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UNITED STATES
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MEMORANDUM FOR: Stuart Rubin
Office for Analysis and Evaluation
of Operational Data

FROM: Thomas R. Wolf
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SUBJECT: TELECON NOTES - CONVERSATION WITH CAROLINA POWER AND LIGHT PERSONNEL CONCERNING JANUARY 16, 1982 LOSS OF RESIDUAL HEAT REMOVAL SERVICE WATER EVENT AT BRUNSWICK STEAM ELECTRIC PLANT - LER 2-82-005/01T

Participants:

NRC - AEOD	CP&L/BSEP	NRC - Region II
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Background

Brunswick Steam Electric Plant (BSEP) Unit 2 reported in Licensee Event Report (LER) 82-005/01T that on January 16, 1982 an unsuccessful attempt was made to initiate normal suppression pool cooling via the residual heat removal (RHR) system. This try came following a sequence of occurrences which included a turbine trip, a reactor scram, a loss of normal feedwater, and a reactor core isolation cooling (RCIC) system initiation. Normal suppression pool cooling (as well as normal shutdown cooling) could not be attained because both residual heat removal service water (RHRSW) trains were inoperable. These RHRSW trains were inoperable since none of the four booster pumps (two pumps per train) could be started. In the LER the reasons given for these pump start failures were:

> "Low suction header pressure lockout signals in each loop prevented starting each loop's pumps. Plugging of the sensing line to each loop's suction header pressure switch prevented both switches from sensing actual pressure, although a lack of operating fluid in the A switch and an open power supply breaker to the B switch also would have prevented pumps from starting."

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Normal cooling of the reactor by utilizing main feedwater steaming to the condenser was restored within a half-hour of the sequence initiation. After maintenance and testing, RHRSW "B" train was declared operational within 4.25 hours of the sequence start and "A" train within 8 hours. At no time during this event were any safety parameters challenged.

Highlights

Sequence

SEQUENCE OF OCCURRENCES

Time (approximate)	Description
January 16, 1982	
< 1625	Reactor power @100%; Steam jet air ejectors (SJAE) develop trouble; Condenser vacuum decreases; Power reduction initiated.
> 1625	One set of SJAE lost.
1632	Select rod insert commanded.
1633	Reactor power @30-40%; Low condenser vacuum; Turbine stop valve fast closure; Reactor scram.
1638	Group 1 isolation (main steam isolation valves /MSIV/ close); Main feedwater flow lost.
1640	RCIC manually started with suction from condensate storage tank; Suppression pool temperature @ 73° - 74°F; Drive steam to RCIC turbine maintains reactor coolant system (RCS) pressure; Per plant procedures, operator attempts to initiate RHR suppression pool cooling by starting "B" train of RHRSW; RHRSW "B" train booster pumps suction header pressure switch PS-1176 low pressure alarm (< 20 psi);

RHRSW "B" train booster pumps (B and D) prevented from starting by low suction pressure interlock;
Operator attempts to start "A" train of RHRSW;
RHRSW "A" train booster pumps suction header pressure switch PS-1175 low pressure alarm (<20 psi);
RHRSW "A" train booster pumps (A and C) prevented from starting by low suction pressure interlock;
Control panel booster pump suction pressure indicted @ 60 psi;
RHRSW declared inoperable;
Maintenance request initiated.

1650 — Condenser vacuum restored;
Group 1 isolation signal reset;
MSIV reopened.

1655 — Reactor feed pump started re-establishing feedwater flow;
RCIC secured;
Suppression pool temperature @ 75° - 76°F.

1710 — Technician discovers PS-1176 power feed 120v-ac breaker open;
Breaker manually closed;
RHRSW "B" train booster pump interlock automatically clears;
RHRSW "B" train booster pumps started and associated RHR train aligned and operated in suppression pool cooling mode.

1810-2040 — RHRSW "B" train cycled on and off several times to run further operability tests.

2040 — RHRSW "B" train declared operational.

January 17, 1982

0025 — After maintenance and testing, RHRSW "A" train declared operational. (PS-1175. repaired. Failure due to leakage of operating fluid in diaphragm housing.)

Pertinent Operational Items

1. Plant procedures at BSEP require the start of suppression pool cooling after any RCIC initiation no matter what the circumstances causing RCIC start or what the suppression pool temperature. Thus, the attempt to start suppression pool cooling in this case was not in itself indicative of an actual or urgent need to accomplish this task or of a serious event occurring which required such cooling.

2. For cases where normal RHRSW is lost and RHR cooling is required, several alternatives are given in the plant operational guidelines. These are:

   a. Supply the RHR heat exchangers (RHRHX) from the SW system utilizing only the main SW pumps without the use of the RHRSW booster pumps. Water can be supplied to the RHRHX in sufficient quantities to meet all heat removal requirements via this method; however, the SW-to-reactor water positive differential pressure across the RHRHX for radioactive fluid outleakage control will be lost.

   b. Utilize available manual connections between the SW and the fire protection system. The fire protection pumps develop sufficient head and flow rates to replace the SW but this source is limited by its water supply storage capacity. The fire protection storage supply consists of a 200,000 gallon minimum technical specification volume in a dedicated 300,000 gallon capacity tank and a connection to the 90,000 gallon minimum technical specification volume in the 150,000 gallon capacity demineralized water storage tank.

   c. At low RHR heat removal rates, utilize available RHR connections to the spent fuel cooling heat exchangers.

   d. Service water system cross connects between units are not included in the BSEP system design. Therefore, at BSEP, this potential cooling method is unavailable.

   In this event, the need for RHRSW was minimal and, consequently, none of the alternative cooling methods were utilized.

Event Causes and Corrective Actions

Investigations into the causes and corrective actions for this event concentrated on the pressure switches, circuit breaker, and starting interlock.

1. Pressure switch: It was determined subsequently to the data utilized to write LER 82-005/01T that silting was not a contributing factor in the failure of the pressure switches. The pressure switch failures were due to (a) an open power circuit breaker to one switch and (b) the loss of operating fluid within the other pressure switch. A study is being conducted to see if this pressure switch type is susceptible to this type of fluid loss failure and to see if some other type of pressure switch is available to replace these switches.

2. Circuit breakers: Functional testing of the subject circuit breaker and associated circuits revealed no abnormalities. As a precaution, the breaker was replaced with an identical unit. It was determined, however, that the particular circuit breaker involved is designed such that it cannot be readily determined upon visual inspection whether the breaker is in the tripped or untripped position. Since this is a commonly used breaker in the plant, consideration is being given to replace all such breakers with ones giving more noticeable position indication. From a human factors viewpoint, such a modification would improve the operational as well as safety security of the affected systems.

3. Booster pump interlock logic: The present interlock design is such that one pressure switch is supplied in each RHRSW booster pump train and this switch controls the starting of both of the booster pumps in its respective train. Consideration is now being given to modify this logic by:

   a. Adding a redundant pressure switch in each loop;

   b. Adding suction valve position indication into the circuitry;

   c. Deleting the suction pressure interlock but replacing it with a valve position interlock.

While these studies continue, BSEP personnel have ordered a supply of the presently utilized pressure switches. Maintenance personnel are being instructed to simply change out any switch if problems develop. Testing has shown that this change out takes about 20 minutes. As a last resort, the interlock may be jumpered out. This procedure takes about 5 minutes.

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