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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

DEFERRAL OF PERMANENT REPAIR TO PRESSURIZER NOZZLE

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT NO. 1 (ANO-1)

DOCKET NO. 50-313

1.0 INTRODUCTION

By letters dated December 20, 1991, and January 21, 1992, Entergy Operations, Inc. (the licensee), discussed a reactor shutdown and a subsequent temporary acceptable repair to a pressurizer upper instrument nozzle on ANO-1. Examination revealed the nozzle failure to be a through-wall crack in the 1.45 inch outside diameter Alloy 600 nozzle. The crack is attributed to primary water stress corrosion cracking (PWSCC) of the Alloy 600 material. The temporary repair consisted of a new nozzle section welded to the exterior of the pressurizer. The original nozzle was welded to the interior Alloy 600 liner of the pressurizer, thereby providing a corrosion barrier for the carbon steel pressurizer vessel. The temporary repair allows the bore through the carbon steel to be exposed to the steam environment of the pressurizer. The exposure is in the crevice-like annulus between the nozzle insert and the pressurizer bore hole.

The licensee has proposed permanent replacement of the nozzle with Inconel 690 (a potentially less susceptible material) after two or more refueling cycles. Several reasons for this permanent repair scheduling delay are given. The licensee contends that current repair technology needs further refinement. Installation can benefit from improved repair/replacement methods. More efficient repair techniques will reduce radiation exposures. Improved repair/replacement designs are being pursued to reduce residual stresses on the replacement nozzle.

2.0 EVALUATION

The proposal to delay the permanent repair for two or more cycles is based upon a proprietary corrosion study submitted by the licensee. In brief, the study indicates that corrosion of the carbon steel will proceed at a rate slow enough to pose no threat to the structural boundary.

To supplement the research results that corrosion effects on the carbon steel of the pressurizer are not significant, the licensee has proposed a monitoring plan. The monitoring plan includes development of an ultrasonic testing (UT) technique to monitor corrosion in the nozzle-bore hole annulus. A mock-up of

the pressurizer nozzle has been fabricated for use in a UT qualification process. Indications have been machined in the bore area to represent corrosion flaws. UT technique development is underway at Southwest Research Institute. The UT technique will not be accepted as fully proven until it is tried under actual field conditions. If the inspection technique proves unsuccessful during field use, a new nozzle will be installed during Refueling Outage 11. If the inspection method detects higher than anticipated corrosion rates, a new nozzle will likewise be installed during Refueling Outage 11. If inspection techniques and results are favorable, a periodic inspection plan will be implemented and nozzle replacement deferred.

3.0 CONCLUSION

The staff has concluded that the present nozzle repair meets the structural requirements of the ASME Code. The proprietary corrosion study indicates that primary water corrosion of the carbon steel will proceed at a slow rate. Since laboratory data may not necessarily duplicate field conditions, the staff accepts this information as an estimate of what to expect in actual service. Thus, the monitoring plan becomes an essential part of the temporary repair to provide the assurance necessary for continued safe operation. For this reason, the staff finds the licensee's plan for permanent nozzle replacement acceptable as proposed, provided that the licensee implements the monitoring program specified above with a nondestructive examination technique demonstrated to be effective in evaluating pressurizer base metal corrosion. If an effective nondestructive examination technique is not developed, the nozzle permanent replacement should be accomplished no later than the end of Refueling Outage 11.

Principal Contributor: G. Hornseth

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