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SUBJECT: Special rept:on 900118,steam-driven auxiliary feedwater pump inoperable for greater than 72 h.

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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
SPECIAL REPORT - SD AFW PUMP INOPERABLE FOR GREATER THAN 72 HOURS

Gentlemen:

In accordance with Technical Specifications 3.4.4.a and 6.9.3.1.f, Carolina Power and Light Company (CP&L) submits the following Special Report regarding the inoperability of the H. B. Robinson Unit No. 2 (HBR2) Steam Driven Auxiliary Feedwater (SDAFW) pump for greater than 72 hours.

Event Description

On January 18, 1990, HBR2 was operating at 100% power with routine shift activities in progress. In accordance with the monthly performance of Operations Surveillance Test, OST-202, "Steam Driven Auxiliary Feedwater System Component Test," the SD AFW pump was started for routine testing and surveillance. Soon after the pump was started, fluid was noticed leaking from the bottom of the turbine casing. This fluid was quickly determined to be SD AFW pump lubricating oil. The pump was shutdown and the source of the leakage investigated. The source of the oil leak was subsequently determined to be a bolted interface between the turbine casing and the bearing casing. The quantity of oil lost was approximately one inch on the oil reservoir dip-stick, which did not result in the reservoir oil level being below the minimum required level. The SD AFW pump was declared inoperable at 2318 hours on January 18, 1990.

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On January 20, 1990, after the appropriate tools and vendor assistance were obtained, the turbine-end of the pump was disassembled. It was determined during disassembly that the oil drain port for the turbine-end journal bearing was blocked. This blockage was caused by shrink fit tubing covering wiring to an embedded thermocouple in the journal bearing (Reference Figure 1). This wiring runs from the journal bearing, through the oil drain port, and into the bearing casing. The shrink fit tubing had apparently swelled when exposed to the oil environment, which blocked the oil drain port and resulted in the oil leakage. An evaluation of this shrink fit tubing was performed. It was determined that this tubing was not required for pump operation or protection of the thermocouple wiring and was, therefore, removed.

Further examination of the pump revealed shrink fit tubing on wiring for the turbine-end thrust bearing thermocouple. However, it was determined that the location of this tubing could not create a blockage of oil flow and was left in place. Also, the pump-end journal bearing and thrust bearing were inspected. The configuration of the shrink fit tubing on the thermocouple wiring for the pump-end thrust bearing was similar to that found on the turbine-end thrust bearing. This tubing was also left in place. Some shrink fit tubing was found on the thermocouple wiring for the pump-end journal bearing, however, the location of this tubing was such that the oil drain port could not be blocked. This tubing was also left in place.

Following reassembly of the SD AFW pump, test equipment was installed to augment the installed instrumentation. This equipment included flow monitoring devices for the recirculation line, the suction line, the seal leak-off line, and the pump discharge line to the steam generators. A vibration spectrum analyzer was also provided to monitor pump vibration. On the morning of January 21, 1990, the pump was started for post maintenance testing and no oil leakage was noted at that time. However, the measured vibration was higher than expected for the testing conditions and the recirculation flow was less than that observed in previous tests. Based on these indications, the pump remained inoperable and a further investigation was initiated.

Since the increased vibration was an expected result of reduced recirculation flow, the investigation was directed at the recirculation piping and components. It was initially expected that a check valve in the recirculation line, AFW-9A, might be malfunctioning in a manner which was restricting flow (Reference Figure 2). This valve was disassembled and inspected. No problems were noted during this inspection, and the valve was reassembled without the internals for further testing of the recirculation piping. The SD AFW pump was subsequently started on the evening of January 21, 1990, and the reduced recirculation flow was still present, which indicated that AFW-9A was not the source of the flow restriction. During this same test, lubricating oil leakage was observed in the location of the previous oil leak.

Further examination of the recirculation line included fiber-optic inspection of various sections of piping downstream of AFW-9A. These inspections revealed no evidence of flow blockage. The pump recirculation orifice, RO-1401, was disassembled. Inspection of this orifice revealed a small wafer on the upstream side of the orifice which had been partially blocking the orifice and restricting flow. A fiber-optic inspection was then performed of a manual isolation valve, AFW-17, which is located upstream of this orifice. During this inspection, it was noticed that the valve disc appeared to be separated from the disc union (Reference Figure 3). The valve was disassembled and the disc was verified to be separated from the disc union. This allowed the disc to rotate, resulting in partial separation of the disc from the disc union, which in turn allowed the wafer to leave the valve and be carried downstream to the orifice. This wafer normally acts as a bearing surface for the stem so that the stem can rotate without causing the disc to rotate. Rotation of the valve disc into the valve seat would result in scoring of the valve seat. On the morning of January 23, 1990, after receiving required information from the valve vendor, reassembly of the valve began.

To determine the reason for the recurrence of the lubricating oil leak, the turbine-end of the pump was again disassembled. When the bearing cap was removed, it was observed that the journal bearing oil drain port was blocked with bearing cap sealant. This sealant was used to seal the metal-to-metal surface between the bearing cap and the bearing casing (Reference Figure 1). This sealant has a thick consistency when applied, but flows more freely when heated. It requires heat to cure, and after heating begins to solidify. When the pump was reassembled following maintenance, it is believed that this sealant was

applied somewhat liberally. When the pump was operated on the morning of January 21, the sealant had not yet flowed into the oil drain port. However, when the pump was shutdown, the heated sealant flowed into the oil drain port and solidified, blocking the drain port. The sealant was removed from the oil drain port and was verified cleared by fiber-optic inspection. The pump was reassembled and the bearing cap reinstalled with the assistance of a technical representative from the pump vendor.

The pump was tested on the evening of January 23, 1990 following reassembly of the pump and recirculation line components. Recirculation flow was observed to be normal and pump vibration had returned to the expected range. With pump parameters and indications normal, the SD AFW pump was declared operable and returned to service at 2150 hours on January 23, 1990. To further ensure that the bearing cap sealant had not flowed and blocked the oil drain port, the pump was operated again on the morning of January 24, 1990. The pump operated satisfactorily with no oil leakage observed.

Root Cause and Corrective Actions

The cause of the initial lubricating oil leak was the shrink fit tubing which was found to be blocking the journal bearing oil drain port. The associated thermocouple wiring had been replaced during a rebuild of the SD AFW pump which was performed during a recent forced outage. The shrink fit tubing had apparently swelled when exposed to oil and blocked the oil drain port, which ultimately resulted in the oil leak. This shrink fit tubing was removed and the other bearing thermocouple wires were inspected. The shrink fit tubing on other wires inspected was left as found. However, during the next available opportunity for major SD AFW pump maintenance, this wiring will be re-evaluated and the shrink fit tubing removed, if appropriate.

The cause of the second lubricating oil leak was the blockage created in the journal bearing oil drain port by the bearing cap sealant. The method of application and the amount of sealant applied resulted in the sealant flowing from the proper sealing surface into the oil drain port. The bearing cap was removed, the sealant cleared from the oil drain port, and the bearing cap was reinstalled and properly sealed. To ensure that future maintenance activities do not result in a similar occurrence, applicable maintenance instructions will be reviewed and enhancements made as needed.

The low recirculation flow and the resultant elevated pump vibration were the result of flow blockage caused by the wafer partially blocking the recirculation flow orifice. This wafer was carried by recirculation flow from the recirculation isolation valve, AFW-17. The tack welds which secured the valve disc to the disc union failed, resulting in the partial separation of the disc from the disc union. This in turn allowed the wafer to leave the valve and move to the flow orifice. Since there had been no prior indication of elevated pump vibration or reduced recirculation flow, it is believed that the recirculation flow blockage occurred during testing of the pump on the morning of January 21, 1990. The valve was repaired, reinstalled, and was observed to be operating satisfactorily during subsequent pump tests. During the next available opportunity, but no later than the next scheduled refueling outage, this valve will be removed and inspected with further repairs or upgrades made as needed.

Should you have any questions regarding this report, please contact Mr. J. D. Kloosterman at (803) 383-1491.

Very truly yours,

C. R. Dietz
Manager
Robinson Nuclear Project Department

CTB:dwm

Enclosure

cc: Mr. S. D. Ebneter
Mr. L. W. Garner
INPO

FIGURE 1

BEARING ARRANGEMENT - TURBINE END

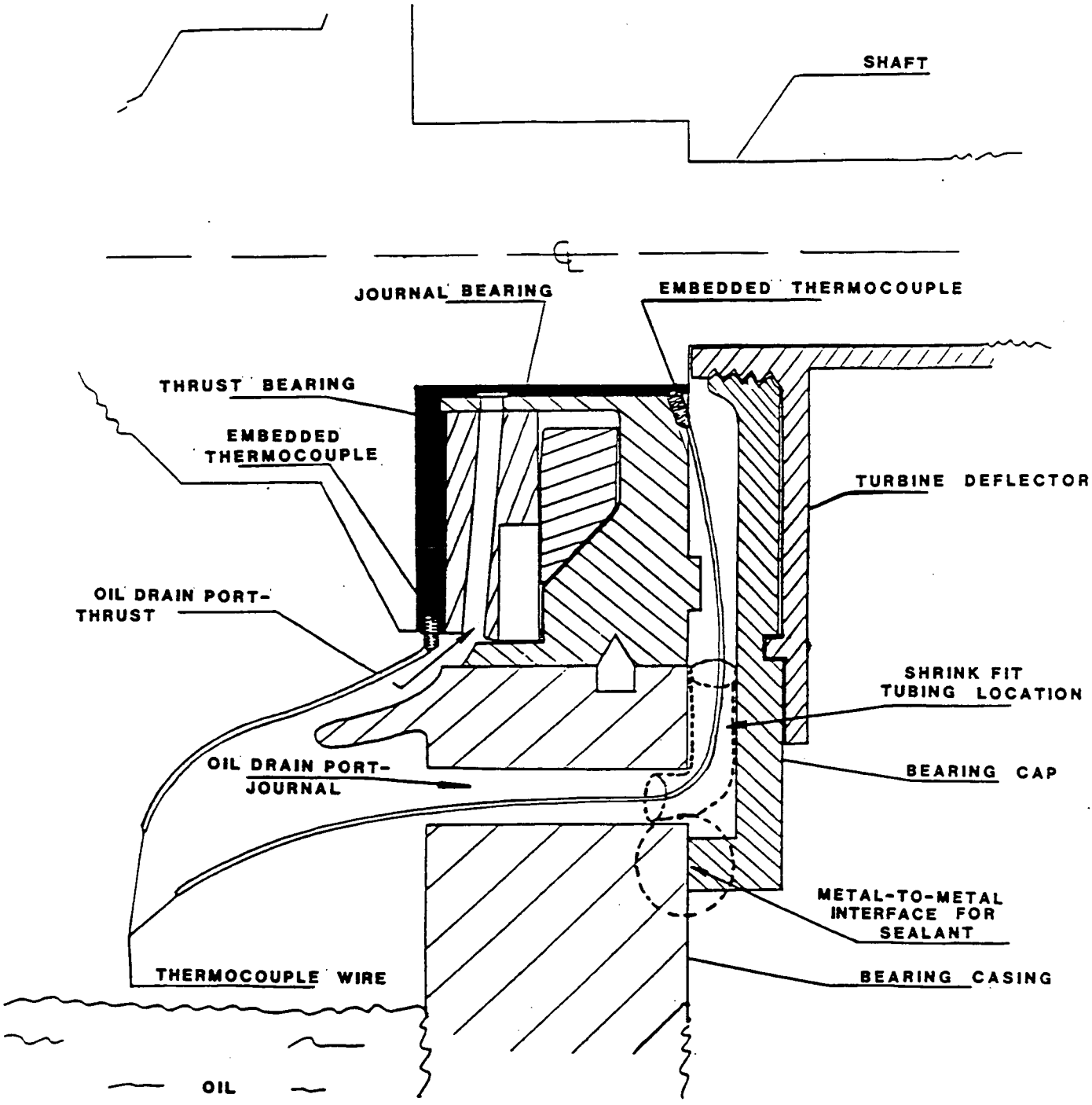


FIGURE 2

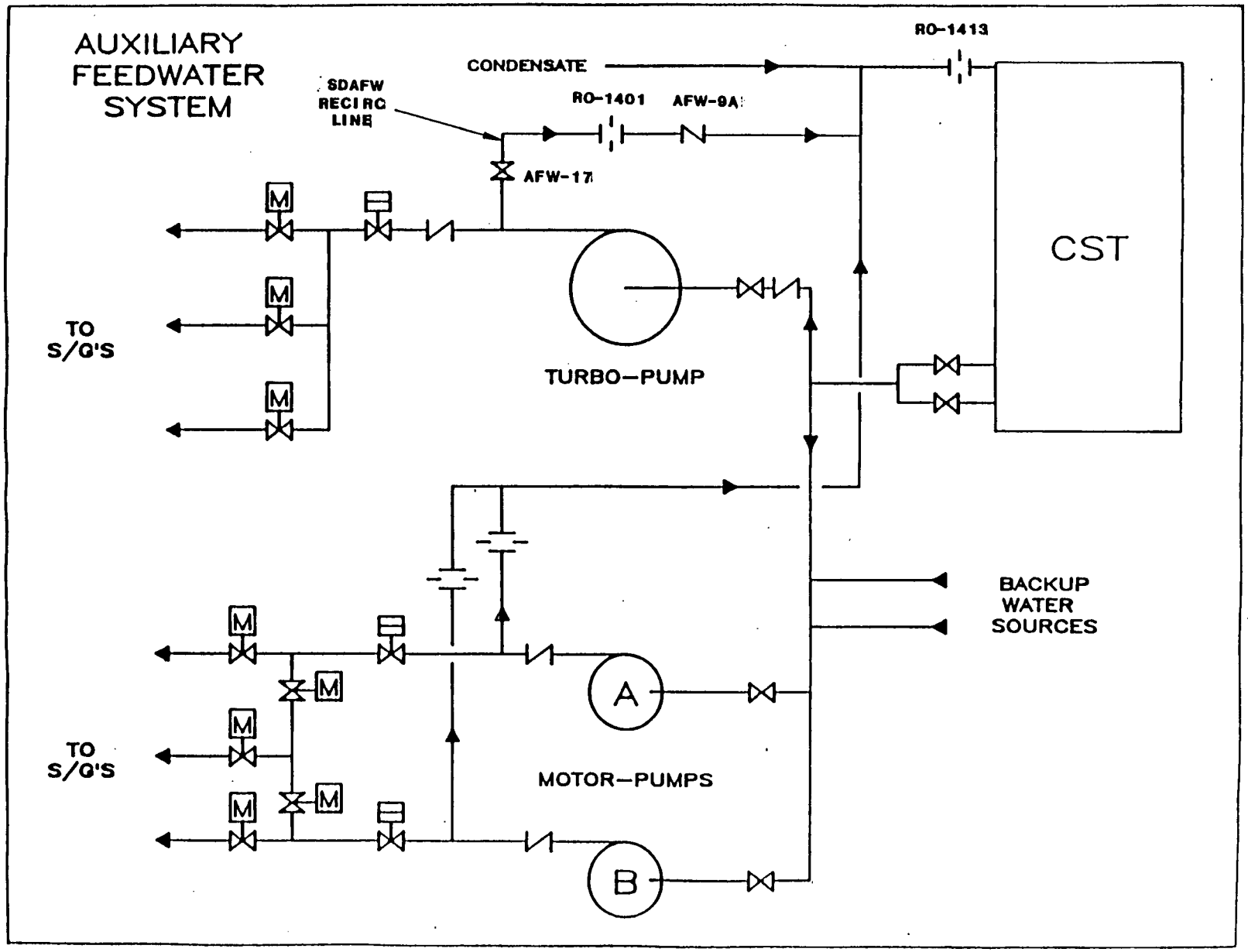
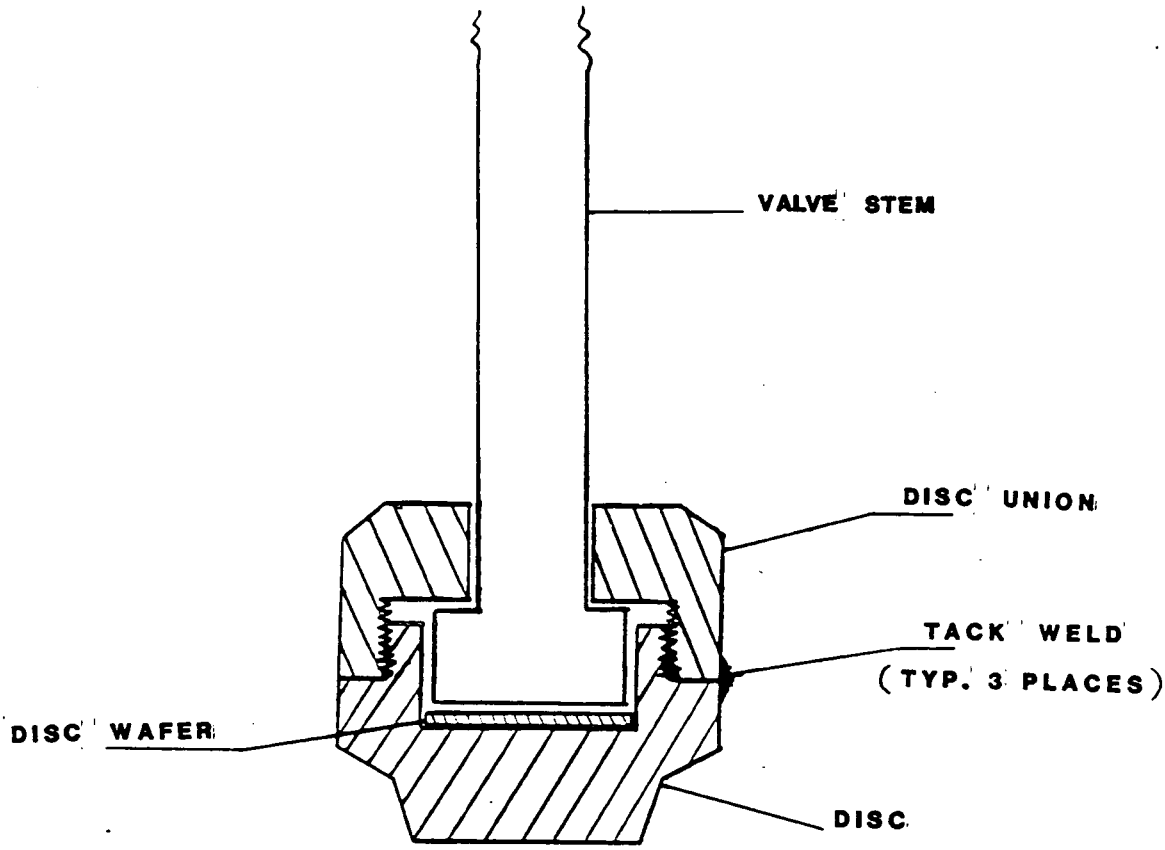

AUXILIARY FEEDWATER SYSTEM
SDAFW RECIRC LINE
CONDENSATE
RO-1413
RO-1401
AFW-9A
AFW-17
CST
TO S/G'S
TURBO-PUMP
BACKUP WATER SOURCES
A
TO S/G'S
MOTOR-PUMPS
B
M

FIGURE 3



GLOBE VALVE

AFW-17