the Code for the proposed period of use, one fuel cycle.

The licensee maintained that a Code repair presented a hardship due to the inability to isolate the leak from the Reactor Coolant System (RCS). There are no valves between the leak location and the RCS. Installation of a freeze plug was considered by the licensee and rejected as having marginal safety. Installation of an internal pipe plug was also explored. This would require removal of over one-third of the reactor fuel in order to gain access for temporary plug installation. The licensee estimated that reactor vessel disassembly and re-assembly would create an additional 11.9 person-REM exposure. Additional exposure would result from the fuel handling operations. Any fuel handling operations pose some level of risk which can result in additional exposure beyond projections. From the ALARA and safety standpoint, requiring additional fuel handling, in this case, is contrary to staff guidance.

Normally, the staff position on temporary repairs discourages their use as a corrective measure when a unit is in a scheduled overhaul. An outage is the only time that many Code repair/replacement actions can be accomplished. Hydrostatic tests during a scheduled outage are a way to identify pressure boundary deficiencies and permit a Code repair prior to a return to operation.

However, for this situation, the staff finds that unloading the reactor core at this time in the refueling outage would constitute a significant hardship and create additional ALARA and safety concerns without a compensating increase in the level of quality and safety beyond the proposed alternative.

A temporary repair must include an augmented inspection of the affected system, or similar systems, to determine whether or not the detected flaw is unique or generic. The licensee reviewed 19 other valves with equalizing lines for a similar material combination and found none. Based on the preliminary root cause analysis, the licensee concluded that the failure was unique to the subject case.

The licensee has formulated a periodic inspection plan for the proposed temporary repair. A VT-2 visual inspection of the repair will be performed during all unit shutdowns in which the containment is deinerted.

3.0 CONCLUSION

Pursuant to 10 CFR 50.55a(a)(3)(i) and (ii), the staff finds that imposing the Code repair requirement in this instance would result in hardship or unusual difficulties without a compensating increase in the level of quality and safety. Furthermore, the staff finds that the proposed temporary repair will assure an acceptable level of quality and safety, similar to that of a Code repair for the proposed period of use of the alternative, because the structural integrity is provided. Relief is granted to perform the proposed temporary non-Code repair until the next scheduled refueling outage in 1994 provided PASNY performs the VT-2 visual inspection described above. The temporary non-Code repair must then be replaced with a Code repair.

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