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RECIP.NAME RECIPIENT AFFILIATION
MERSCHOFF,E.W. Region 4 (Post 820201)

SUBJECT: RO:on 980617,flooding of RB northeast stairwell with consequential flooding of two ECCS pump rooms.Caused by inadequate fire protection sys design.Pumped out water from affected areas to point below berm areas of pump rooms.

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM
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June 30, 1998
GO2-98-111

Docket No. 50-397

Mr. E. W. Merschoff
Regional Administrator
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Dear Mr. Merschoff:

Subject: **WNP-2, OPERATING LICENSE NPF-21, CAUSE OF EMERGENCY CORE COOLING SYSTEM PUMP ROOM FLOODING EVENT**

Reference: Letter GO2-98-102 dated June 19, 1998, PR Bemis (SS) to EW Merschoff (NRC), "Commitments Prior to Restart Following Fire Header Line Break and Flooding Event"

The Staff was notified on June 17, 1998 that the Supply System had declared an Unusual Event due to a fire header line break that resulted in equipment room flooding at WNP-2. In the referenced letter, the Supply System committed to formally brief NRC staff prior to WNP-2 entering Mode 2 (Startup).

Attached is a report which describes the apparent cause of the flooding event. Despite some preliminary information, this draft report may be useful to NRC personnel in gaining a more thorough understanding of this event prior to the Staff briefing. Should you have any questions or desire additional information regarding this matter, please contact me or Mr. P. J. Inserra at (509) 377-4147.

Respectfully,

RL Webring (Mail Drop PE23)
Vice President, Operations Support

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CAUSE OF EMERGENCY
CORE COOLING SYSTEM PUMP ROOM FLOODING EVENT

DESCRIPTION OF EVENT:

The event is defined as flooding of the Reactor Building northeast stairwell with consequential flooding of two Emergency Core Cooling System (ECCS) pump rooms.

On Wednesday, June 17, 1998, maintenance personnel were removing hanger material in the Division II Diesel Generator (DG-2) room. Acetylene tanks were placed in the corridor outside the DG-2 room with the room door open. Smoke resulted from the effort and propagated into and down the corridor. Two fire protection pre-action systems actuated. A rapid decrease in the fire protection header pressure occurred as a result of the fill of the pre-action piping. The decrease in header pressure resulted in the automatic starting of all four standby fire pumps with three starts occurring at nearly the same time. A significant water hammer event then occurred within the fire protection system resulting in the catastrophic failure of fire protection valve FP-V-29D, located in the Reactor Building northeast stairwell. Fire protection system water from the ruptured valve created flooding in the northeast stairwell which caused water to enter the Residual Heat Removal C (RHR-C) pump room. Water entered the low pressure core spray (LPCS) pump room. Operator mitigation of the event included securing the fire pumps and then reducing ECCS pump room water levels.

CAUSE OF EVENT SUMMARY STATEMENT:

The cause of the event is inadequate fire protection system design in that the system is configured such that a water hammer event can occur when the fire protection system operates in response to a potential fire.

Fire protection valve FP-V-29D catastrophically failed due to water hammer occurring in the fire protection system when three of the four standby fire pumps received start signals at nearly the same time. The primary effect of the valve failure and resulting rupture in the fire protection system was the flooding of the RHR-C and LPCS ECCS pump rooms. The RHR-C pump room flooding was caused by the flow of fire-main water from the northeast stairwell into the vestibule at the bottom of the stairs. The fire water flow from the vestibule to the RHR-C room was through an open watertight door that is normally closed. The reason the watertight door was open is indeterminate at this time, but it is suspected that the most probable cause was human error. The LPCS room flooding was primarily caused by flow from the RHR-C room through an open floor drain valve between the RHR-C room and the LPCS pump room. Floor drain valve FDR-V-609 failed to close on high sump level to isolate water flow from the RHR-C room to the LPCS pump room. The floor drain valve did not close due to an air leak in a solenoid valve which actuates the floor drain valve to its closed position.

CONDITIONS PRIOR TO THE EVENT:

The plant was in cold shutdown (mode 4) with the RHR A subsystem in shutdown cooling. The fire protection system was being maintained pressurized by the keep-fill (jockey) pump at essentially zero demand. Motor driven fire pumps 2A and 2B, and diesel driven fire pumps 1 and 110 were in standby. Preparations were being made to perform a plant start up later in the day.

EVENT AND CAUSE DETAILS:

On Wednesday, June 17, 1998, maintenance craft personnel were cutting/grinding in the DG-2 room to remove hangers and piping. The work was performed under an approved normal work order, ignition source and transient combustible permit. The work required the use of a cutting torch with its bottle cart located in the corridor outside the DG-2 room. The cutting torch hoses were routed through the open door of the DG-2 room. As a result of this work, smoke propagated out of the DG-2 room and into the corridor. Personnel involved in the work activity noted the accumulation of smoke, stopped work and contacted the control room to obtain guidance. The situation was reviewed by the on-shift Control Room Supervisor who allowed the work activity to continue.

At 1343, fire protection pre-action system 66 was actuated by a smoke detector in the corridor. It was later determined that pre-action system 81 also actuated. It is believed that these two systems actuated at very close to the same time. The zone 66 smoke detectors are located in the corridor outside the DG-2 room and in the adjoining laundry room. The zone 81 heat detectors are located in the DG-2 room, but not in the area where the cutting was taking place. Actuation of the fire protection pre-action system consists of the actuation of a sprinkler pre-action valve that, in turn, fills the piping to the sprinkler heads. The pre-action system provides additional assurance that a spurious actuation does not result in sprinkler flow onto sensitive station equipment within the protected area.

Motor driven fire pumps 2A, 2B and diesel driven fire pump 110 started at nearly the same time. The motor driven pumps are equipped with a Clayton valve that controls the discharge flow of the pump such that it takes about 5 seconds to achieve full flow into the piping system. The diesel driven fire pump discharged into the system at full flow when reaching full speed (about 3 seconds after a start initiation). The fourth pump, diesel driven fire pump number 1, is equipped with a starting time delay that is set for 30 seconds, and actually started about 34 seconds after the other three pumps.

The actuation of the pre-action systems opened corresponding fill valves which allowed firewater to pressurize the normally empty pre-action system piping. At the time of the pre-action actuation, the fire protection jockey pump FP-P-3 was running. This pump is a low volume high-pressure pump that maintains the system pressure during normal standby conditions. This pump is not designed to maintain system pressure with any appreciable demand on the system.

The riser pipe within the northeast Reactor Building stairwell is connected to the section of firemain that serves both pre-action systems 66 and 81, and provided the source of the water that filled both pre-action systems. The filling of these two systems from the riser resulted in a voiding of the upper section of the riser piping. The fire protection system pressure then dropped significantly resulting in the starting of the standby fire pumps on low system pressure. A severe water hammer was experienced on the supply valve for the riser, FP-V-29D, located at the bottom of the riser piping in the stairwell approximately 12 feet above the floor of the Reactor Building basement. This valve catastrophically failed resulting in approximately 163,600 gallons of water entering the Reactor Building stairwell and basement. Alarms associated with the actuation of the pre-action systems and the automatic start of the fire pumps alerted the main control room. High water level alarms actuated by switches in the RHR-C pump room also alerted the main control room of water leakage in the reactor building. The operators entered into the Emergency Operating Procedures (EOPs) based upon the high water level alarms.

The RHR-C and LPCS pump rooms are adjacent to the stairwell in the area of the riser piping. The flooding water entered the RHR-C pump room through a watertight door, which was found to be open after the water was removed from the stairwell. The rising water in the RHR-C pump room reached the level of the RHR keep-fill pump (RHR-P-3) and resulted in the tripping of this pump. RHR pump 2B, located in a non-effected watertight room, was started in suppression pool cooling mode to maintain this system operational. The RHR-C pump room subsequently flooded to approximately 17 feet above the floor, submerging the RHR-C pump motor.

The water hammer was loud enough to be heard by many station personnel. As a result, a Shift Support Supervisor in the area commenced a visual inspection and noted the flooding in the stairwell. This individual promptly notified the Main Control Room of the flooding. The control room operators initiated action to secure the fire pumps after verifying that there was no fire or threat of fire. All four fire pumps were secured to terminate the source of the flooding. A floor drain isolation valve, FDR-V-609, open at the time of the event, failed to actuate closed on a high water level. This provided a flow path from a sump located in the RHR-C pump room to floor drains in the LPCS room. Water flowed through this pathway and began to flood the LPCS pump room.

Rising water level in the LPCS pump room actuated a room high water level switch that annunciated in the main control room. The operators noted this as an additional point of entry into the EOPs. The LPCS-ECCS pump (LPCS-P-1) was manually started from the control room when operators anticipated the probable loss of the LPCS system keep-fill pump (LPCS-P-2). Control room personnel subsequently secured LPCS-P-2. The other Division I ECCS System (RHR-A) served by LPCS-P-2 was running in shutdown cooling mode at the time of the event . During this time the water level within the LPCS pump room continued to rise. Due to the continued increase in water level, LPCS P-1 was also secured.

Action was initiated to pump out the water from the ECCS pump rooms and the stairwell. This effort resulted in a removal of the water to a point below the berm areas of the pump rooms by 2205 the evening of the event.