SAFETY EVALUATION REPORT

SUSCEPTIBILITY OF SAFETY-RELATED SYSTEMS TO FLOODING FROM FAILURE OF NON-CATEGORY I SYSTEMS FOR TURKEY POINT PLANT, UNITS 3 AND 4

I. INTRODUCTION

By letter to the Florida Power and Light Company (FPLCO) dated September 26, 1972, the Nuclear Regulatory Commission (NRC) requested a review of nuclear generating plants to determine whether the failure of any non-category I (seismic) system could result in a condition, such as flooding, that might adversely affect the performance of safety-related equipment. By letter dated November 6, 1978, and subsequent letters (see reference of enclosure), the Florida Power and Light Company submitted the additional information requested by the NRC as well as descriptions of various plant changes implemented to mitigate the effects of failure of non-Category I systems on safety-related equipment.

A continuing review of potential sources and consequences of flooding at Turkey Point Unit 3 and 4 was conducted by the FPLCO between 1972 and 1975. Initially, at the request of NRC in September 1972, the FPLCO reviewed several water systems as sources of flooding. Following the forwarding of more descriptive guidelines for review of flooding from failure of non-Category I systems in December 1974, the facilities were again reviewed on broader bases. The potential sources of flooding were described; and safety-related equipment which could be damaged by flooding were identified, and measures taken to minimize the effects of flooding and to protect safety-related equipment were reviewed.

II. EVALUATION

The enclosed technical evaluation was prepared by us by Lawrence Livermore Laboratory as part of our technical assistance program.

III. CONCLUSION

The consultant has reviewed the licensee's submittals for Turkey Point Units 3 and 4 to determine if postulated failures of non-Category (seismic) components could adversely affect the operability of safety-related equipment. The consultant's findings, with which we agree, indicate a degree of vulnerability of some safety-related equipment due to postulated flooding from some non-Category I (seismic) sources. To minimize this vulnerability, the licensee has performed modifications in the form of encasing piping in sheet steel boxes to divert water outside the building, rerouting piping, installed sumps/pumps and has instituted operating procedures to provide assurance of proper operator action in the event of flooding.

Based on our review of the consultant's technical evaluation, we have concluded that the proposed protective measures, in conjunction with existing design features, will provide a sufficient level of protection for safety-related equipment from flooding as a consequence of failure of non-Category I (seismic) sources; and, therefore, are acceptable.

TECHNICAL EVALUATION OF THE SUSCEPTIBILITY OF SAFETY-RELATED SYSTEMS TO FLOODING CAUSED BY THE FAILURE OF NON-CATEGORY I SYSTEMS FOR TURKEY POINT NUCLEAR POWER PLANT, UNITS 3 AND 4

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SUSCEPTIBILITY OF SAFETY-RELATED SYSTEMS TO FLOODING

CAUSED BY THE FAILURE OF NON-CATEGORY I SYSTEMS

FOR

TURKEY POINT NUCLEAR POWER PLANT, UNITS 3 AND 4

1. INTRODUCTION

By letter to the Florida Power and Light Company (FPLCO) dated September 26, 1972, the Nuclear Regulatory Commission (NRC) requested a review of nuclear power plants to determine whether the failure of any non-Category I (seismic) equipment, particularly in the circulating water system and fire protection system, could result in a condition, such as flooding, that might adversely affect the performance of safety-related equipment required for safe shutdown of the facilities or which might be required to limit the consequences of an accident (Ref. 1). By letter dated November 6, 1972 (Ref. 2), and subsequent letters listed in the reference section of this report, the Florida Power and Light Company submitted the additional information requested by the NRC, as well as descriptions of various plant changes implemented to mitigate the effects of failure of some non-Category I systems on safety-related equipment. The NRC guidelines (Ref. 3) are provided as an Appendix to this report.

The purpose of this technical evaluation is to determine, on the basis of the information provided (refer to References), whether the Licensee's response and equipment/plant modifications seem to be adequate to preclude the flooding/damage of equipment important to safety.

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2. EVALUATION OF TURKEY POINT UNITS 3 AND 4

2.1 INTRODUCTION

Three separate reviews of the Turkey Point Units 3 and 4 were conducted by the FPLCO between 1972 and 1975. Initially, at the request of NRC in 1972, the FPLCO reviewed several water systems as sources of flooding. Subsequently, as a result of an abnormal occurrence, the drainage system was reviewed. Finally, the facilities were again reviewed at NRC's request and both the potential sources of flooding and safety-related equipment which could be damaged by flooding were identified. The sources of flooding and the appropriate safety equipment are discussed in Sections 2.2 and 2.3. Section 2.4 provides an evaluation of measures that were taken by FPLCO to minimize the danger of flooding and to protect safety-related equipment.

2.2 SOURCES OF FLOODING

During the Licensee's three reviews of Turkey Point Units 3 and 4, the following potential sources of flooding were identified:

(1) Circulating water system
(2) Fire protection system
(3) Drainage system
(4) Chemical and volume control system (holdup tanks)
(5) Primary and service water tanks

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2.3 SAFETY-RELATED EQUIPMENT SUBJECT TO FLOODING DAMAGE

The following safety-related systems, equipment, or locations were considered by the Licensee to require protection from flooding:

(1) Diesel generator room
(2) Residual heat removing system
(3) Switchgear rooms
(4) Safety-injection pumps
(5) Motor control centers
(6) Charging pumps, containment spray pump rooms, and boric acid transfer pump room
(7) Component cooling water pumps
(8) Auxiliary feedwater pumps
(9) Control room, reactor protection equipment rooms, and battery rooms

2.4 EVALUATION

2.4.1 General Considerations

Turkey Point Units 3 and 4 are outdoor nuclear power plants. As a result, flooding problems are, in general, minimized. Flooding occurring outdoors at grade elevation (18 feet) in the turbine area generally free-flows into the yard where it is drained off to the circulating water intake canal immediately east of the plants or to the discharge canal just west of the plants. Protection from flooding for equipment located in the Auxiliary Building is generally provided by the arrangement of the equipment [Ref. 4]. All safety-related equipment with the exception of the residual heat removal system is located in rooms at grade elevation or above. Furthermore, equipment that could be damaged by flooding is located above the floor (a minimum of 18 inches) in these rooms.

The Auxiliary Building has a considerable amount of free volume below grade level. The non-Category I tanks whose rupture could result in the flooding of the Auxiliary Building have negligible volume when compared to the free volume of the building that would have to be flooded before the rooms housing safety equipment and located at grade elevation were reached.

The chemical and volume control system holdup tanks are located, below grade elevation, in individual compartments which can be isolated to contain the tank volume in the event of a tank rupture. Only the piping connecting the holdup tanks, the primary water tank, and the service water tank to the Auxiliary Building could cause flooding if a rupture occurred. The Licensee has indicated that the piping is small, and that its rupture would be detected and isolated sufficiently early to prevent serious flooding.

Pipe trenches are blocked to prevent flow into the Auxiliary Building. Entrances into the Auxiliary Building are closed by doors with water-tight sills. These doors are maintained closed by administrative procedure. In addition, there is also at least one operator in the area who would become aware of any flooding problems emanating from the turbine area. We consider these measures adequate.

2.4.2 Diesel Generator Rooms

The diesel generator rooms are at grade elevation. The generators are located on pedestals, and any water in the rooms from ruptures in the 1 1/2-inch piping (which carries water used for washdown) would run out through large vent openings in the doors at floor level to yard storm drains (Ref. 5). We consider this drainage to be adequate in mitigating the consequences of flooding.

2.4.3 Residual Heat Removal System Pumps

The residual heat removal pump rooms, located below grade elevation in the Auxiliary Building, could be subject to flooding should a fire protection system piping break occur (Ref. 4). The pump rooms, however, contain sump level alarms which sound in the control room to apprise the operator of an abnormal condition in the room (Ref. 2). In addition, each pump room is equipped with a sump and automatic pumping system. The motors of the pumps and valves are positioned at least 30 inches above the floor (Ref. 6). Water entering the rooms from the rupture of piping would be

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pumped out, or the alarm would be received in time for the operator to take action before serious flooding could occur. These measures are considered adequate in mitigating the consequences of flooding.

2.4.4 Switchgear Rooms

The 4160-volt switchgear rooms are located at grade elevation in the Turbine Building. These rooms are subject to several possible sources of flooding, thereby causing damage to the redundant 4-kV buses located inside.

The first possible source of flooding (and one which resulted in an abnormal occurrence at the facility in 1972) is rainwater backing up floor drainpipes and entering the switchgear rooms by seeping under the doors during a heavy rain storm. Since that occurrence, the drains have been blocked off (Ref. 10). The Licensee has further indicated that two sumps were installed in each of the switchgear rooms. Each sump is equipped with a high water-level alarm and a sump pump which would automatically begin to pump out any water flooding the rooms (Ref. 6). In addition, grating-covered drains have been installed outside the switchgear rooms in front of the main door leading to the rooms to preclude rainwater from entering under the doors again (Ref. 6). We consider these measures adequate.

A second possible source of flooding is a circulating water system piping rupture which would flood the condenser pit and possibly subsequently overflow into the switchgear area. The water from this type of overflow would run off to area storm drains without achieving any level which would impair the operation of the 4-kV buses.

Steam and water pipes which pass (or passed) through the switchgear rooms were considered as the third possible source of flooding. These pipes have been modified or re-routed. Specifically, the fire main riser pipe in Unit 3 and the low pressure steam lines in Unit 4 were re-routed

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outside the switchgear rooms, while several small, low-energy cooling water pipes which carry water to the generator exciters and to priming air ejector coolers for both Units 3 and 4 were encased in sheet steel boxes so that any leakage would run outside the structure through the annular space between pipes and the wall penetration holes (Ref. 8, 9). We consider these measures adequate to mitigate the consequences of flooding.

2.4.5 High Pressure Safety Injection (HPSI) Pumps

The HPSI pumps are located, at grade elevation, in a separate compartment which is not in communication with non-Category I systems which could flood the pumps (Ref. 4). Pipe trenches leading to or from the room are blocked to prevent water flow. These measures are considered adequate to prevent flooding of the safety injection pumps.

2.4.6 Motor Control Centers

All safety-related motor control centers are located at grade elevation, are physically separated from each other, and are mounted on 6-inch pedestals (Ref. 4).

Two of the motor control centers (3C and D), which are located in the east-west cooridor of the Auxiliary Building, might be subject to wetting should a failure of the fire protection system piping occur. The auxiliary room operator is stationed in this immediate area and would detect any such pipe failure in sufficient time to mitigate the flooding problem. We concur with this evaluation.

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Two additional motor control centers (3B and 4B) are located in separate rooms and are not in contact with any non-Category I systems which would result in flooding (Ref. 4). We concur with this evaluation.

One motor control center (4A) is located in an open area in the vicinity of the Unit 4 switchgear room (refer to Section 2.4.4). This area could receive water from the condenser pit in the event the pit floods from a rupture in the main circulating water system piping. The water, however, would flow to yard storm drains without achieving any level and without impairing the operation of the motor control center (Ref. 4).

2.4.7 Charging Pumps, Containment Spray Pump Rooms, and Boric Acid Transfer Pump Room

The charging pump rooms, containment spray pump rooms, and the boric acid transfer pump room are located at grade elevation and are in contact with the Auxiliary Building at or below grade elevation. For flooding to occur in any of these rooms, it would be necessary for the entire Auxiliary Building below grade level to be flooded (Ref. 4). Such flooding would be detected by the Auxiliary Building operator sufficiently early to isolate the source of flooding.

The charging pump motors are located at least 24 inches above the floor and the containment spray and boric acid transfer pump motors are at least 17 inches above the floor (Ref. 6). These measures are considered adequate to mitigate the consequences of flooding.

2.4.8 Component Cooling Water Pumps

The component cooling water pumps are located, at grade elevation, in an outdoor area. Any piping failure in this area (specifically in the intake or cooling water discharge piping) would result in the water flowing to yard storm drains (Ref. 4). Pipe trenches leading from the component cooling system rooms are blocked to prevent water flow into the Auxiliary Building (Ref. 2). These measures are considered adequate to mitigate the consequences of flooding.

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2.4.9 Auxiliary Feedwater Pumps

The auxiliary feedwater pumps are located outside the Auxiliary Building at grade elevation. The pumps and controls are elevated above grade, and the Licensee has stated that water will run off on the ground the discharge or intake canal (Ref. 4). We concur with that evaluation.

2.4.10 Control Room, Reactor Protection Equipment Rooms, and Battery Rooms

The control room, the reactor protection equipment rooms, and the battery rooms, while located above grade level, do have service water piping which passes through the rooms or through adjoining non-water-tight rooms. The reactor protection equipment rooms and the battery rooms have floor drains which are part of the storm drain system (Ref. 6). The Licensee states that the drainage system and operator action to isolate ruptures in the piping would be sufficient to protect the rooms from flooding should a rupture in one of the lines occur because the lines are small (less than 1 inch in diameter) (Ref. 4). We concur with this evaluation.

3. CONCLUSIONS

Based on our review of the documentation provided by the Licensee (refer to the References), the existing equipment/proposed modifications for Turkey Point Units 3 and 4 are acceptable insofar as they prevent or mitigate the consequences of the failure of a non-Category I system which would result in the flooding of safety-related systems that are required for the safe shutdown of the facilities.

APPENDIX

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NRC GUIDELINES FOR PROTECTION FROM FLOODING OF EQUIPMENT IMPORTANT TO SAFETY

Licensees are required to investigate their facilities or review their designs to assure that equipment important to safety will not be damaged by flooding due to rupture of a non-Class I system component or pipe such that engineered safety features will not perform their design function. No single incident of a non-Class I system component or pipe failure shall prevent safe shutdown of the facility.

Further guidelines:

1. Separation for redundancy - single failures of non-Class I system components or pipes shall not result in loss of a system important to safety. Redundant safety equipment shall be separated and protected to assure operability in the event a non-Class I system or component fails.

2. Access doors and alarms - watertight barriers for protection from flooding of equipment important to safety shall have all access doors or hatches fitted with reliable switches and circuits that provide an alarm in the control room when the access is open.

3. Sealed water passages - passages or piping and other penetrations through walls of a room containing equipment important to safety shall be sealed against water leakage from any postulated failure of non-Class I water systems. The seals shall be designed for the SSE, including seismically indicated wave action of water inside the affected compartments during the SSE.

4. Class I watertight structures - walls, doors, panels, or other compartment closures designed to protect equipment important to safety from damage due to flooding from a non-Class I system rupture shall be designed for the SSE, including seismically induced wave action of water inside the affected compartment during the SSE.

5. Water level alarms and trips - rooms containing non-Class I system components and pipes whose rupture could result in flood damage to equipment important to safety shall have level alarms and pump trips (where necessary) that alarm in the control room and limit flooding to within the design flood volume. Redundance of switches is required. Critical pump (i.e.,

high volume flow, such as condenser circulating water pumps) trip circuits should meet IEEE 279 criteria.

6. Class I equipment should be located or protected such that rupture of a non-Class I system connected to a tower containing water or body of water (river, lake, etc.) will not result in failure of the equipment from flooding.

7. The safety analysis shall consider simultaneous loss of offsite power with the rupture of a non-Class I system component or pipe.

The licensees' responses should include a listing of the non-Class I systems considered in their analysis. These should include at least the following systems:

Firewater	Demineralized Water
Service Water	Drains
Condensate	Heating Boiler Condensate
Feedwater	Condenser Circulating Water
Reactor Building Cooling Water	Makeup
Turbine Building Cooling Water	Potable Water

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[3] George Lear, NRC, Wash., D.C., private communication to Robert E. Uhrig of FPLCO, Miami, FLA (December 5, 1974).

[4] Robert E. Uhrig, FPLCO, Miami, FLA, private communication to George Lear, NRC, Wash., D.C. (January 7, 1975).

[5] E. Kejka Collins of EG&G, San Ramon, CA, private communication to John F. Burdoin, NRC, Wash., D.C. (December 5, 1978).

[6] Turkey Point Flooding Review response to NRC questions (March 6, 1979).

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[9] Robert E. Uhrig, FPLCO, Miami, FLA, private communication to George Lear, NRC, Wash., D.C. (August 18, 1975).

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