AEOD TECHNICAL REVIEW REPORT*

UNIT: Nine Mile Point - 1
DOCKET NO.: 50-220
LICENSEE: Niagara Mohawk
NSSS: GE

TR REPORT NO.: AEOD/T336
DATE: November 17, 1983
EVALUATOR/CONTACT: M. Chiramal

SUBJECT: DESIGN DEFICIENCY RESULTING IN ISOLATION OF BOTH LOOPS OF THE EMERGENCY CONDENSER SYSTEM

EVENT DATE: November 20, 1981

REFERENCES:
1) 81-053 dated 12/14/81
2) 81-053, Rev. 1, dated 04/18/83
3) Letter from Niagara Mohawk, C. V. Mangan, Vice President, Nuclear Engineering and Licensing to M. Chiramal, NRC, dated August 23, 1983.

SUMMARY

At Nine Mile Point 1 on November 20, 1981, while operators were preparing to remove a motor-generator set from service, an RPS instrument bus was de-energized. This led to the de-energization of one of two emergency condenser vent radiation monitors in each loop of the Emergency Cooling (EC) System and caused the isolation of both emergency condenser loops and placed the plant in a limiting condition of operation. This event was reported in LER 81-053 (reference 1). LER 81-053 revision 1, issued on April 18, 1983 (reference 2), stated that while reviewing the EC system design in connection with the event in Novemer 1981, the licensee discovered that single failure of an electrical power supply could, in one case, isolate both emergency condenser loops and, in another case, cause a failure to isolate. The single failure that could cause isolation of both loops was the loss of electric power to one channel of the condenser vent radiation monitor in each loop; and the failure that could prevent automatic isolation was the loss of dc power to one channel of the isolation logic circuit. The licensee also stated that the required design changes to correct these problems would be implemented prior to plant start-up.

We initiated a review of these LER's based on the implication of a single failure disabling both redundant loops of a safety-related system. By letter dated August 23, 1983, the licensee provided additional information regarding the design and analysis of the Nine Mile Point 1 EC system to enable us to have a better understanding of the operation of the system.

Our review and evaluation of the design modification of the EC system has led us to conclude that the corrective actions taken by the licensee will assure the operability of the EC system despite a wide range of postulated single failures of the electric power supplies associated with the initiation and isolation circuits.

We also performed a generic review of the operation of the EC system at other operating BWRs that utilize such a system. Included in this review were Millstone - 1, Dresden 2 & 3, Oyster Creek and Big Rock Point. We utilized information provided in the updated FSAR's.

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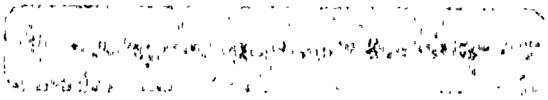

Based on this review we have concluded that the problem associated with the emergency condenser vent radiation monitors and the automatic isolation of the EC System, does not apply to the other operating BWRs.

DISCUSSION

LER 81-053 described an event that occurred at Nine Mile Point 1 on November 20, 1981. The event occurred during plant operation at 99% power, while preparation was being made to remove motor-generator set MG# 172 from service. Due to a problem with the speed control of the dc motor of the M-G set, the operators were unable to effect a synchronized transfer of the Reactor Protection System Bus # 12 from its normal supply (MG #172) to its emergency supply (I&C Bus #130). Considering the redundancy of the loads normally powered from RPS Bus # 12, it was decided to de-energize the bus and then re-energize it by connecting to I & C Bus #130 (i.e., a dead bus transfer). When the RPS Bus #12 was de-energized, one of the two emergency condenser vent radiation monitors in each Emergency Cooling (EC) System loop was de-energized. By design this caused the closure of the normally open EC System steam isolation valves, thus isolating both #11 & #12 EC System loops. Thus, on the loss of a single RPS bus both loops of the EC System were isolated.

LER 81-053, Revision 1, issued on April 18, 1983, stated that while performing the EC System design review to correct the problem that occurred in November 1981, it was discovered that a single failure of an electrical power supply could, in one case, isolate both EC System loops and , in another case, cause a failure to isolate. This LER also stated that the EC System logic for isolation and initiation has been thoroughly reviewed and the design changes required to assure operability of the EC System upon a wide range of postulated single failures of the power supplies associated with the logic circuits, would be implemented prior to plant start-up.

Based on a review of the information provided in the LERs and the applicable sections of Nine Mile Point 1 updated FSAR, we were unable to determine the implications of the design deficiency and problems associated with the plant's EC System. Thus, upon our request the licensee by letter dated August 23, 1983, submitted additional information regarding the design modifications and analysis of failures performed.

The EC System at Nine Mile Point 1 consists of two independent EC loops and each loop has two condensers. During normal operation the EC System is in the standby condition with the steam inlet isolation valves (two motor-operated valves in series in each loop) normally open so that the EC condenser tube bundles are continuously at reactor pressure. When the system is initiated, it is placed into operation by opening the normally closed condenser return isolation valve (one in each loop). This valve is a dc solenoid air-operated valve and will fail open in the event of a total loss of dc power or air pressure, thus putting the system into operation.

Automatic operation of the EC System is initiated by high reactor pressure in excess of 1080 psig sustained for 10 seconds (the time delay is provided to prevent unnecessary actuation of the system during anticipated turbine trips). The system is also initiated on low-low reactor water level to assist in depressurization for small breaks.

During operation of the system, water in the shell side of the condensers boils and vents to atmosphere while condensing steam inside the tube bundles. Radiation monitors are located in the vent to detect any tube bundle leak and isolate the respective condensers by closing the steam and condensate isolation valves. Two radiation detectors are provided for each emergency condenser vent line and isolation is initiated using a one-out-of-two logic. A flow detector is also provided in the inlet line to each loop. This detector initiates closure of the isolation valves in the event of a line break resulting in a flow of about 300% of rated flow.

The isolation logic circuits of the EC System are arranged into two channels, EC channel 11 and EC channel 12, which are supplied by feeders from 125 v dc Battery Buses 11 and 12 respectively. Each channel has separate logic circuits for initiation of isolation of each EC System loop. That is, EC channel 11 has separate circuits for EC 11 and EC 12 valves, and EC channel 12 has separate circuits for EC 11 and EC 12 valves. The isolation logic circuits are energized-to-close and the isolation logic uses one-of-two logic, i.e., either EC channel 11 or EC channel 12 actuation can cause isolation of both loops. Loss of power to a logic channel will not cause isolation since circuits are energized-to-close.

Based on our review of the LERs and the additional information provided by the licensee, we were able to analyze the event as follows. During the event of November 1981 when RPS M-G set #172 was de-energized the isolation logic circuit in EC channel 12 actuated due to the loss of power to one-of-two radiation detectors in each loop that were supplied by RPS Bus # 12. This loss of power to the detectors caused the respective contacts in EC channel 12 to close and energize the isolation logic relays, which in turn caused the isolation valves to close. The licensee has modified these isolation logic circuits to rectify this problem.

During the reviews of the isolation and initiation circuits of the EC System, the licensee also discovered that on certain single failure conditions the EC System cannot be isolated when required. From the information provided we found that on the loss of dc power supply to EC channel 11 or EC channel 12, the condensate return isolation valve on EC loop 11 cannot be isolated. The other identified single failures which could disable the automatic isolation function of the EC System were the loss of Battery #11 or Battery #12 when offsite power is not available (in the case of loss of Battery #12 with no offsite power, the remote manual switch isolation capability from the control room is still available).

The licensee has modified the logic circuits associated with the EC System to correct all problems identified during their analyses. The licensee has also conducted a detailed single failure analysis (similar to the one performed that identified the problems) of the modified circuits to assure that the EC System meets all its design basis requirements.

Based on our review of the information provided we consider the EC System modification and the subsequent analysis performed by the licensee to be adequate in correcting the problems identified.

In order to determine the generic implications of the events at Nine Mile Point 1, we searched the RECON data base for events involving emergency condenser cooling systems at other operating nuclear plants. The search was confined to those GE BWR units that have the EC System- i.e., Dresden 2 and 3, Millstone 1, Big Rock Point and Oyster Creek. A review of the abstracts of the LER's obtained by this search was conducted to look for events in which a single failure of a power supply led to isolation of both loops of the EC System. No similar events were found.

Since only 5 other plants had EC Systems, we reviewed the information provided in the updated FSAR's of these plants to determine whether the problem of the Nine Mile Point 1 EC System applies to them. A brief description of our review for each plant is as follows:

1. Dresden 2 and 3

   The emergency isolation condenser system at each operating Dresden unit consists of a single isolation condenser with two tube bundles and one steam inlet and condensate return line with associated valves. The valves in the steam inlet line to the condenser are normally open so that the tube bundles are at reactor pressure.

   The isolation condenser is placed into operation by operating the normally closed condensate return valve (powered from a 250 v dc bus). The system is initiated automatically on a high reactor pressure signal of 1070 psig sustained for 15 seconds. During operation the water in the shell side of the condenser will boil and vent to atmosphere. Two radiation monitors are provided on the shell vent to detect and warn the operator of a tube leak. The output of each monitor is indicated and recorded in the control room. When the gross activity in the vent line reaches a preset level, an alarm is sounded and the operator can then manually isolate the EC isolation condenser. Automatic isolation of the condenser is initiated on a Group 5 isolation - i.e., high isolation condenser steamline or condensate flow. Since the EC System at the Dresden units has a single condenser and single inlet and outlet lines, it is susceptible to a single failure. Hence, the problem associated with the two loop EC System at Nine Mile Point 1 does not apply to the single loop system at Dresden.

2. Millstone 1

   The EC (Isolation Condenser) System at Millstone 1 is similar to that at Dresden. It is a single loop isolation condenser system. Therefore, the problem at Nine Mile Point 1 does not apply to Millstone 1 EC System.

3. Big Rock Point

The EC System at Big Rock Point has a single emergency condenser with two internal sets of condensing tube bundles. Each tube bundle is connected to a steam inlet and condensate return line thus forming a two loop system sharing a single condenser. A single tube bundle is sufficient to remove reactor decay heat of 2% rated power. Since there is only one condenser and one condenser vent, the radiation monitoring system that alarms in the control room on a tube leak requires the operator to isolate both loops of the EC System. If the leak can be verified to be in one loop, then the intact loop can be returned to service. Thus although the EC System at Big Rock Point has two loops, it utilizes only a single condenser. Hence, the problem seen at Nine Mile Point does not apply to the Big Rock Point EC System.

4. Oyster Creek

The EC Isolation Condenser System at Oyster Creek is a two loop, two condenser system approximately similar to that at Nine Mile Point. (The system has only one condenser per loop and the normally open condensate return valve is a dc motor-operated valve.) Leakage of reactor water through the tubes in any condenser can be detected by four shell side radiation monitor channels, two on each isolation condenser vent line. Each channel has an upscale and downscale trip output for annunciation. Upon receipt of a high radiation alarm the operator is required to isolate both isolation condensers. The operator is then required to monitor shell side temperatures of each condenser to confirm leak. Following confirmation, the operator can restore the intact loop to operation.

The EC System at Oyster Creek is a two loop system, but it differs from the Nine Mile Point 1 System in the method of isolation on high condenser vent radiation. The Oyster Creek system requires manual isolation of both loops on high radiation while the Nine Mile Point 1 system automatically isolates only the affected loop. Therefore, the problem associated with the automatic isolation logic circuits at Nine Mile Point 1 EC System does not apply to the Oyster Creek EC System. Since sufficient information regarding the power supplies associated with the EC System at Oyster Creek is not available in the FSAR, we were unable to perform a detailed single failure analysis of the system as was done by the Nine Mile Point 1 licensee. However, our review of operating experience at Oyster Creek did not reveal any such problem.

FINDINGS

The EC System at Nine Mile Point 1 consists of two isolation condensers and associated cooling loops. However, the arrangement of the two channels

of automatic isolation logic circuits was such that on certain single failures of associated power supplies, both loops of the EC System would automatically isolate in one case and, in another case, would fail to isolate automatically. The licensee has made the necessary circuit modifications and performed adequate post modification analysis to assure that the EC System would function as designed. Our review of the EC System at other operating BWR units has shown that at four of these units (i.e., Dresden 2 & 3, Millstone 1 and Big Rock Point) only a single isolation condenser is utilized in the EC System; and hence, the problem at Nine Mile Point 1 does not apply to them. At a fifth unit (Oyster Creek) the EC System is similar to that at Nine Mile Point 1. However, Oyster Creek EC System design is such that the Emergency Condenser Vent Radiation Monitoring System is used for indication and alarm only and is not used for automatic isolation of the EC System.

CONCLUSION

Based on our review of the event at Nine Mile Point 1 and the subsequent design modification and analysis performed by the licensee, we conclude that adequate measures have been taken to assure that the EC System at Nine Mile Point 1 will perform its intended design functions with a single failure of the power supplies associated with the EC System logic circuits. Our review of the LER data base on events involving EC System at other operating BWRs and the information on these systems in the updated FSAR's of the applicable plants has shown the problem at Nine Mile Point 1 not to be applicable to the other plants.