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

AEOD/E125

This is an internal, pre-decisional document not necessarily representing a position of AEOD or NRC.

OCT 15 1981

219

MEMORANDUM FOR: AEOD Files

FROM: George Lanik

SUBJECT: ENGINEERING EVALUATION REPORT ON SHUTDOWN COOLING SYSTEM HEAT EXCHANGER FAILURES AT OYSTER CREEK, AUGUST 1981

Enclosed is a copy of an Engineering Evaluation report on shutdown cooling system heat exhanger failures which occurred at Oyster Creek in late August 1981. The event was of interest primarily because all three trains of SDC were declared inoperable: two HXs experienced tube failures and the third was removed from service as a precaution against common mode failure. The failures have been diagnosed as fatigue failures due to flow induced vibration. Alternate means of decay hat removal were maintained by use of the Reactor Water Cleanup System non-regenerative HX and augmented letdown to the main condenser. The SDC system at Oyster Creek is not part of the engineered safety features. Since redundant and diverse safety grade equipment for decay heat removal was available via the isolation condensers, safety relief valves, and torus cooling system, it is recommended that this event not be considered as an Abnormal Occurrence. IE Regional personnel are closely following the testing and repair of the heat exchangers to assure their ability to function during subsequent shutdowns. Completion of repairs and restart of the reactor is currently scheduled for the week of October 12, 1981.

George Lanik

George Lanik

Enclosure:
As stated

cc: C. Michelson, w/ enclosure
S. Rubin, w/enclosure
M. El-Zeftawy, w/enclosure

XA

8110230085

A113

ENGINEERING EVALUATION REPORT

ON

SHUTDOWN COOLING SYSTEM HEAT EXCHANGER FAILURES

AT OYSTER CREEK, AUGUST 1981

Prepared by: George F. Lanik

EVENT DESCRIPTION

While in cold shutdown with the vessel head in place on August 27, 1981, a tube failure in the "C" shutdown cooling system heat exchanger (SDCHX) resulted in leakage to the reactor building closed cooling water (RBCCW) system. The RCBBW surge tank overflowed and spilled into floor drains. This failure was initially interpreted by plant personnel as "a loss tube in a ten year old HX."

When a tube failed on the "A" SCDHX the next day, the plant personnel and utility management recongized "a possible serious problem." The NRC resident was onsite during this event and was called within five minutes. At this time, the "B" SDCHX, although thought to be operable, was isolated against the possibility of a common failure mode. In fact, it was initially thought that an elevated chloride level in the RBCCW system one week earlier had caused the problem.

CORRECTIVE ACTION

An alternate means of decay heat removal was implemented using the Reactor Water Cleanup System (RWCS). Flow through the RWCS was increased to approximately 500 gpm from a normal 180 gpm and letdown from the RWCS to the condensate system was increased to 300 gpm from a normal 40 gpm. Heat removal was accomplished by the RWCS nonregenerative HX and using an available condensate spray mode in the main condenser. Water was pumped back to the reactor using a condensate pump. During this time, the isolation condensers, safety relief valves, core spray, and torus cooling were available as backup means of heat removal if needed. These are safety systems and were not affected by the event.

CAUSE INVESTIGATION

At this point in the licensee's investigation, metallurgical examination of ruptured tubing taken from the SDCHXs does not shown evidence of stress-corrosion. The failure appears to be fatigue due to flow-induced vibration. The NRC resident mentioned that he was aware of similar tubing failures at Nine Mile Point which has HX design identical with Oyster Creek. The problem appears to be unrelated to a particular event (chloride incursion), but is the result of flow induced vibration, which may be characteristic of this HX design. IE has sent a metallurigal expert (Joe Collins) to Oyster Creek to monitor testing, evaluation, and plugging activities. It is his intention to delay startup until a sufficient basis is established to believe that additional tube ruptures will not occur during the next shutdown.

FINDINGS AND RECOMMENDATIONS

Our findings are that the actions taken by the licensee to provide alternate shutdown cooling were and are adequate. However, prior to restart of the plant, it is recommended that a thorough examination of DHRHX tubes be required to verify that recurrent tube ruptures do not occur. Also, because redundant and diverse means of decay heat removal were available (in addition to the RWCS which was used, the isolation condensers, safety relief valves, and torus cooling were operable) it is recommended that this event not be considered as an Abnormal Occurrence.

REFERENCES

1. PNO-I-81-97

2. PNO-I-81-99

Enclosure

Recent NRC Activities with Respect to Decay Heat Removal Systems

NRC actions with respect to decay heat removal systems reliability and operability in the recent past include IE Bulletin 80-12, IE Information Notices 80-20 and 81-09, and IE Circular 81-11. These were sent to all licensees.

IE bulletins usually require a licensee response. No response to headquarters was required by the BWR licensees because the bulletin was written specifically for events at PWR facilities. Circular 81-11 was addressed specifically to BWRs and covered areas in BWR RHR systems equivalent to those in IE Bulletin 80-12 and IE Information Notices 80-20 and 81-09. Licensee responses to IE circulars are monitored by the IE Resident Inspector.

One NRC action not taken on BWRs, that has been taken on the PWRs, is implementation of Technical Specifications to formalize some of the procedural and administrative changes required by Bulletin 80-12. At this time, it is the judgment of the IE and NRR personnel involved that BWRs have more diversity and redundancy in methods for removal of decay heat and for monitoring and maintaining vessel water level and, consequently, additional technical specification controls of RHR system operation are unnecessary.

The justification that additional actions are not required at this time for BWRs is based on the fact that to this point, no BWR loss of decay heat removal event has resulted in a complete inablility to remove decay heat as was the case at Davis Besse for a time.

The RHR events that have occurred at BWRs to this point have been handled by the BWR diverse and redundant system as quickly as the discovery of the event and realignment of equipment could be made. For example, during the August 28 loss of DHR system at Oyster Creek, the RWCS with augmented letdown to the main condenser was used to decay heat. If there had been a failure in this system, it would be possible, since the head was on the vessel, to allow the plant ot heat up and remove heat via the redundant isolation condensers. Had the head been removed, it would be possible to remove decay heat via the fuel pool cooling system. In addition, feed and bleed using core spray and an open SRV in conjunction with torus cooling could be used. Torus cooling at Oyster Creek is by redundant systems whose pumps and heat exchangers are separate from the DHR system and were available throughout the event described in this memo.

With respect to the question of whether further action should be taken in the case of BWRs, another point can be made. The Oyster Creek event of August 22-28, 1981 and the Brunswick Unit 1 event of April 25, 1981 were both caused by common failure modes affecting all RHR heat exchangers, without prior knowledge by plant operator. Even if the licensee had followed the recommendation of the IE Bulletin 80-12, IE Information Notices 80-20 and 81-09, and IE Circular 81-11, the unforeseen, multiple failures to the HXs in the events required that the plant operators develop alternate provisions for cooling that had not been considered in detail prior to the given event.

At this point, the recommendation of the bulletin should prompt the plant operator to develop redundant or diverse means of removing decay heat in

response to the specific equipment deficiencies pertaining to the given event. In other words, the redundant diverse means of removing decay heat available at any given time are determined by the equipment failures during a given event. However, for those situations where planned maintenance is the cause of removal from service of decay heat removal capability, the relevant IE bulletins, circulars and information notices require that the licensee develop additional redundant and diverse means of decay removal prior to beginning the maintenance operation.