AEOD TECHNICAL REVIEW REPORT*

UNIT: North Anna Unit 1
DOCKET NO.: 50-338
LICENSEE: Virginia Power
NSSS/AE: Westinghouse/Stone & Webster

TR REPORT NO.: AEOD/T513
DATE: November 7, 1985
EVALUATOR/CONTACT: D. Zukor

SUBJECT: FLOODING OF SAFETY-RELATED VALVES IN PITS

EVENT DATE: January 28, 1985

SUMMARY

Between February 15 and 18, 1985, testing of the recirculation spray valves indicated that one of these valves was sticking in the 75% open position. Maintenance personnel found mineral deposits on the valve yoke nut and valve stem which prevented the valve from operating properly. The valve was submerged and impurities in the water had solidified on the valve. Groundwater infiltration is a chronic problem at the North Anna site. This particular problem does not appear to have generic implications. It can, however, have safety implications for specific sites. The resident inspector is tracking North Anna's resolution of the problem.

INTRODUCTION

AEOD identified an event which could cause a common mode failure of safety-related equipment at North Anna Units 1 and 2. Due to groundwater infiltration into the valve pits containing the outside containment recirculation spray pump suction valves, the valves in the pits frequently remain submerged for prolonged periods and impurities in the water solidify on the valve stem rendering the valve inoperable. The purpose of this review is to determine if this problem is widespread and/or generic among other nuclear power plants.

DISCUSSION

On January 28, 1985, the licensee found that eight check valves in the hydrogen removal system were not being tested as required by the station valve inservice testing program (Ref. 1). As a result, the licensee reviewed its inservice testing program and found six other valves that were not being tested at the correct frequency because the procedures had not been revised. These valves included the following: two outside recirculation spray pump suction valves (MOV-RS-155A,B), two outside recirculation spray pump discharge valves (MOV-RS-156A,B), and two low head safety injection pump discharge valves (MOV-SI-1890C,D) to the reactor coolant system (RCS).

The recirculation spray (RS) subsystem is an engineered safety feature (ESF) used to remove heat from the containment following a LOCA or a main steam line break (Ref. 2). Each RS subsystem is comprised of a recirculation spray pump, a recirculation spray cooler, and a 180-degree spray ring header. Each RS subsystem has a 50 percent capacity. Following a LOCA, water flows into the

* This report supports ongoing AEOD and NRC activities and does not represent the position or requirements of the responsible NRC program office.

containment sump. Once the recirculation mode of safety injection is actuated, the containment sump provides the suction points for the four recirculation spray pumps -- two inside and two outside containment. The heat from the containment sump water is removed by service water when it is pumped through the recirculation spray coolers. A drawing with the indicated flow paths of the RS subsystem may be found in Figure 1. Both suction isolation valves to the two outside recirculation spray pumps are in one valve pit and are separated by a baffle.

The arrangement of the outside recirculation spray pumps is such that a break in the suction piping of the pumps does not affect the operation of the system. If a break in the suction piping occurred between the containment isolation valve and the pump, the valve could be closed and the redundant recirculation spray pump would be used. If a break occurred in the piping between the containment and the valve, the pump could take suction directly from the flooded pit. No motion of the valves is necessary following a LOCA. The valves are only needed if a break occurs at a specific place in the suction piping and containment isolation is necessary.

During power operation, these six valves remain open and are given a signal to open following an accident so no change of valve position is required for them to perform their safety function. These valves are tested quarterly as required by technical specification 3/4 6.3. The technical specification also requires that each unsecured valve in each recirculation spray subsystem be verified for correct position every 31 days.

During the surveillance testing of the Unit 1 recirculation spray valves, the outside recirculation spray pump suction valve (MOV-RS-155 A), which is a 12-inch Velan gate valve, stuck in the three quarters open position when it was cycled. None of the other valves experienced similar problems.

Upon examining the failed valve, maintenance personnel discovered mineral deposits on the valve yoke nut and valve stem which had caused the valve to malfunction. The motor operators for these valves were not submerged because they are located high above the valves themselves.

The North Anna site has severe groundwater infiltration problems and the valve pit sumps cannot be kept drained. Consequently, the outside recirculation spray valves remain submerged a large percentage of the time. Temporary sump pumps are currently being used to keep the water level in the valve pits at a minimum. Keeping the basemat sump water level low seems to alleviate the problem somewhat. An improved dewatering system for the site is being considered.

All four outside recirculation spray pump suction valves were replaced during the 1984 Unit 1 and 2 refueling outages. The licensee's review of the maintenance histories of these valves since replacement included three failures on Unit 1 and one failure on Unit 2. These failures were not found in the SCSS or NPRDS data bases.

The data bases were first searched for other events occurring at PWRs. At Surry, the valve pits used to flood routinely due to maintenance work (Ref. 3). Surry has since solved this problem and has not had any events since 1983 when

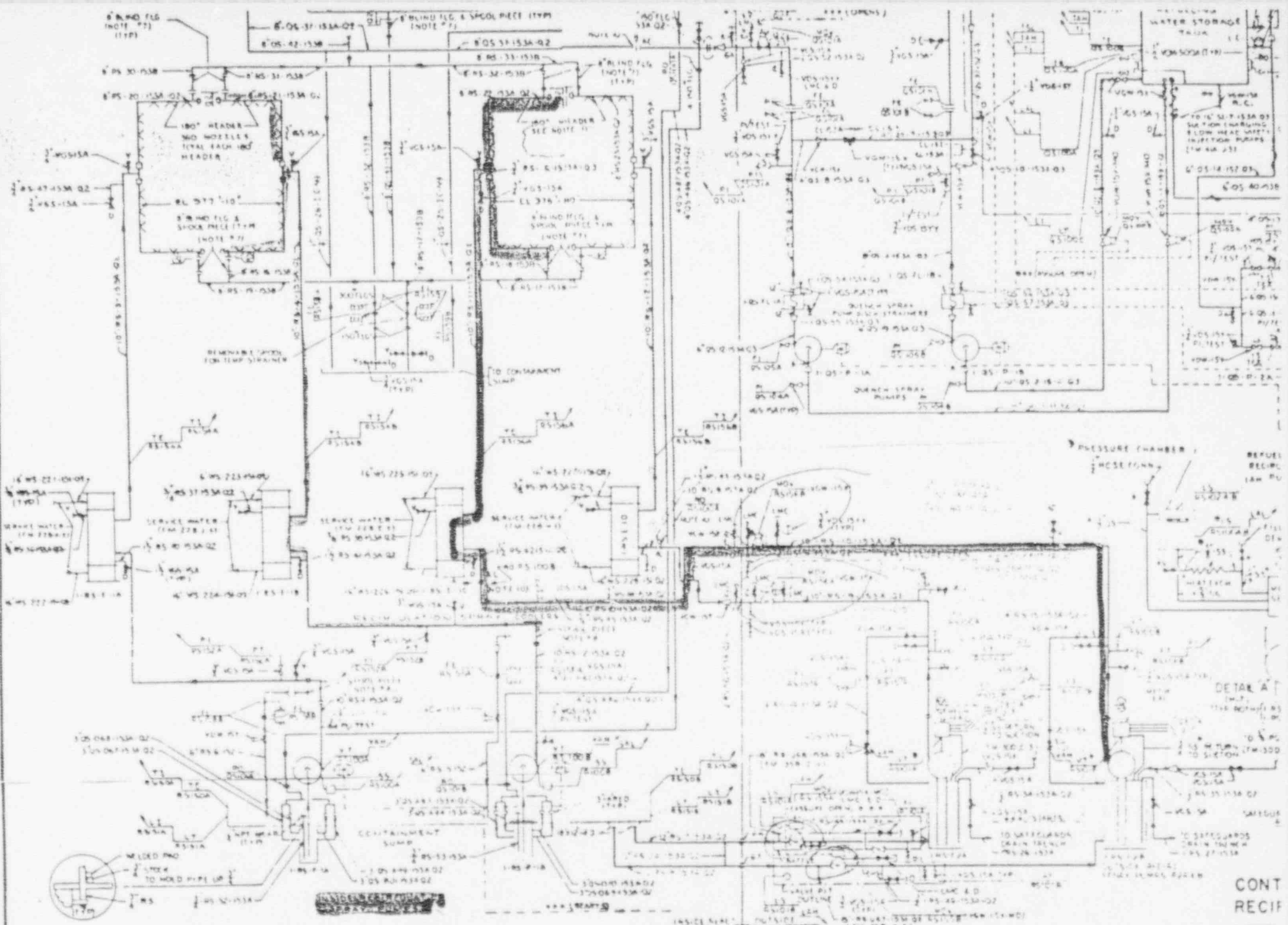
CONTAINMENT SUMP
TO CONTAINMENT SUMP
REMOVABLE COVER FOR TEMP STRAINER
WELDED PAD
TO HOLD PIPE UP
WATER STORAGE TANK
PRESSURE CHAMBER
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FIGURE 1

seven out of eight valves failed to open to admit service water to the recirculation spray coolers (Ref. 4). Many events attributing valve inoperability to moisture intrusion or corrosion were found at other plants but it was not possible to determine whether this was due to actual immersion of the valve in water or the humid atmosphere surrounding the valve. Many events were due to electrical shorting of the motor operator.

The search was then expanded to include events at BWRs. The events were similar to those described above for PWRs. Most of the events described rust or corrosion on the valves due to packing leaks. Some of the events attributed valve inoperability to the surrounding humid atmosphere which rusted the valve and caused corrosion on electrical parts of the motor operator. As mentioned above for PWRs, moisture intrusion or corrosion was frequently given as the cause of valve failure, and it was not possible to determine whether or not the valve was actually immersed in water. No cases of external valve flooding which caused valve inoperability could be found for BWRs.

The North Anna event would not have been reportable had a surveillance test not been missed. Since single failure events have not been reportable as LERs since January 1, 1984, some other plants were polled to see if they had or knew of plants that had similar flooding problems. No other similar problems were found.

Following the February 9, 1983 event at Surry Units 1 and 2 where seven out of eight valves failed to open to admit service water to the recirculation spray coolers due to shorted motor operators and corroded valves, the follow-up of the electrical portion of this event was made part of multi-plant action (MPA) B-60 review for Surry (Ref. 5). The operability of class 1E electrical equipment, which includes the motor operators of safety-related valves, is being studied as part of the resolution of USI A-24* which is being implemented as MPA B-60. The flooding of safety-related equipment at plants licensed prior to the implementation of the SRP is being studied under Generic Issue (GI) 77.** GI 77 will consider flooding of safety-related equipment due to groundwater seepage, rivers, lakes, and rainfall for plants licensed prior to the formalization of the standard review plan (SRP). Thus, GI 77 will not include consideration of the types of problems noticed at Surry or North Anna.

FINDINGS

A review of the operating data indicated that most of the events involving water affecting the operability of the valves was a result of wetting the electrical components associated with the valve. Some events were due to corrosion of the valve internals due to packing leaks. Very few events were found where external flooding of the valve caused valve inoperability. Thus, this problem does not appear to be generic.

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* USI A-24: Qualification of Class 1E Safety Related Equipment

** GI 77: Flooding of Safety Equipment Compartment by Back-Flow Through Floor Drains.

The valve which failed at North Anna is a containment isolation valve and must be available to close when called upon. The frequent immersion of this valve in water adversely affects its operability and its safety function. The licensee is evaluating the situation to determine if reliability of these valves can be improved.

CONCLUSIONS AND SUGGESTIONS

Although failures of motor operators are being considered as a generic issue, no evidence for widescale failures of safety-related valves themselves due to external flooding could be found. Therefore, the problem of flooding of valves in pits does not appear to be a generic problem. It could, however, be a site-specific problem depending upon the containment's location relative to the water table of the area and the capacity of the dewatering system at the site. Resolution of these problems should be handled on a plant by plant basis.

The North Anna site appears to have a difficult time keeping the groundwater out of their plant sumps. Their use of temporary sump pumps to keep up with the problem may not be an adequate solution. The resident is tracking the licensee's actions to assure an adequate resolution of this problem. No further AEOD action on this issue is planned.

REFERENCES:

(1) Licensee Event Report 85-002, Virginia Power Company, North Anna Unit 1, Docket No. 50-338, dated February 27, 1985.

(2) Virginia Power Co., "Updated Final Safety Analysis Report," Docket 50-338 and 50-339.

(3) AEOD, "Valve Flooding Event at Surry," E303, February 16, 1983.

(4) IE Information Notice No. 83-46, "Common-Mode Failures Degrade Surry's Recirculation Spray Subsystem," July 11, 1983.

(5) U.S. Nuclear Regulatory Commission, "Unresolved Safety Issues Summary," NUREG-0606, Vol. 7, No. 2, May 17, 1985. Available for Purchase from National Technical Information Service, Springfield, Virginia 22161.