2/17/77
AM

✓Goller
Schwencer / Neighbors
Buckley

I suggest you review this carefully - are the facts stated OK? Mark ~~return~~ and return by 2/18/77

(This has "laid around" for 4 months.)

L Nichols

POOR ORIGINAL

8001090 769

MEMORANDUM FOR: R. E. Heineman, Director, Division of Systems Safety

FROM: V. Stello, Jr., Director, Division of Operating Reactors

SUBJECT: OPERATING EXPERIENCE MEMORANDUM NO. 7
FLOODING OF TURBINE BULDING AT OCONEE

PROBLEM

With Oconee Units 1 and 2 at full power operation and Unit 3 shutdown for refueling, partial flooding of the turbine building occurred; a common turbine building serves the three Oconee nuclear units.

The gravity flow of circulating water from Lake Keowee continued for about 30 minutes through opened manways in the Unit 3 condenser. The full water level in Lake Keowee provides about a 25 foot head referenced to the basement floor of the turbine building. The back flow of water from the lake through one of six condenser outlet valves was stopped after an accumulation of 16 to 24 inches of water in the basement of the turbine building. Oconee Units 1 and 2 remained at power operation.

PRESUMED CAUSE

The Unit 3 main condenser was isolated for inspection; manways were open. The six 78 inch manually operated inlet valves and the six 78 inch pneumatic-piston operated outlet valves were closed. As a backup measure a jackscrew was installed on each outlet valve to preclude inadvertent opening. Solenoids to each outlet valve were energized to provide closure air to the pneumatic driven outlet valves.

Loss of AC power to the solenoids occurred. Air "to open" was introduced to each of the six pneumatic pistons of the outlet valves. The driving force of one piston was sufficient to fail the attendant jackscrew and one valve opened. This resulted in backflow of water from Lake Keowee through opened condenser manways to the turbine building. AC power was restored after about 30 minutes reenergizing the solenoids, and properly securing each of the six outlet valves.

An isolated air supply to the pneumatically operated valves would have precluded this event. These outlet valves are of course designed to fail open upon loss of power to the solenoid control valve.

SAFETY SIGNIFICANCE

A. Oconee Nuclear Station

Twenty one inch curbs between the ~~commonly shared~~ auxiliary and turbine buildings at the Oconee Station prevented water flowing to the auxiliary building. Water accumulated to a depth of about 16 inches along the curbs. ~~common wall~~.

Within the turbine building, an electrically driven oil pump for one of the three steam-driven emergency feedwater pumps, and a hotwell pump became inoperable as a result of the flooding. The electrically driven oil pump to the emergency feedwater pump was the only affected safety equipment.

All hotwell, booster, and main feedwater pumps, which are located on the floor of the turbine-building basement, could have become inoperative if the flooding had not been stopped.

If flooding of the auxiliary building had occurred the pumps of the LPCI and the HPCI systems, and all sources of water to the secondary side of all steam generators, could have become inoperable.

B. Generic Implications

REPAIR

To preclude recurrence of this incident, the licensee, Duke Power Company will take the following steps:

1. Dual-coil, mechanically latched solenoids will be used to replace the present ones on the condenser outlet valves. The latched solenoids do not change state with loss of power.
2. The power for the controls of the condenser circulating water (CCW) system will be changed to provide automatic, uninterrupted, transfer to a backup power source.
3. Position indicating lights for the condenser outlet valves will be placed in the control room.
4. Procedures for opening the CCW system inside the turbine building will be revised as necessary to require,
   a) Vented inlet and outlet CCW pipes if all CCW pumps are shutdown.

The Oconee flooding incident occurred as a result of the inadvertent opening of a main condenser isolation valve in the circulating water system while the condenser was open for maintenance. The fact that flooding of the turbine building continued until the valve could be repositioned raised concerns regarding the consequences of an unisolable break in the circulating water system piping inside the turbine building. It should be noted that, if a facility's ~~main condenser~~ circulating water system piping is located at an elevation higher than that of the source of circulating water, the adverse consequences of an unisolable break in the circulating water piping would be minimized.

b) Manually operated valves at the condenser inlet are closed and mechanically locked;

c) air to pneumatic-piston valves be blocked and the pistons vented;

d) Screw jacks be placed at condenser outlet valves; and,

e) Lock closed the emergency condenser discharge valve to the gravity drain system.

Additionally, the licensee is reviewing other potential flooding modes to determine necessary facility modifications to preclude, regardless of the source, unacceptable flooding levels. Consideration is being given to a gravity drain system from the basement of the turbine building.

DOR ACTION

DOR has reviewed the sources of cooling water to the main condenser for operating facilities to determine whether a hydrostatic head exists that could cause a flooding event as occurred at Oconee. It has been determined that ten operating facilities have a positive head differential between the water source and the condenser; however, during the initial plant design, provisions were incorporated to preclude such events from affecting safety-related plant shut down equipment. None of the ~~nine~~ ten facilities are equipped with Seismic Category I circulating water system piping.

Salient design features for each of the ten facilities are outlined below:

1. Palisades, D. C. Cook 1, Pilgrim 1, and Nine Mile Point 1 have safety-related equipment located at an elevation higher than the postulated flooding level.
2. At Trojan, the turbine building ~~has provisions for directing~~ is designed to divert water to the yard in the event of flooding.
3. At Zion 1 and 2, no safety-related equipment is located in the turbine building. The turbine and auxiliary buildings are separated by barriers.
4. At Monticello, at least one complete train of redundant safety-equipment is located at ~~sufficient elevation.~~ an elevation higher than the postulated flooding level.
5. At Humboldt Bay, other design basis events envelopes postulated flooding from a circulating water system failure.
6. At Rancho Seco, the condenser and turbine are located outdoors with appropriate grading of the yard to preclude flooding of safety equipment.

RECOMMENDATIONS

Section ~~10.5.4~~ 10.4.5, Circulating Water System (CWS), of the Standard Review Plan contains the bases for acceptance of the CWS. However, there are no explicit requirements related to the type of flooding event that occurred at Oconee. We recommend that consideration be given to the development of an NRR position to preclude such flooding events that could damage safety-related equipment.

We also recommend that facilities now under review be evaluated to assure that design and operational methods are appropriate to preclude the occurrence of similar events. This applies to those facilities where elevation differences between the source of circulating water and the circulating system could potentially jeopardize the operation of safety-related equipment.

PRINCIPAL DOR PERSONNEL

Reviewers: B. C. Buckley

F. Clemenson

Project Manager: J. D. Neighbors

Victor Stello, Jr., Director
Division of Operating Reactors
Office of Nuclear Reactor Regulation