NORTHEAST UTILITIES
The Connecticut Light And Power Company
Western Massachusetts Electric Company
Holyoke Water Power Company
Northeast Utilities Service Company
Northeast Nuclear Energy Company

General Offices · Selden Street, Berlin Connecticut

P.O.BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203)665-5000

Docket No. 50-423
Re: 10CFR50.
March 27, 1992
MP-92-328

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
Refueling Water Storage Tank Level Switch Failure

This Special Report is being submitted to disseminate information to the industry regarding the presence of microbiological induced corrosion (MIC) in stagnant instrument sensing lines.

Summary

During the performance of Operations surveillance procedure SP 3451BO3, on March 1, 1991, at 1000 hours while in Mode 0 at 0% power, atmospheric pressure and 88 degrees Fahrenheit, RWST Level Switch 3QSS*LS54A was found to have failed in the low-low level condition. With this level switch indicating a low-low level condition, it would block the "'A" Residual Heat Removal (RHS) Pump from starting automatically upon receipt of a Safety Injection Signal (SIS).

The root cause of the ASCO level switch failure is microbiological induced corrosion (MIC) of the viton diaphragm. Corrosion products from the zinc-plated carbon steel backing plate and from the breakdown of the viton blocked the instrument sensing port.

As short term corrective action, the failed level switch was replaced with a spare of the same model and the failed switch was destructively disassembled and examined to determine the failure mechanism. The long term corrective action plan included chemical sampling the instrument sensing lines when plant conditions permitted.

Investigation

The failed switch was destructively disassembled to determine the cause of the failure. This examination revealed the breakdown of the viton sensing diaphragm and its zinc plated carbon steel pressure (backing) plate. The sensing port was completely blocked by corrosion products. The sensing lines and switch housing are made of stainless steel and showed no evidence of corrosion or degradation. The corrosion by-products are from the breakdown of the zinc-plated carbon steel pressure (backing) plate. The viton diaphragm was clearly degraded and deformed. The diaphragm had become permeable and leaked by, as evidenced by corrosion of the pressure (backing) plate.

Cert No P8788736105

IE22 1/0

Chemical sampling of the fluid in the sensing lines to all of the level switches was performed on January 28 & 30, 1992 and March 6, 1992. The samples obtained on January 28 & 30, 1992 revealed a depressed level of pH (2.0) in the process fluid of the sensing lines to the level switches. This was significantly more acidic than the RWST pH of 4.6-4.8. These results indicated the presence of microbiological activity in the sensing lines.

RWST level switches 3QSS*LS54B and 3QSS*LS56B were destructively examined on February 17, 1992 by Buckman Laboratories. Samples of the bacteria were obtained from the switches and the sensing lines. The chemistry report from Buckman Laboratories indicates the growth of an anaerobic microflora, not typically associated with MIC. This is involved either as an inducing mechanism or an influencing mechanism for the failure of the RWST level switches. A supplemental chemistry report may be provided by Buckman Laboratories if the samples will grow over a longer period of time. This supplemental report will provide additional chemical information in determining the exact form of bacteria (MIC) present.

The chemical samples obtained on March 6, 1992 revealed an increase in the pH measurement (4.6-5.84). This indicates degradation of the viton diaphragms in the level switches. The samples were rust colored which indicates that the backing plates are corroding due to contact with the corrosive boric acid fluid matrix. The resultant Iron Hydroxide (3FeOH2) formed as the water dissociates causes a caustic imbalance, which causes the pH to increase.

The gas created by MIC apparently permeates the viton diaphragm which protects the zinc plated carbon steel pressure (backing) plate. This exposes the pressure plate to corrosive degradation causing failure of the switch due to clogging of the orifice from the deformation of the backing (pressure) plate.

Evaluation

The corrosion products created by the MIC clogged the level switch orifices, blocking pressure signals from reaching the diaphragm. There have been three (3) level switch failures in six (6) years. All failures occurred in 3QSS*LS54A, and C which are interlocked to the "A" RHS pump. These switches (LS54 series) have 1/8" orifices integral with the switch and all three failures appear to have been caused by clogging of the orifice. The other level switches, 3QSS*LS56A, B, C & D do not have an orifice, and are not subject to this failure mechanism.

Surveillance testing of the RHS and QSS pumps verifies operability of the level switches on a quarterly basis. Two switches on separate trains have not failed within the same quarter. Since it is felt that the life expectancy of the switches would depend upon the amount of contaminants in the switch, and since the amount of contaminants could vary significantly, it is unlikely that both trains would be affected at the same time. A review of the equipment history indicates that there have been three (3) failures of the level switches interlocked to the RHS pumps, (3QSS*LS54A, & C), over a six (6) year period. All three failures only affected the "A" RHS pump. These switch failures occurred to 3QSS*LS54A and C, which affect the "A" RHS pump only. A check of all switches at the time of the third failure found one switch interlocked to the "B" RHS pump to be sluggish, which indicated partial blockage of the switch orifice. However, the switch was still operable. There have not been any failures of the level switches interlocked to the QSS pumps (3QSS*LS56A, B, C & D). The switches interlocked to the RHS pumps (3QSS*LS54A, B, C & D) will annunciate upon a LO-LO RWST Level (failed position of a switch) when a Safety Injection Signal (SIS) is initiated. The level switches interlocked to the QSS pumps will annunciate upon a LO-LO RWST Level (failed position of a switch), regardless of a Safety Injection Signal (SIS) initiation.

Conclusion

Millstone 3 Engineering will implement a design change to allow for the immediate detection of a failed level switch interlocked to an RHS pump start. Based on the recommendations of Buckman Laboratories, a chemistry sample and flush program has been established with a monthly frequency. Should these samples indicate accelerated MIC related anaerobic microflora growth, the sample and flush frequency will be increased. Also, Millstone Unit 3 Engineering will consider a preventative maintenance program to replace the switches every two (2) years at that time. Since the shortest experienced time to failure of the switches is five (5) years, the two (2) year replacement schedule is considered conservative. MP3 Engineering and Chemistry are investigating the possibility of performing a flush of the sensing lines with a chemical cleaning agent. Also, MP3 Engineering, Chemistry and I&C are investigating the possibility of replacing the viton diaphragm with a different material.

The Licensee contact for this Special Report is Mark A. Smith, who may be contacted at (203) 444-5487.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

FOR: Stephen E. Scace
Director, Millstone Station

BY: Carl H. Clement
Millstone Unit 3 Director

SES/MAS:bjo

cc: T. J. Martin, Region I Administrator
W. J. Raymond, Senior Resident Inspector, Millstone Units Nos. 1, 2, and 3
V. L. Rooney, NRC Project Manager, Millstone Unit Nos. 1 and 3.