

# POST FIRE SHUTDOWN CAPABILITY

## TURKEY POINT UNITS 3 AND 4

BNL Reviewers - H.J. Thomas and E.A. MacDougall

### 1.0 INTRODUCTION

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#### 1.1 Background

The Turkey Point Units 3&4 Appendix R review, transmitted by Florida Power and Light's July 1, 1982 letter, outlines the licensee's fire protection involvement dating back to their March 1977 fire hazards analysis. Included in the report is the licensee's response to the NRC's generic letter 81-12 dated February 20, 1981 and the subsequent clarification letter dated May 10, 1982. A telephone conference was held with representatives of NRC, FP&L and BNL on August 17, 1982 to discuss aspects of the submittal (Appendix A).

The licensee's submittal supports requests for exemptions from Appendix R based on analyses. Since the task of reviewing and preparing recommendations for exemptions on this basis is not within the scope of work assigned to Brookhaven National Laboratory, the following commentary does not constitute a recommendation for or against their proposals. It is felt that the comments provided herein might be useful in assisting the NRC in making a determination in this case.

The submittals which were reviewed are as follows:

1. Fire Protection Report for Turkey Point Plant Unit Nos. 3 and 4, July 1, 1982.
2. Fire Protection SER - 3.2.4 Auxiliary Building Hallway and 3.2.5 Cable Spreading Area, April 2, 1982.
3. Request for exemptions from certain requirements of 10 CFR - 50.48 and Appendix R to CFR Part 50, March 19, 1981.
4. Response to staff summary of requirements to resolve "open items", February 4, 1981.
5. Safe Shutdown Evaluations for the auxiliary building hallway and cable spreading room, June 9, 1980.

#### 1.2 Fire Protection SER Position

Section 4.1 of the SER, Safe Shutdown Systems, states that the licensee has demonstrated in most areas of the plant, an unmitigated fire would not threaten the capability to achieve safe shutdown with the exception of areas identified in Sections 3.2.4 Auxiliary Building Corridor and 3.2.5 Cable Spreading Area.

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### 1.3 Plant Description

Turkey Point Units 3&4 are twin Westinghouse PWR plants rated at 728 MWe. Unit 3 went into operation in December 1972 and Unit 4 in September 1973. They are owned and operated by the Florida Power & Light Company. Two additional oil fired units are available at the Turkey Point site.

## 2.0 REVIEW AND EVALUATION

### 2.1 Section III.G - Fire Protection Shutdown Capability

#### 2.1.1 Systems Used for Post Fire Safe Shutdown

Reactivity control is accomplished by control rod insertion and boric acid injection by the charging pumps which take their suction from the boric acid storage tanks via the boric acid transfer pumps. A secondary boration method is borated water injection from the refueling water storage tank via gravity feed directly to the charging pumps. A cross tie to the Units 3&4 charging pump discharge piping is installed.

Reactor coolant systems makeup is achieved by the use of any of three charging pumps taking suction from the refueling water storage tank. Other sources of reactor cooling system makeup are the primary water storage tanks or the spent fuel pools.

Decay heat removal is accomplished through the steam generators by throttling the condensate/feedwater back to the system generator no load condition with steam relief to the condenser via four turbine bypass valves. Should the turbine bypass, condenser vacuum or condensate/feedwater pumps be unavailable, steam generator heat removal is maintained by the auxiliary feedwater system with steam relief via the three atmospheric dump valves (located upstream of their respective main steam isolation valves).

Auxiliary feedwater is provided by three turbine driven auxiliary feedwater pumps. A manual cross tie to the Units 3 and 4 main steam header and a manual crosstie to the fossil Unit 1 and 2 desuperheater steam header are available to supply the auxiliary feedwater pump turbines. The auxiliary feedwater pumps are normally aligned to take suction from the Unit 3 and 4 Condensate Storage Tank. Additional condensate is available from the water treatment plant or the primary water storage tank.

Residual heat is removed by redundant trains of residual heat removal (RHR), component cooling water (CCW), and intake cooling water (ICW) equipment. A cross tie to the Units 3&4 CCW discharge piping is installed.

Reactor pressure control is achieved by use of redundant trains of pressurizer heaters. The backup heaters can be loaded on to the two emergency diesels.



Process monitoring is provided for the following parameters at areas remote to the control room:

<u>PARAMETERS</u>	<u>LOCATION</u>
Pressurizer pressure and level	Charging pump room panel
Reactor coolant cold and hot leg temperatures	Unknown
Steam generator pressure and temperature	Auxiliary feedwater control station
Auxiliary feedwater flow	Auxiliary feedwater control station
Boric acid tank levels	Unknown
Refueling water tank levels	Unknown

No source range flux monitoring is available remote to the control room.

Mechanical support systems required for hot and cold shutdown are as follows: Component Cooling Water, Intake Cooling Water, Diesel Generators, and HVAC for Containment, Auxiliary Building and Control Room.

Electrical systems used for safe shutdown are the 4.16KV, 480V, 120V AC and the 125 V DC Distribution Systems.

#### 2.1.2 Type of Fire Protection Provided

The licensee has divided the plant into one hundred and thirty-two fire areas.

The licensee proposes to make backfit modifications to comply with Section III.G of Appendix R to thirty-four (34) fire areas. They are however, making schedule exemption requests to provide desired time to complete the modifications. The type of modifications which are embodied in the following:

- Protect one train of shutdown (SD) cables utilizing thermal insulation wrap equivalent to one hour fire barrier rating.
- Install automatically activated fire suppression.
- Upgrade perimeter walls, floor, and ceiling to one hour fire rating.
- In some fire areas, upgrade perimeter walls, floor, and ceiling to three hour rated barrier and installing three hour fire dampers and doors.

There are some eighteen (18) fire areas which do not fully comply with Appendix R Section III.G. Based on a combination of fire protection modification, administrative procedural controls and fire hazards analyses, the licensee has requested exemptions. In the event that the exemptions are not granted, a schedule exemption request is included for each of the eighteen fire areas.



The licensee proposes to make modifications to support their exemption requests. To a great extent, these backfits depend very heavily on the use of flamemastic as a deterrent to flame propagation. A comparison between the proposed backfit modifications in support of exemption requests and those backfits required in the event that exemptions are denied follows.

BACKFIT MODIFICATIONS IN SUPPORT OF EXEMPTION REQUESTS	BACKFITS REQUIRED IN THE EVENT THAT EXEMPTIONS ARE DENIED
Cable Tray Flame Impingement/ Thermal Shields	Cable Tray Thermal Insulating Wrap
Conduit Thermal Insulating Material	Conduit Thermal Insulating Material/ Spray
N/A	Automatic Fire Suppression
Fire Dampers	Fire Dampers
Barriers, Penetration Seals, and Fire Doors	Barriers, Penetration Seals, and Fire Doors/Fire Proofing
	Fire Detection
Part Height Walls, Penetration Seals	Fire Detection
Valve Operator Fire Barrier Enclosures	One Hour Rated Valve Operator Fire Barrier Enclosures
N/A	Fire Detection
Cable Rerouting	Cable Rerouting
	Alternate Shutdown Control Room and Instrumentation and Control Modifications
Automatic Fire Suppression System in Cable Spreading Room and Control Building Stairwell	Automatic Fire Suppression in Aux. Bldg. Corridor, Cable Spreading Room and Control Bldg. Stairwell Main Steam Platform, Feedwater Platform, Fire Pumps
Equipment Fire Barriers/Walls A&B Diesel Generator Radiators, Curbing Adjacent Diesel Generator Radiators	Total Enclosure of One Diesel Generator Radiator with Three Hour Rated Barriers





A review of the fire modeling techniques was conducted and was found to be representative of the present state-of-the-art for the cases outlined in Appendix A of the submittal. These include models for heat release rates, stratification, turbulent, buoyant diffusion plumes and radiation.

Appendix A.5 deals with an analytical method for determining the size of thermal shields used to divert hot fire gases from direct impingement upon electrical cable trays. The temperature reduction calculated in the wake of the thermal shield is calculated as being linearly proportional to velocity when in fact, it is proportional to the square root of the velocity effect. Due to this discrepancy, the calculated temperature in A.5 tends to be more conservative than warranted.

Appendix B presents an evaluation of the effectiveness of flame retardant cable coatings in reducing the damageability of the types of cables used in this plant when they are subjected to exposure fires. This report by Factory Mutual Research Corporation concludes that coatings are effective in early stages of a fire, enhancing energies required for initiating cable jacket degradation and piloted ignition to a greater degree than for auto-ignition and electrical failure. At a stage where a fire is burning at its maximum intensity, coatings are expected to have an insignificant effect on the fire.

The task of reviewing and evaluating these modifications and exemption requests is not within the scope of work assigned to BNL. However, the following comments are offered for consideration.

1. Auxiliary feedwater pump auto-start circuits for Unit 3, Unit 3 backup, Unit 4, and Unit 4 backup are all contained in fire area 106. Since it appears that a single fire could destroy all these cables, we recommend that the staff request that the requirements of Section III G.2 and III G.3 be met in this area.

This also applies to control cables for the charging pumps, component cooling water pumps, intake cooling water pumps, boric acid transfer pumps, pressurizer heater control group and pressurizer heater backup group.

2. The use of the pressurizer heater A&B backup groups represent the primary mode of pressure control. There is no clear indication of the actions which will be taken in the event of total loss of the pressurizer heater function. This concern was answered during the telecon, at which time, the licensee indicated that the safety injection pumps would be used.

Procedures are required which describe necessary operator actions to compensate for the loss of pressurizer heaters due to a fire.

3. Unit 3 and Unit 4 power and control cables for the charging pumps and diesel generator breakers are installed in fire area 79 switchgear rooms. The licensee proposes to protect one train with the equivalent of a one hour fire rated barrier. However, an exemption request is made to negate the installation of additional fire detection and suppression systems.



4. The licensee does not intend to provide an alternate shutdown panel for hot or cold shutdown. There are available at various switchgear and motor control centers, isolation devices which will enable the transfer of control power from the control room to a local control station. In addition, control stations exist at the Unit 3 and Unit 4 auxiliary feedwater control stations and other locations which were not described in the submittal. These systems will be used for hot shutdown. Cold shutdown will be conducted from the control room. There is a request for exemption from installing a fixed fire suppression system in the control room.

#### 2.1.3 Alternative or Dedicated Systems Proposed

Since the licensee stated that they must leave the control room in case of a control room fire, we consider that alternate shutdown is required for this area.

The licensee does not propose to install an alternate or dedicated shutdown panel. They indicate that remote control stations are available which have provision to control power to equipment which is required for hot shutdown.

In Section 3.1.6 of their submittal, the licensee states that should the local and remote control stations, associated with equipment utilized to maintain hot shutdown conditions, become inaccessible or lose control power, the equipment can be restarted or tripped at their associated power sources. Equipment fed from the 4160 switchgear can be operated at the associated 4160 V switchgear. Equipment fed by the 480V load centers or 480V motor control centers can also be operated at their respective load center. If reposition of 480V motor operated valves is required and the associated MCC supply is out of service, required valve operations may be conducted manually.

#### 2.2 Section III-L Alternate and Dedicated Shutdown Capability Compliance

##### 2.2.1 Performance Goals

None of the performance goals listed as 2a, b, c, d, and e can be assured for alternative shutdown since the licensee proposes to use remote panels that do not meet the requirements of Section III G.2. Furthermore, no new remote shutdown panels have ever been discussed by the licensee.

The goal of process monitoring is not met since the licensee does not propose to provide the following instrumentation in case of inaccessibility of the control room due to a fire, source range flux monitoring, or storage tank levels.

##### 2.2.2 72 Hour Requirement

The licensee did not definitively state in their submittal that cold shutdown conditions can be met in 72 hours. This concern was addressed during the telecon at which time, the licensee positively stated that this condition can be satisfied.



### 2.2.3 Procedures and Manpower

The licensee has made a number of exemption requests which are affected by the status of these requests. The final procedures will be forthcoming when final decision is made relative to the exemption requests.

The licensee intends to provide emergency operating procedures such as opening of circuit breakers, manual operation of valves, and removing fuses.

During the telecon, the availability of the current procedures for safe shutdown actions in the event of a fire in the control room was discussed. The procedures supplied by the licensee was titled "Emergency Operating Procedure 20005." "Control room inaccessibility" dated April 25, 1980. This procedure incorporated some thirty-seven (37) operations which are required of the operators in order to setup the plant for remote operation. The manpower requirements to accomplish these actions are not clearly delineated in the submittal.

### 2.2.4 Repairs

Our concern about pulling of fuses which is considered a repair is discussed in 2.2.5.

The licensee stated that no repairs were planned for post fire shutdown.

### 2.2.5 Associated Circuits and Isolation

The licensee proposes to pull fuses to close the PORV's, main steam isolation valves and steam generator blowdown valves. This is unacceptable because Appendix R precludes the use of repairs during hot shutdown, and the pulling of fuses is considered a repair.

This concern was addressed during telephone conference with FP&L and NRC which occurred on August 17, 1982. At that time the licensee indicated that the pulling of fuses would be an action of last resort and would only be initiated should all efforts to isolate the valves fail.

The licensee has satisfactorily addressed associated circuits of concern. They have used the guidance provided in the NRC generic letter 81-12 and the subsequent clarification letter dated May 10, 1982.

Common Bus Analysis. The licensee has analyzed for common bus concern and concludes that all circuits connected to common power sources have coordinated circuit protection. As a result of the telecon, the licensee will submit some schematics which demonstrate that this concern has been addressed.

Spurious Signal Analysis. The licensee states that all power, instrument, and control cable of equipment needed for hot and cold shutdown that might be affected by spurious signals has been traced throughout the power plant to identify the cable functions routed through each fire area. The analysis was conducted as follows:

- a. Developed table listing all power supplies for instrument, control, and power cables.
- b. Reviewed the power supplies to assure that each connected circuit had circuit protection.
- c. Location of protective device for each circuit was evaluated relative to the location of the protective device of shutdown circuits and circuits required to mitigate the consequences of a fire.

With regard to equipment whose spurious operation could impact safe shutdown capability or violate high/low pressure interface, the licensee has treated these circuits identically to the circuits required for safe shutdown. All circuits in this category have been identified as "equipment required to mitigate the consequences of a fire" and are discussed in Section 3.3 of the submittal and analyzed similarly to safe shutdown circuits. Emergency safety feature actuation signals were also reviewed and analyzed.

The licensee proposes to utilize the following methods to disable equipment which is being cycled by spurious signals:

- Open circuit breakers,
- Lock disconnect switch open,
- Remove fuses,
- Close associated block valve, and
- Shutdown pumps.

Some examples which demonstrate the use of the above methods are:

<u>VALVES</u>	<u>METHOD</u>
MOV 3/4 - 751	Disconnect locked open
PCV 3 - 455C	Close associated block valve additionally remove fuses.
POV 3/4 - 2604	Remove fuses
PCV 3 - 455A	Secure reactor coolant pumps additionally open associated circuit breakers.

Valves such as POV 3/4 - 2604 are required for hot shutdown. In instances such as this, the pulling of fuses during hot shutdown is considered a repair and as such is unacceptable in accordance with Appendix R.

Common Enclosure. This concern was analyzed from two perspectives:

1. Does the circuit have circuit protection?
2. Will the circuit allow fire spread from one fire area to another?

The licensee concluded that associated circuits that share a common enclosure with safe shutdown cables are not a concern because all power, control, and instrumentation circuits are electrically protected. In addition, all circuits are fire sealed where they penetrate walls, floors, and ceilings. The only associated of concern, subsequently, are those associated with equipment required to mitigate the consequences of a fire.

In addition to determining circuits to be reviewed with the safe shutdown circuits, the licensee took the position that should the 3/8" sample valves for the RCS inventory be left open that the resultant loss is well within the capacity of the charging pumps.

#### 2.2.6 High/Low Pressure Interface

The licensee has addressed this concern via the associated circuits review in Section 3.3 of the submittal. This concern has been satisfactorily addressed with the exception of fuse pulling during hot shutdown.

#### OPEN ITEMS

1. The licensee has not demonstrated that any of the basic performance goals (2a, b, c, d, and e) can be met for alternative safe shutdown around the control room (see 2.2.1 "Performance Goals").
2. The NRC requirement for source range flux monitoring capability during shutdown when the control room is inaccessible is not being met.
3. The capability to monitor boric acid storage tank level and RCS cold and hot leg temperatures during shutdown remote from the control room should be demonstrated.
4. The pulling of fuses during hot shutdown is not allowed, therefore, modification of the procedures to isolate some valves is required.
5. Manpower requirements to effect shutdown remote from the control room should be clearly delineated.
6. Where cross connection, piping between Units 3&4 is being installed in systems such as the charging system, main steam supply to the auxiliary feedwater system, and component cooling water system, the pump discharge piping should be checked to assure that excessive pressure drop does not result.
7. The licensee should provide assurance that one train of shutdown cables is protected against fire damage in all areas such as area 106 etc. The protection should be in conformance with Appendix R, Section III G.1, 2, or 3.

BROOKHAVEN NATIONAL LABORATORY  
M E M O R A N D U M

DATE: August 18, 1982  
TO: Files  
FROM: H.J. Thomas and E. MacDougall  
SUBJECT: Turkey Point Units 3 & 4 - Post fire safe shutdown review  
telecon of August 17, 1982

The Turkey Point review consisted of several documents submitted over a span of two years. The major submittal of July 1, 1982 which is a report entitled "Turkey Point Units 3 & 4, Fire Protection Review" served as the basis for the telecon held on August 17, 1982. The participants for this conference were as follows:

NRC

V. Panciera - Section Leader, Auxiliary Systems Branch  
D. MacDonald - Project Manager  
R. Gramm - Reviewer  
W. LeFave - Reviewer

BNL

H. Thomas - Reviewer  
E. MacDougall - Reviewer

LICENSEE

J. Burford - FP&L  
S. Hill - FP&L  
J. Hayes - FP&L  
P. Case - FP&L  
J. Purcell - FP&L

A short discussion as to the status of the exemption requests by FP&L preceded the responses to the prepared questions which constituted the basis for the telecon. It was clarified that the exemption requests are handled by the Chemical Engineering Branch and consequently were not a consideration of this conference. The licensee's responses should therefore be based on the assumption that the exemption requests would be granted, but that this review would not constitute any determinations as to the exemptions. The following is arranged in the question and answer format used during the conference.





1. BNL: Where are the isolation switches and remote control stations physically located?

LICENSEE: After stating that the present control mode for safe shutdown does represent a form of alternate shutdown, the licensee indicated that the isolation switches were located at the following locations.

4160 Volt 4A Switchgear Room  
4160 Volt 4B Switchgear Room  
Load Center Room Location, Unit 4 (So. Wall)  
MCC4A - North End Location  
Cable Spreading Room Location  
D.C. Switchgear Room Location

The licensee was not sure whether this listing represented the most current information since it was compiled in June 1980. They are to re-check and obtain the most current listing and forward to NRC - BNL. This will be reviewed at an upcoming meeting. Remote stations are located at the following locations:

- Unit 3 Auxiliary Feedwater Control Station.
- Unit 4 Auxiliary Feedwater Control Station

and elsewhere - information to be provided at upcoming meeting.

2. BNL: What systems are controlled from the remote panels?

LICENSEE: Some of the processes which are controlled are:

- Auxiliary Feedwater
- Pressurizer Level
- Boration

BNL: Asked the licensee which systems are to be used in the event that the pressurizer heaters are lost?

LICENSEE: Safety injection.

3. BNL: When the control room is not available, is the following information available?

- Neutron Flux
- Auxiliary Condensate Flow
- RCS Cold and Hot Leg Temperatures

LICENSEE: No, for neutron flux. The additional information will be provided through correspondence.



4. BNL: Are tank level indications available for all tanks which are proposed for use during shutdown such as:

- Boric Acid Storage Tank
- Primary Water Storage Tank
- Refueling Water Storage Tank
- Spent Fuel Storage Tank

LICENSEE: The primary tank which is proposed for boration is the boric acid storage tank.

BNL: Is there sufficient capacity of boric acid in this tank to satisfy the boration needs to achieve cold shutdown condition?

LICENSEE: If additional boration is required, then the refueling water storage tank or the spent fuel storage tank is available.

5. BNL: When will procedures to effect safe shutdown in the event of fire in the control room be available?

NRC: Does the licensee have them and can they provide by mail?

LICENSEE: Yes.

6. BNL: Are cold shutdown conditions achievable within 72 hours?

LICENSEE: Yes.

7. BNL: Are isolation switches NEMA, UL or ANSI rated?

LICENSEE: Does not know, however, they would not attempt to degrade the quality of installed devices. If anything, they would try to improve on the quality. They will recheck.

8. BNL: What is done to assure that the isolation switches are properly matched to the connected load?

LICENSEE: They certainly would not purposely overload a switch or device and make every effort to take voltage, current, temperature, and environmental condition into consideration.

9. BNL: When modifications to existing systems are required, do replacement isolation devices have the same level of quality?

LICENSEE: Equivalent or better.

10. BNL: Pulling fuses is proposed for some valves such as MISV POV-4-2604, POV-3-2604, etc. NRC believes that fuse pulling for D.C. circuits during hot shutdown should not be allowed. Further discussion during a conference is desirable.



LICENSEE: They have based their fire protection design on the belief that there will not be any cable damage because of the precautions that have been taken they are protecting both trains of shutdown cables in most cases. They have analyzed spurious operation of valves during a fire. Should valves or pumps be operated spuriously, they postulate that there will be sufficient time to allow for analysis and evaluation of the phenomena. They will try all corrective action possible prior to pulling fuses. Pulling fuses will be a last resort operation.

11. BNL: Can licensee provide electrical elementaries which describe alternate shutdown provisions at the remote panels and six emergency control stations? Elementaries which depict isolation devices in various circuits are desirable.

LICENSEE: Yes.

12. BNL: Can licensee provide schematics of mechanical systems required for safe shutdown?

LICENSEE: Yes.

#### IMPROMPTU QUESTIONS

- A. BNL: Cross ties are installed for charging system, component cooling water system, steam supply to auxiliary feedwater pumps. Has the piping in these systems been checked to assure that flow will not be restricted because of pressure drop when supplying the needs of Units 3&4?

LICENSEE: Yes

- B. BNL: Are there any repairs postulated for hot or cold shutdown?

LICENSEE: None

- C. BNL: Are there any motor driven auxiliary feedwater pumps?

LICENSEE: Two are proposed for installation in their exemption requests.

- D. BNL: Are there any control interlocks such as limit switches which will inhibit the ability to achieve safe shutdown?

LICENSEE: Will check.

The licensee suggested that a face to face meeting be arranged at which time efforts will be made to resolve all questions. There was general agreement between all parties, and NRC will arrange a meeting.

