LER Full Text for LER Number: 26697041

ACCESSION #: 9712020095
NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Point Beach Nuclear Plant, Unit 1 PAGE: 1 OF 7

DOCKET NUMBER: 05000266

TITLE: Potential Common Mode Failure in Auxiliary Feedwater
System Control Circuits

EVENT DATE: 10/23/97 LER #: 97-041-00 REPORT DATE: 11/24/97

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(ii)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:
On October 23, 1997, while Point Beach Nuclear Plant (PBNP) Unit 1 was in a cold shutdown condition, licensee engineers discovered a potential common mode failure in the auxiliary feedwater (AFW) pump control circuits that could result in the loss of two auxiliary feedwater (AFW) pumps; 1P-29 and P-38A. The Final Safety Analysis Report provides for failure of only one AFW pump. The remaining AFW pump (P-38B) may not be capable of providing the feedwater flowrate that is assumed in the accident analyses. The postulated common mode failure to the adjacent cables is not a consequence of the accident, but has been considered to be a random, design basis single failure that should be considered. The common mode condition was created by a modification that installed a low suction pressure trip function on each AFW pump. Plant modifications will remedy the potential common mode failure described herein.

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Event Description:

On October 23, 1997, while Point Beach Nuclear Plant (PBNP) Unit 1 was in a cold shutdown condition, licensee engineers discovered a potential common mode failure in the control circuits of the Auxiliary Feedwater (AFW) System [BA]. Several low voltage signal and control cables [CBL1] associated with the Unit 1 turbine-driven AFW pump [p] 1P-29 and a motor-driven AFW pump common to both units (P-38A) were found to be located in common conduits [CND] and cable trays or wireways. A single failure in these raceways could thereby disable both of the subject AFW pumps, and challenge the capability of the remaining motor-driven AFW pump (P-38B) to satisfy the feedwater requirements for those design basis events which require AFW System operation.

Specific discoveries of non-separated cable included:

(a) cable between the pump P-38A suction pressure transmitter [PT](PT-4042) and the SPEC-200 instrumentation racks is routed adjacent to cable between the pump 1P-29 suction pressure transmitter (PT-4044) and the SPEC-200 instrumentation racks.

(b) cable between the SPEC-200 racks and the pump P-38A low suction pressure trip logic in main control board C-01 is routed adjacent to cables between the SPEC-200 racks and pump 1P-29 low suction pressure trip circuits in main control board 1C-03.

Electrical failure (i.e., short circuit or open circuit) of these cables has the potential to affect the starting or running functions for the associated AFW pumps. Common routing creates the potential for a single failure to prevent both P-38A and 1P-29 from starting and creates the potential that two operating pumps may fail to trip for a genuine low suction pressure condition.

This potential common mode failure was discovered during a design review for modifications to improve the response of the existing low suction pressure trip circuitry. These modifications were being pursued to address the nonconservative low suction pressure trip setpoints and postulated DC power failures reported in PBNP Licensee Event Report (LER) 266/97-031-00.

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For the non-separated cables described in (a) above, a temporary modification was initiated to re-route cables such that physical separation requirements were satisfied.

For the non-separated cables described in (b) above, an operability determination was conducted. This operability determination included a design evaluation and walkdown which concluded that, despite the lack of physical separation, there was negligible potential for a common mode 4 failure which would compromise the capability of the AFW System to satisfy design basis requirements. The system was considered operable based on evaluation of electrical fault propagation phenomena and the available overcurrent protection. The evaluation was also based on the integrity of the control room environment and the negligible potential for physical damage which could lead to common mode failure.

Cause:

The commonly-routed AFW control circuits were installed by a plant modification in the mid-1980s which provided automatic low suction pressure trip protection for each AFW pump. The objective of this modification was to ensure that AFW pumps would not be damaged by a loss of suction source in the event of a seismic event or tornado. At the time of this design, physical separation for AFW pump control circuits was not a well-established design criterion. At that time, the FSAR had specifically required physical separation for Reactor Protection Systems, but did not specifically require physical separation for the AFW System control circuits.

As a result of the Three Mile Island event and the Salem Anticipated Transient Without Scram (ATWS) Events, the increased importance of the AFW System for accident mitigation was recognized. In response to these events, PBNP started backfitting the "safety-related" classification to appropriate systems, including AFW, and improving the AFW System as necessary.

In response, PBNP described the AFW initiation circuitry as neither a Reactor Protection System (RPS) nor an Engineered Safety Feature (ESF) System. However, to address the increased importance recognized in the mid-1980's, PBNP described the AFW System as "equivalent to systems listed as ESF's in the FFDSAR" (Final Facility Description Safety

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Analysis Report). AFW was described as a "safety-grade system which provides for automatic initiation and is designed to meet single-failure criteria." Based on our preliminary review, these objectives were met in the AFW System modification in that the "safety-grade" term was applied to ensure that Quality Assurance (QA) procurement standards and rigorous design control processes were applied. At that time, the standard had not risen to the point that physical separation criteria would have been applied to the modification design and independent power supplies would not have been provided for each pump circuit.

Corrective Actions:

1. A temporary modification will restore physical separation for the cables located between the AFW pump suction pressure transmitters and the

SPEC-200 racks described in case (a) above. This temporary modification will be installed prior to restart of Unit 1 from its current outage.

2. As described previously, an operability determination was completed to justify that the cables located between the SPEC-200 racks and the low suction pressure trip logic in the main control boards were operable. As described in the corrective actions of LER 266/97-036-00, a permanent modification is being developed to eliminate the potential common mode failures in the AFW System, prior to dual-unit operation. This modification will address the potential common mode failures imposed by the non-separated cables described herein.

3. A thorough root cause evaluation is being completed. Any additional corrective actions identified by that evaluation will be managed under the corrective action process.

Component and System Description:

As described in the PBNP FSAR, the AFW System supplies high-pressure feedwater to the steam generators to maintain a water inventory for removal of heat energy from the reactor coolant system by secondary side steam release in the event of inoperability of the main feedwater system. Redundant supplies are provided by using two pumping systems, using different sources of power for the pumps. One system uses a turbine-driven pump (designated 1P-29 for Unit 1) capable of providing 200 gpm to each steam generator in the associated unit. The other system uses two

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motor-driven pumps (designated P-38A and P-38B) which are shared bet a the two nuclear units, and each is capable of providing at least 100 gpm to each of the two steam generators (one per unit) aligned to its discharge.

The original system design did not provide an automatic low suction pressure pump protection for a loss of suction source that may result from a seismic or tornado event. This protection was later provided in response to NUREG-0737 Item II.E.1.1, when Wisconsin Electric committed to provide an automatic pump trip (Reference WE letter to NRC dated 9/14/81, "TMI Action Plan Update - Revision 2").

As described in the PBNP FSAR, all electrical systems and components vital to plant safety, including the emergency diesel generators, are designed as Class I and designed so that their integrity is not impaired by the maximum potential earthquake, wind storms, floods, or disturbances on the external electrical system. FSAR section 8.2.2 states that wires and cables related to engineered safeguard and reactor protection systems are routed and installed to maintain the integrity of their respective redundant channels and protect them from physical damage. The basis for this requirement is to ensure that a single failure (including an electrical failure or physical damage caused by a credible event) would not disable the minimum required number of engineered safeguards system components needed to mitigate the consequences of an accident.

With consideration of credible single failures, the AFW System is required to mitigate accidents described in the FSAR, including the loss of normal feedwater (LONF) event, the loss of all AC (LOAC) power, the steam generator tube rupture (SGTR), and the main steam line break (MSLB). The limiting AFW flow requirement described in the FSAR is 200 gallons per minute (gpm) to a unit or 100 gpm to each steam generator of a unit. The PBNP FSAR (Table 10.3-1) currently describes the limiting single failure to the AFW System as the failure of a single pump to start.

Safety Assessment:

At the time of discovery, Unit 1 was in a cold shutdown condition. Technical Specifications do not require AFW operability in this condition. Therefore, the identified condition posed no immediate

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operability concerns for Unit 1. However, as described below, the identified condition could have affected the capability of the AFW System to achieve design basis requirements during previous power operation of Unit 1.

If an electrical fault (i.e., a single failure) would have occurred at either of the described locations coincident with a LONF event, it is possible that the control circuit failures of pump 1P-29 and pump P-38A would have prevented the automatic starting of these pumps. It is also possible that such an electrical fault could have prevented the function of the low suction pressure trip to stop these pumps if the suction source were not available. The latter malfunction could have damaged 1P-29 and P-38A. In either case, one single failure at the location of common circuit routes could have disabled two AFW pumps associated with the operability of Unit 1. Only the remaining motor-driven AFW pump (P-38B) would have been available to meet the steam generator makeup requirements for a LONF event.

By providing its nominal flow rate of 200 gpm to the "B" steam generator of the affected unit, pump P-38B would have provided adequate makeup to mitigate all but the worst-case event scenarios. The most-limiting event for the described common mode failure would be a steam generator tube rupture on the "B" steam generator. In this event, feeding the "A" steam generator would be complicated by the postulated circuitry failure to pumps 1P-29 and P-38A, and feeding the "B" steam generator would be precluded by the need to isolate the ruptured steam generator tube. In these worst-case event scenarios we believe that the availability of manual actions to restore the tripped AFW pumps would help mitigate the event. Reactor core protection is addressed in the Emergency Operating Procedures (EOPs) and Critical Safety Procedures (CSPs) which provide guidance for the loss of the secondary heat sink. These procedures direct the restoration of AFW or the initiation of primary system feed and bleed to ensure that decay heat removal is achieved and that the health and safety of the public is not affected by the event.

It is highly unlikely that the AFW pumps would fail as postulated because the scenario is predicated on the coincidental occurrence of an accident and a random failure to the particular control circuits described herein. The safety-related control circuits are Seismic Class I and should not fail mechanistically due to the initiating event.

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Based on the low probability of the precursors, the likelihood that this event could ever have occurred is extremely low. Based on the availability of procedures and equipment to address the consequences, the health and safety of the public were not at risk.

System and Component Identifiers

The Energy Industry Identification System component function identifier for each component/system referred to in this report are as follows:

Component/System Identifier

Auxiliary Emergency Feedwater System BA
Pump p
Transmitter, Pressure PT
Cable, Low-Level Signal CBL1
Conduit CND

Similar Occurrences:

The following reports also identify recent examples where the AFW System operability has been challenged by postulated single failures:

LER Description

266/97-036-00 Potential Common Mode Failure in DC Power Supply Could Disable Auxiliary Feedwater System

266/97-031-00 Nonconservative Setpoint For Auxiliary Feedwater Pump Low Suction Pressure Trip

266/97-014-00 Auxiliary Feedwater Inoperability Due To Loss Of Instrument Air

*** END OF DOCUMENT ***

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